Switzerland's Submission on Reference Levels as an accounting approach for Forest Management under the Kyoto Protocol

Bern, 28 February, 2011

Contents

1 Introduction

Detailed information on Annex I Party forest management reference levels was requested in Cancun Decision X/CMP.6, paragraph 4 (Land-use, land-use change and forestry). As requested by the aforementioned decision, this submission updates and replaces the Swiss reference level currently in Annex I of Decision X/CMP.6 provided in the voluntary data submission of November 2009 by following the guidelines provided in Annex II of Decision X/CMP.6.

Switzerland supports in general a process in which accurate, transparent and verifiable accounting methods for forest management activities are developed and implemented. Forest-related activities that provide real benefits for the climate should be promoted by accounting approaches that reinforce a balance of national climate, forest and wood policies, such as incentivizing sustainable forest management, the cascaded use of wood or the substitution of wood products for non-renewable materials.

We believe that in the current LULUCF accounting rules there is room for improvement so that they do not arbitrarily penalize domestic forest and wood policies that pursue long-term goals which are fully compatible with an ambitious climate protection policy. In the interest of improving these rules and contributing to the interchange of comparable and uniform data on reference levels between Annex I Parties, Switzerland provides this information in accordance with a net-net accounting approach using projections. In making this submission, Switzerland wishes to make it clear that this effort to contribute towards maximum transparency among Parties is not an association with the precedence or necessarily an endorsement of this accounting approach.

2 General description

For calculating the reference level with reference period 2013-2020, Switzerland took into account Decision X/CMP.6, footnote 1 of paragraph 4. Historical data were taken into account as described in FOEN 2010 (see Section 5.4.1). Future emissions and removals were calculated using the models:

- Forest management scenario model MASSIMO3,
- Organic soil carbon cycle model Yasso07.

Calculations for harvested wood products (HWP) are based on Table 3a.1.3 of the 2003 IPCC Good Practice Guidelines

For a more detailed description of the models and methods please see Section 4.

Table 1: Switzerland's implementation Decision X/CMP.6, footnote 1 of paragraph 4 for calculating the reference level (RL) with reference period 2013-2020.

Footnote 1 Paragraph 4	Switzerland's implementation
(a) Removals or emissions from forest management as shown in greenhouse gas inventories and relevant historical data;	Switzerland's reference level is based on the CO_2-gains and losses as reported in the yearly NIR since 1990 (most recent submission see FOEN 2010). - MASSIMO3 is the model that was used to estimate changes in living biomass and the relevant CO_2-gains and losses for the past as well as projections for the future as influenced by forest management and other factors. - Linked to MASSIMO3 is the model Yasso07, which was used to calculate the changes in soil carbon stocks as influenced by factors such as the trees and climatic conditions.
(b) Age-class structure;	The RL considers age-class structure for the respective calculation of gains and losses of living biomass. Data were derived from the National Forest Inventories (NFI; see Fig. 3).
(c) Forest management activities already undertaken;	The RL is calculated inter alia based on historical data of the 3 NFIs covering the time period 1985-2005, which comprise all management activities.
(d) Projected forest management activities;	The proposed RL is based on the BAU scenario, in agreement with Switzerland's Wood Policy (see section 5.4.2).

(e) Continuity with the treatment of forest management in the first commitment period;	The proposed RL does not diverge from KP 3.4.
(f) The need to exclude removals in accordance with decision 16/CMP.1, paragraph 1 (h).	With current scientific data and modelling approaches available to Switzerland no accurate factoring-out is yet possible. Especially the CO_2 and N-fertilizing cannot be factored-out easily (see also Section 5.7). Switzerland has therefore always proposed a conservative discount factor that would allow to exclude removals from accounting in accordance with decision 16/CMP.1, paragraph 1 (h) without needing to first solve the associated scientific problems.

3 Pools and Gases

3.1 Pools and gases included in reference level

Projections with the model MASSIMO3 considers changes in carbon stocks of living biomass. The estimation of gains in living biomass is described in section and depends on species specific stand structure, stand growth, age class structure etc. How future harvesting rates were determined is described in detail in section 5.4). By using biomass conversion and extension factors (FOEN 2010 Chapter 7.3.4.4), changes in living biomass reported under the pool "above ground biomass" also include the changes of the pool "below-ground biomass".

Harvested Wood Products (HWP) are accounted for in accordance with paragraph 27 of the integrated version of the negotiating text FCCC/KP/AWG/2010/CRP.4/Rev.4, on the basis of Swiss country-specific data according to Tier 2. Section 4.3 describes how HWPs were calculated and Section 5.5 contains Swiss data on HWPs as well as describes how emissions and removals from HWPs were included in the reference level.

3.2 Explanation of reasons for omitting pools and gases from the reference level

The following greenhouse gas emissions or removals due to forest management were not taken into account:

3.2.1 Pools

- CO_2-emissions or removals from dead wood: since 1990 there has been a remarkable increase in the stock of dead wood. We assume that this increase will level off in the next years. However, we used a conservative approach and assumed the dead wood pool for the construction of the reference level 2013-2020 to remain as high as in the recent past.

3.2.2 Gases

- CO_2-emissions from forest fires: CO_2 emissions from forest fires are reported under the item "losses of living biomass", since the NFI-data cover many kinds of losses (including losses due to forest fires) under "cut and mortality (see FOEN 2010 section 7.3.4.13).
- Emissions of other greenhouse gasses from forest fires: the amount of these emissions is negligible (0.001% of total removals due to forest management in 2008 – see FOEN 2010 Table 5(KP)) and were therefore not taken into account when setting the reference level 2013-2020.

- Greenhouse gas emissions from liming, fertilization or drainage: fertilization and drainage of forests is prohibited by the Swiss Forest Law and adherent ordinances (see FOEN 2010 section 7.3.4.12).

The above listed omitted greenhouse gas emissions from the reference level are negligible (0.001% of total removals due to forest management).

4 Approaches, methods and models used

4.1 MASSIMO3

MASSIMO3 is a stochastic empirical single tree forest management scenario model, which was derived using data from the three successive National Forest Inventories (NFI). The major model components are:

- single tree growth: based on a single tree model
- wood harvesting: derived from a baseline scenario (see section 5.4.3) and rotation lengths
- mortality rates: based on data on all management activities from the 3 NFIs covering the period 1985-2005
- natural regeneration: based on information extracted from a database containing NFI-regeneration plots

All model components as well as in-growth and mortality rates were empirically derived from NFI data. For more details on the model, please see the references listed below.

4.2 Yasso07

Yasso07 is a model that describes the cycle of organic soil carbon. The model calculates the stock of organic soil carbon, changes over time in the stock of organic soil carbon and heterotrophic soil respiration. It is a relatively simple model requiring information only on climate and soil carbon input. Additionally, Yasso07 calculates an accurate estimation of uncertainties.

Yasso07 simulates the dynamics of different types of soil carbon depending on the type and chemical composition of litter and underground biomass as well as climatic conditions. The model computes the sequestered carbon as affected by human disturbances, i.e. mainly from harvesting, or as impacted by natural disturbances, i.e. mainly storms causing wind throw. For more information on the model, please see the references listed below.

4.3 Calculation of Harvested Wood Products (HWPs)

Switzerland has used tier 2 country-specific data to improve estimates of annual carbon change in "products in use" as per IPCC Guidance (LULUCF Chapter 12 HWP). Improved data includes Swiss data on:

- annual production by product types and wood species;
- factors to convert activity data to carbon;
- rates at which products are discarded, taking into account that different wood products have different life spans (e.g. sawn wood versus panels);
- HWPs from the waste sector are accounted for by instantaneous oxidation and in Switzerland wood products are not deposited in solid waste disposal sites (SWDS).

5 Description of Construction of Switzerland's Reference Level

Submission table on the determination of Switzerland's projected reference level 2013-2020: Required information on both historical data and reference level

	Historical Data as reported in Switzerland's NIR	Reference level data – MASSIMO3, Yasso07
Pools included		
Above ground living biomass	Yes	Yes
Below ground living biomass	Included in above ground living biomass (BCEF)	Included in above ground living biomass (BCEF)
Dead wood	Estimates based on data from NFI and Sanasilva Network	Included mortality rates: 14% of total losses of living biomass.
Soil organic matter	In Switzerland's NIR a conservative estimate was chosen and no changes were reported. The soil model Yasso07 was accordingly modified (hind casts) and provides these estimates.	The soil model Yasso07 has been linked to the MASSIMO3 forest management model to produce more accurate projections
Litter	Changes in litter have been estimated by the model Yasso07 (see comments on soil organic matter above).	Changes in litter have been estimated by the model Yasso07
HWP	- For domestically produced and consumed harvested wood products, Swiss data were used - Existing pool since 1900 - Exports not yet taken into account in the RL	- For domestically produced and consumed harvested wood products, Swiss data were used - Existing pool since 1900
Non- CO_2 gasses included		
N_2O CH_4	Yes	N_2O and CH_4 Emissions from forest fires were not taken into account since the amount is negligible. In 2008, GHG emissions from forest fires only amounted 0.001% of total removals due to forest management (see FOEN 2010 Table 5(KP)).
Area under Forest Management (ha)	Total Swiss forest area (brushwood and inaccessible stands excluded)	Total Swiss forest area (brushwood and inaccessible stands excluded)
Source of data	National Forest Inventory and Forest Statistics	National Forest Inventory
Time series	1990-2007	Modelled data 2008-2020; Ref. Level period: 2013-2020

5.1 Area under Forest Management

As described in Switzerland's Initial Report (FOEN 2006h), all Swiss forests are under Forest Management. Changes in this area (under KP Art. 3.4 or UNFCCC) present a strong correlation with CO_2 removals. As described in FOEN 2010, the main factor which influences the yearly fluctuations in CO_2 emissions from forest management is the amount of wood being harvested in the respective year. The historical harvesting rates are derived from the Swiss Forest Statistics.

5.2 Relationship between forest management and forest land remaining forest land

In Switzerland, all forests are subject to Forest Management (FOEN 2006h), thus the total Swiss forest area is considered for reporting under both the UNFCCC (Forest Sector) and Kyoto Protocol (Art. 3.4). Changes in the forest area are accounted for under both the Convention and the Protocol (Art. 3.3), but separately, either in the categories Forest Land converted to another land-use category, or land converted to Forest Land, either in Deforestation or Afforestation, respectively. The emissions and removals from Forest Management (FM) under the Kyoto Protocol and from Forest Land remaining Forest Land under the UNFCCC (FL-FL) are almost equal (see Fig. 1). This difference is insignificant for the calculation of the reference level and due to different reporting rules under UNFCCC and the Kyoto Protocol. Whereas under UNFCCC all conversions from forest land are reported as land converted from forest land, under the Kyoto Protocol only direct human-induced conversions to another land use are reported as deforestation.

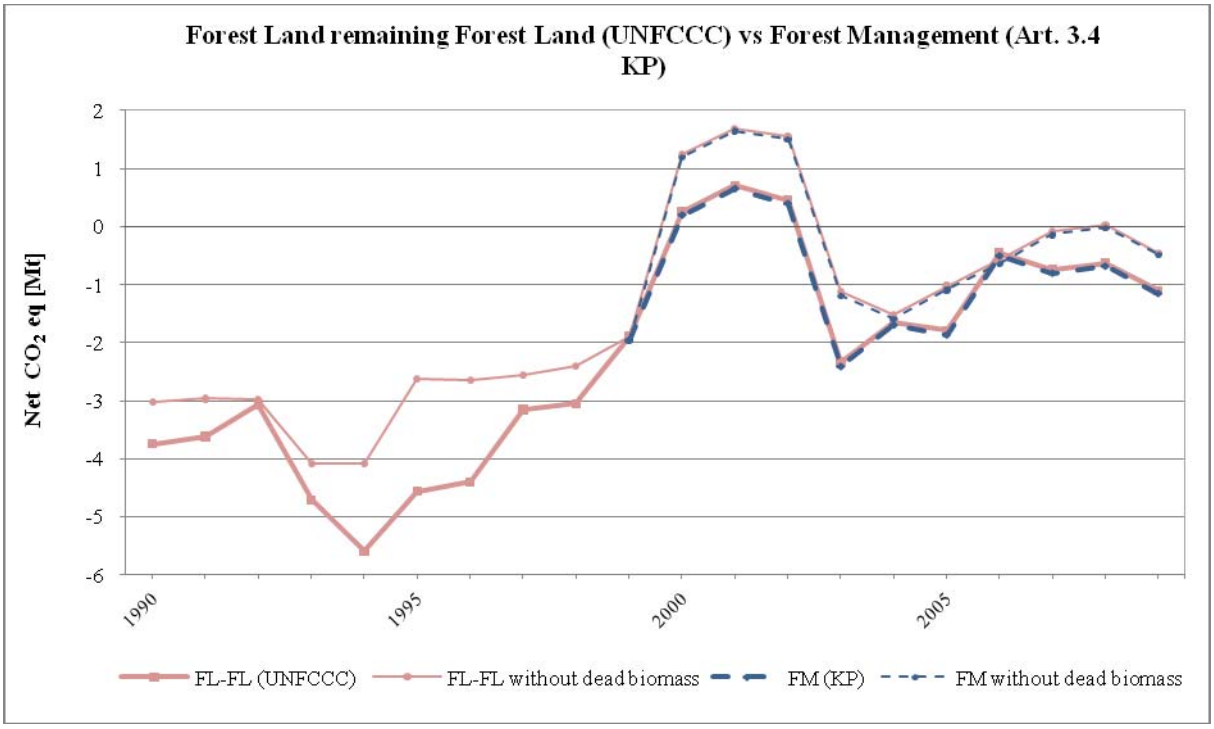

Fig. 1: Historical (1990-2009) CO_2 eq. emissions/removals from Forest Land remaining Forest Land (FL-FL, under the UNFCCC) and Forest Management (FM, under Art 3.4 of the Kyoto Protocol) as reported in Switzerland's Inventory Report, Submission 2011 (data to be submitted in April 2011). Data on FM (KP) are available since 1999 only.

5.3 Historical development of Swiss forests and forest law

There is a long tradition of forest protection in Switzerland. The first federal Forest Act came into force in 1876, but covered only the Alpine region. Its aim was to put a halt to the depletion of forests, to manage the remaining forest areas in a sustainable way, and to promote afforestation. The Forest Act of 1902 covered the whole country. The Forest Act and an enabling overall economic development resulted in an increase of the forested area in Switzerland today by nearly 50% compared to the mid-19th century (Fig. 2). The Forest Act (SR 921.0) that came into force in 1993 reaffirms the long-standing Swiss tradition of preserving both forest area and forest as a natural ecosystem. It prescribes sustainable forest management, prohibits clear-cutting, and bans deforestation unless it is replaced by an equal area of afforested land or an equivalent measure to improve biodiversity. As a consequence from this century-long consistent forest policy forest area as well as the growing stock have increased, the latter from less than 150 in 1880 to 359 m^3/ha in 2005 (Fig. 2).

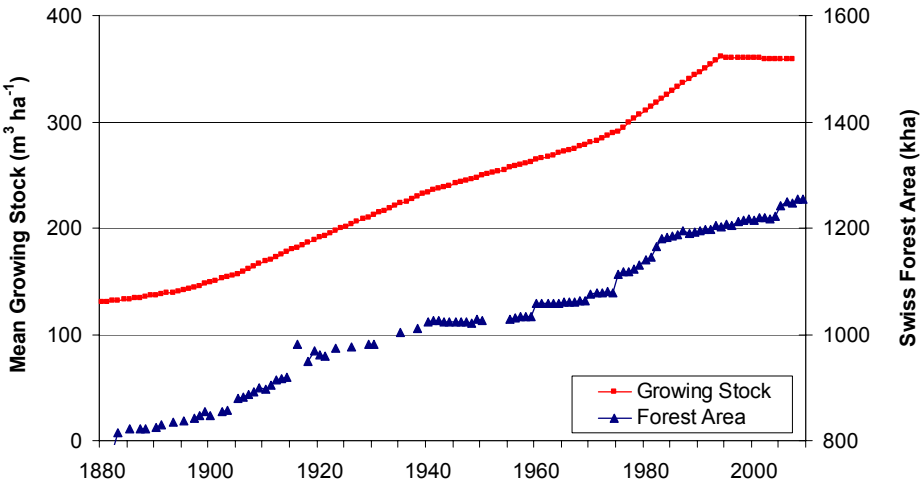

Figure 2: Historical time series 1880-2005 of mean growing stock and Swiss forest area.

Switzerland, similarly to most central European countries is characterized by an advanced forest age structure (Fig. 3), relatively large and growing forest area and very little deforestation. Moreover, Swiss growing stocks are the highest among all European countries. Due to the age structure large fractions of the Swiss forest are mature for harvesting. Unless those parts are harvested, period lengths would have to be extended to a degree that conflicts with the forest's stability, the silviculture of sustainable forest management, and commercially viable harvesting. Consequently, the levels of harvesting are expected to and should continue increasing in the near future as this has been the case in the recent past. The objective of increasing harvesting levels is also to avoid episodic large quantities of GHG emissions originating from decay, should these excessive accumulations of C stocks be disturbed by drought, fires, storms, or insects. This is particularly important in light of the future increase in storm intensity and occurrence, as well as increased pest outbreaks, both of which are partly projected to result from climate change.

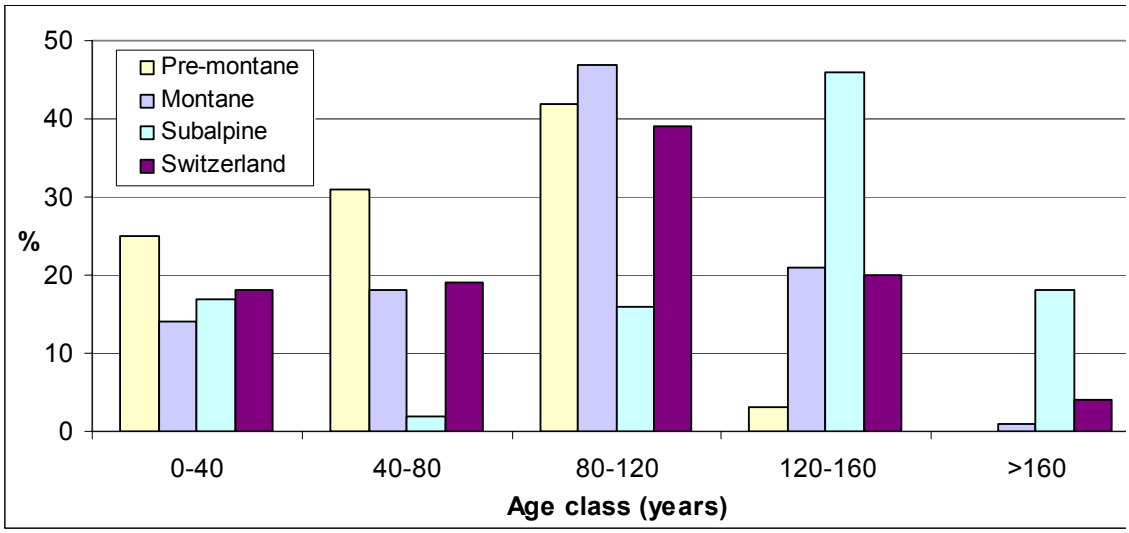

Figure 3: Age class distribution of trees in Swiss Forests according to year-ring analysis of trees sampled during the third National Forest Inventory (2004-2006): average age class distribution (Switzerland) and detailed information for three altitudinal levels: pre-montane (<600 m), montane (601-1200 m) and subalpine (>1201 m).

5.4 Historical and assumed harvesting rates

Switzerland's Business as Usual (BAU) scenario for harvesting until 2025 is determined by aggregating future harvesting rates:

- as derived from extrapolating historical data linearly (see below section 5.4.1), and
- as projected from Switzerland's Wood Policy (see below section 5.4.2) using following two studies:
    - Switzerland's Potential Sustainable Wood Supply (FOEN 2008a)
    - Wood Market Model, Pauli and Thees (2009).

Changes in the C-pool "living biomass" always comprise changes in above- and below-ground living biomass (for more details see description in Switzerland's NIR, FOEN 2010).

5.4.1 Extrapolating trend of historical data

We extrapolated the trend of historical harvesting rates from two base periods: 1990-2007 and 2003-2007 (Fig. 4). The historical data were taken from the Swiss Forest Statistics (FOEN 2009). These data are also used as a basis for reporting losses of living biomass (harvesting part of "cut and mortality") in Switzerland's National Inventory Report (FOEN 2010). The years 1990, 2000 and 2001 following the storm events Vivian (1990) and Lothar (1999) were excluded from the trend calculations, since those storms lead to excessive harvesting rates.

Extrapolating the trend from the base period 1990-2007 results in an increase of 30% of the mean annual harvesting rate for the period 2013-2020 (7.3 Mio m^3) compared to the historical mean annual harvesting rate within period 1990-2007 (5.6 Mio m^3). Using the trend of the more recent 5 year base period 2003-2007, results in an increase of 53% of the projected mean annual harvesting rate for the period 2013-2020 (8.6 Mio m^3) compared to the historical mean annual harvesting rate within period 1990-2007.

The use of the longer base period 1990-2007 was considered to provide more realistic projections, since a 17 year period better reflects the long-term cyclical forest and market dynamics and is therefore more likely to be representative.

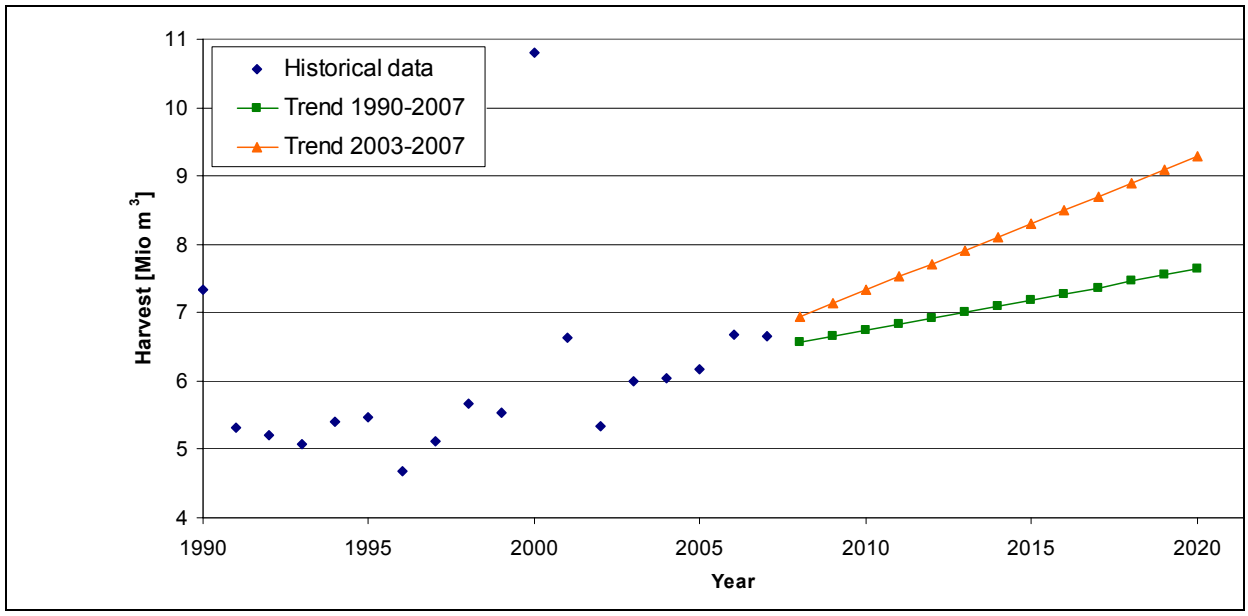

Figure 4: Historical (1990-2007) and future annual harvesting amounts until 2020 as derived from extrapolating historical trends.

5.4.2 Switzerland's Wood Policy

5.4.2.1 Potential Sustainable Wood Supply

In 2004 the National Forest Programme was published, which outlines an Action Plan at the federal level for 2004–2015. Through a wide participatory process five high priority objectives were identified, according to which Swiss forests are to be managed: (1) maintaining and/or enhancing protection from natural hazards (avalanches, rock fall, mudslide etc.) as provided by healthy forests, (2) improving the economic viability of the forestry sector, (3) recognizing and/or strengthening the value-added by wood to the Swiss economy, (4) conserving biodiversity, and (5) conserving and/or protecting trees and soils in catchments used to gain drinking water. While pursuing these objectives GHG removals by sinks and emissions by sources in the forests are to be fully considered according to the Kyoto Protocol requirements while nevertheless making better use of the previously underutilized potential of the Swiss forests to sustainably produce timber and fuel wood through economic incentives and the implementation of new, more efficient technologies.

To implement the objectives of the national forest programme, the Swiss Federal Office for the Environment FOEN has formulated also its Wood Resource Policy (FOEN 2008b) which was coordinated with the other relevant sectoral policies (e.g. energy policy, regional development policy).

The main focus in the implementation of the "Wood Action Plan", which started in 2009, lies in the ecologically and economically effective use of wood. With a view to a more efficient use of wood, cascaded use was prioritised. In cascaded use, harvested wood is to the utmost extent possible first converted into wood products, prior to burning the products as late as possible for gaining energy. Moreover, targeted efforts are set into motion to improve the use of fuel wood through state-of-the-art burning technologies, reduced pollution, and a greater overall efficiency in the chain from harvesting to final consumption. Switzerland's Wood Resource Policy aims to promote higher harvesting rates in Swiss forests, with the excellent image of sustainably produced Swiss wood, are expected to increase the future demand for wood products.

Therefore the aim of Swiss wood policy is to increase wood production for the period 2013-2020 by roughly 30%. The feasibility of such an increase in harvesting was determined in a scientific study, "Switzerland's Potential Sustainable Wood Supply". Several forest management and harvesting scenarios have been used (FOEN 2008a) together with the model MASSIMO3 to project up to 2100 forest carbon stocks, GHG balances, and wood production levels. The project "Switzerland's Potential Sustainable Wood Supply" conforms to the objectives and the methodology used for a wood resource assessment in Europe as described in "Potential Sustainable Wood Supply in Europe" (UNECE 2008).

5.4.2.2 Wood market model

Wood supply is also influenced by the wood market. Future wood demand has been simulated using a wood market model (Pauli and Thees 2009). The following scenarios were investigated (Fig. 5):

Scenario "constant carbon stocks": To keep carbon stocks in Swiss forests at a constant level, harvesting rates would need to be increased by 17% for the period 2013-2020 (6.6 Mio m^3) compared to 1990-2007 (5.6 Mio m^3). This resulted from a modelling experiment with the model MASSIMO3.

"Basic Scenario": This scenario is very close to present conditions. It uses present trends of decreasing harvesting costs and assumes otherwise stable environmental conditions. Harvesting rates increase by 30% for the period 2013-2020 (7.3 Mio m^3) compared to 1990-2007 (5.6 Mio m^3) or by another13% compared to the scenario "constant carbon stocks".

Scenario "Increased Energy Cost": An increase of 25% in energy costs is assumed. Harvesting rates increase by 35% for the period 2013-2020 (7.6 Mio m^3) compared to 1990-2007 (5.6 Mio m^3) or by another 18% compared to the scenario "constant carbon stocks".

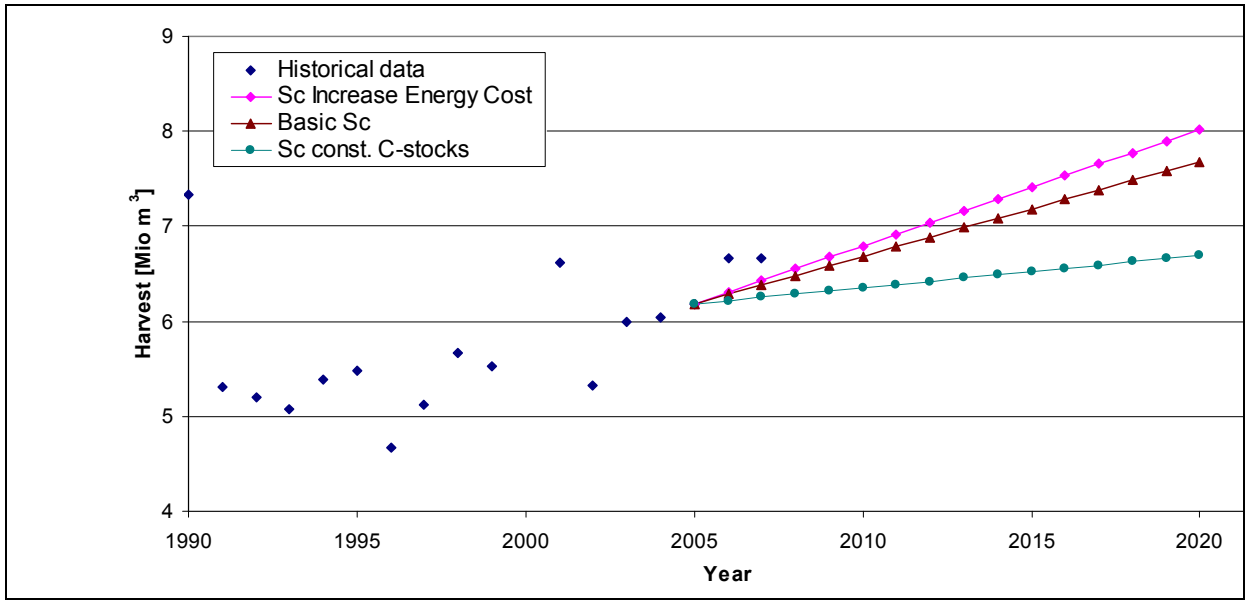

Figure 5: Historical (1990-2007) and future harvesting amounts until 2020 as derived from the wood market model by Pauli and Thees (2009) using the scenarios "basic scenario" and "scenario with an increase of energy costs". For comparison, the amount of harvesting needed for keeping carbon stocks in Swiss forests constant ("scenario constant carbon-stocks") is shown.

5.4.3 Switzerland's business as usual (BAU) scenario for harvesting

Very similar values for future harvesting amounts were derived from (1) extrapolating the trend of historical harvesting rates 1990-2007 excluding the years with extreme harvesting amounts due to storms and (2) the wood market model using the basic scenario translating

Switzerland's Wood Resource Policy as it is defined in the "Potential Sustainable Wood Supply" (Fig. 6): Both scenarios project an increase of 30% in harvesting rates for the period 2013-2020 compared to mean harvesting rates in 1990-2007.

For the period 2013-2020 Switzerland's Business as Usual scenario projects harvesting amounts that are 13% higher than harvesting levels that would keep carbon stocks in Swiss forests constant.

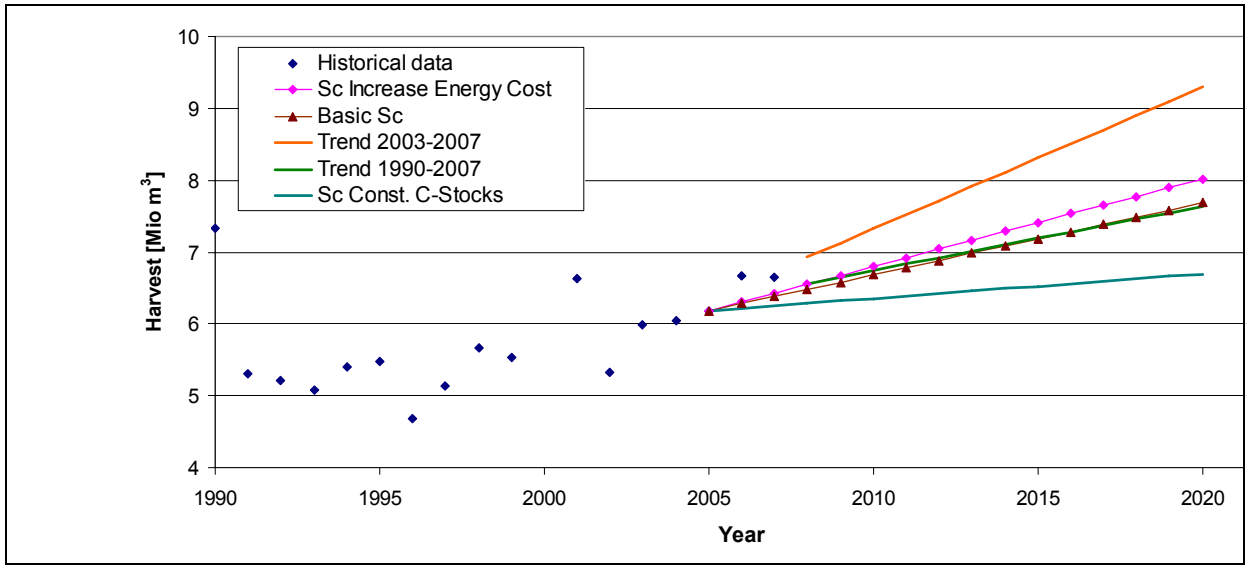

Figure 6: Future harvesting amounts until 2020 as derived from linearly extrapolating historical trends and from the wood market model by Pauli and Thees (2009). Sc – Scenario.

5.5 Harvested Wood Products

HWPs are accounted for in accordance with paragraph 27 of the integrated version of the chair's negotiating text FCCC/KP/AWG/2010/CRP.4/Rev.4, on the basis of Tier 2 Swiss country-specific data.

Emissions and removals from HWPs have been included in the reference level for reasons of methodological consistency. For domestically produced and consumed harvested wood products, country specific data were used in accordance with the definitions and estimation methodologies in the relevant and most recently adopted IPCC Guidelines.

HWP exports were not taken into account in the reference level. In the future as export data become available we plan to account for these on the basis of first order decay functions with default half-lives of two years for paper, 25 years for wood panels, and 35 years for sawn wood. No significant deforestation takes place in Switzerland and therefore we assumed that all HWPs accounted for will be produced only by forests that fall under forest management as defined in accordance with the KP.

Emissions from the existing pool of HWPs removed from forests prior to 1 January 2013 (paragraph 15 sexies of the chair's text) were included in the reference level. Switzerland has included all products in the pool extracted from forests since 1900[1], in accordance with IPCC Guidelines.

[1] In the existing HWP pool in Switzerland there are also products from before 1990 that could be included in accounting, since there exist sufficient data. Since our national data do not allow for distinguishing between HWPs produced before and after 1990, Switzerland plans to account for the entire extant HWP pool. This would add to the conservativeness of the accounting.

5.6 Disturbances in the context of force majeure

Emissions from the constant, background level of storms affecting Switzerland each year have been included in the projections for the period 2013-2020. However, force majeure events were not included in the reference level. The only two force majeure events affecting Switzerland in the last 2 decades were the major storms Vivian (1990) and Lothar (1999). The emissions from these events as well as the subsequent secondary damage from insect infestations were not included in the calculation of the reference level.

5.7 Factoring out according to 16/CMP1 para 1(h)

Factoring out the effect of elevated CO_2 concentrations was not performed for historical nor projected data because the effects cannot yet be estimated reliably and considerable scientific uncertainties remain. In fact, several Swiss field experiments, have shown, that an increase in CO_2- as well as N-concentrations does not necessarily lead to long-term increase of sequestered carbon in living biomass:

- Körner (2006) did not find a correlation between elevated CO_2-concentration and tree growth at the Swiss measurement site Hofstetten.
- Elevated N-deposition can lead to a decrease in gross growth (see Braun et.al. 2011)

The mentioned few studies only illustrate how conflicting the scientific evidence still is, calling for another approach to factoring out.

6 Policies included

Switzerland's Wood Resource Policy (FOEN 2008b) is described in Section 5.4.2. The estimation of future harvesting rates is based on the assumption that this policy is being continued (cf. "Switzerland's Potential Sustainable Wood Supply"). This policy has been developed and implemented before 2009. Since then, no new wood policies have been developed nor envisaged. Therefore Switzerland's reference level for 2013-2020 is likely to remain unaffected by any changes in wood policy.

7 Switzerland's reference level 2013-2020

Using a "net-net accounting approach with reference period 2013-2020", taking into account all of the above-mentioned input and methodology, Switzerland's reference level amounts to **0.22 Mt CO_2 y^{-1}**.

Mt CO_2 y^{-1}	
0.48	Calculated reference level, wood harvesting
0.21	Annual HWP production from wood harvested in the reporting country (domestic harvest) including existing pool since 1900
0.05	Organic soil carbon
0.22	**Swiss reference level 2013-2020**

The HWP and organic soil carbon data are provisional and may be adjusted according to still ongoing revision for accuracy.

8 References

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