Submission of information on forest management reference levels by Sweden

This submission by Sweden responds the request set out in paragraph 4 of Decision [-/CMP.6] on Land-Use, Land-Use Change and Forestry.

Stockholm, 25th February of 2011

Sweden

1. Forest management reference level values

Proposed Reference Level [1], (GgCO2eq per year)	
applying first order decay function for HWP [2]	assuming instantaneous oxidation of HWP [3]
-41 336	-36 057

[1] The reported values are averages of the projected FM data series for the period 2013-2020, taking account of policies implemented before mid-2009.

[2] Including emissions/removals from HWP estimated using the product categories, half lives and methodologies as suggested in para 27, page 31 of FCCC/KP/AWG/2010/CRP.4/Rev.4. Activity data is starting from 1961 as described in section 5 of this document.

[3] Provided for transparency reasons only.

Due to recalculations of reported data for Forest management as presented in the National inventory report 2011, NIR (Swedish EPA 2011) changes have been made to the reference levels compared to the reference levels submitted earlier. Since the submission of reference levels in December 2009, new data for most carbon pools has become available for the historical data set (1990-2009). In addition a new method to calculate sequestration in stumps has been implemented, calculations of net removals in small trees have been updated and the Soil organic carbon pool has been recalculated because of increased data availability and new methods.These recalculations also affect the calculations used in the projections for 2015 and 2020. No changes have been made in the underlying assumptions used for the projection.

The tables below are provided to facilitate the assessment of the reference level according to the provisions set out in the CMP.6-decision on LULUCF (http://unfccc.int/files/meetings/cop_16/application/pdf/cop16_lulucf.pdf)

Net Removals (-) or Net Emissions (+) ($GgCO_2eq$ per year) [1]					
	FM applying first order decay function for HWP[2]	FM assuming instantaneous oxidation of HWP[3]		FM applying first order decay function for HWP [2]	FM assuming instantaneous oxidation of HWP [3]
1990	-52 044	-47 544	**2008**	-44 439	-37 887
1991	-52 188	-48 571	**2009**	-48 478	-44 527
1992	-48 194	-45 178	**2010**	-45 032	-38 460
1993	-46 505	-42 142	**2011**	-44 478	-38 173
1994	-47 250	-42 823	**2012**	-43 970	-37 885
1995	-48 007	-42 551	**Avg. of 2008-2012**	-45 279	-39 386
1996	-48 049	-43 756	**2013**	-43 495	-37 598
1997	-50 918	-44 922	**2014**	-43 044	-37 311
1998	-50 311	-44 902	**2015**	-42 611	-37 023
1999	-48 418	-43 397	**2016**	-41 817	-36 451
2000	-50 979	-44 135	**2017**	-41 047	-35 878
2001	-48 231	-42 910	**2018**	-40 295	-35 305
2002	-50 555	-44 912	**2019**	-39 555	-34 732
2003	-50 277	-43 966	**2020**	-38 825	-34 159
2004	-47 134	-40 773	**Avg. of 2013-2020**	-41 336	-36 057
2005	-47 698	-39 592			
2006	-46 937	-37 680			
2007	-46 444	-36 924			
Avg. of 1990-2007	-48 897	-43 149			

[1] Data for 1990-2009 represents the greenhouse gas inventory 2011 (Swedish EPA 2011)
[2] emissions/removals from HWP estimated using the product categories, half lives and methodologies as suggested in para 27, page 31 of FCCC/KP/AWG/2010/CRP.4/Rev.4. Activity data is starting from 1961 as described in section 5 of this document.
[3] provided for transparency reasons only

Pools and gases included in the reference level [1]											
Change in C pool included in the reference level						GHG sources included in the reference level					
Above-ground biomass	Below-ground biomass	Litter	Dead wood	Soil		Fertilization	Drainage of soils	Liming	Biomass burning		
				mineral	organic	N_2O	N_2O	CO_2	CO_2	CH_4	N_2O
Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes

[1] "Yes/No" indicate if the pool or gas is included or not in the projections used to set the reference level. Full consistency will be ensured with paragraphs 12 quater, 12 quinquies and 25 of the document FCCC/KP/AWG/2010/CRP.4/Rev.4

Harvest rate [1](roundwood overbark, 1000 m^3)				
2000	2005	2010	2015	2020
74 100	115 900	NA	88 825	87 780

[1] Further information on harvest rates are provided in section 5 of this document.

2. General description of the proposed reference levels

The proposed reference levels for Forest management are the expected average annual net removals in 2013-2020 based on reported net removals 2005-2009 (Swedish EPA 2011) and business-as-usual scenarios for 2015 and 2020 (results are presented in table 1). In the scenarios present forest management practices are assumed, including measures in forestry and environmental policy aimed at preserving biological diversity. The effect of already implemented cross-sectorial policies and measures such as the present energy and carbon dioxide taxes and current scale of the EU emissions trading scheme as well as the renewable electricity certificate system is included in the projection, resulting in increased removals of forest residues and an increased stump harvest.

In this submission, the following approaches have been taken:

- The proposed reference levels include only policies and measures already in place (mid-2009).
- Age structure is considered in the model used to calculate the projection for 2015 and 2020.
- The projections comprise all carbon pools currently reported under the Kyoto protocol (Living biomass above ground, Living biomass below ground, Dead wood, Litter, Soil organic carbon).
- Models used for projections can be used to simulate historical data based on the state of the forest in 1990 and observed harvest levels. The structure of the standing stock at the start of the model simulation is based on the Swedish National Forest Inventory (NFI), which also forms the base for the annual reporting to the UNFCCC and under the Kyoto protocol.

- The reference level calculation for 2013-2020 use the most recent national data 1990-2009 and the projections for 2015 and 2020 are based on available forest statistics at the time of the simulation.
- The methods used are open for future review. Historical data is presented in the National inventory report, NIR (Swedish EPA 2011) whereas the projections are described (with relevant references) in this submission and in the final report of a government commission (SLU 2009).

3. Pools and gases included in the Forest management reference level

In the reference level for Forest management the following pools are included: Living biomass above ground, Living biomass below ground, Dead wood, Litter, Soil organic carbon. In addition to carbon pool changes, emissions from nitrogen fertilization of forest soils and emissions from forest fires are included as required under the current KP-LULUCF reporting obligations.

The coverage of pools and other emissions in the Forest management reference level is consistent with the information provided in the most recently submitted National inventory report, NIR (Swedish EPA 2011) according to the UNFCCC-LULUCF format with three carbon pools. However, due to technical reasons the boundaries between pools according to KP-LULUCF in the historical data and the projected data differ slightly (table 1).

Sweden also provides estimates on harvested wood products, HWP. The same definitions are used both for historical data and projected data on HWP.

Table 1. Historical reported and projected carbon pools and emissions for Forest management.

UNFCCC-pool	Historical data	Projection
Carbon stock change in Living biomass	Living biomass above ground	Living biomass above ground
	Living biomass below ground	Living biomass below ground
Carbon stock change in Dead organic matter	Litter	Fine litter
		Forest residues
	Dead wood (including stumps)	Dead wood (above ground)
		Stumps
Carbon stock change in Soil organic carbon	Mineral soils	Carbon stock change in Soil org. carbon
	Organic soils	
Other emissions	Nitrogen fertilization	Nitrogen fertilization
	Forest fire	Forest fire

4. Approaches, methods and models used in the construction of reference levels

Historical data

Carbon pool changes and other emissions

Definitions and methods related to carbon pool changes in Living biomass, Dead organic matter (Litter and Dead wood) and Soil organic carbon and other emissions from Forest management 1990-2009 are described in the National inventory report, NIR (Swedish EPA 2011).

HWP

Emissions and removals from harvested wood products, HWP, were calculated for wood removed from forests in Sweden and that was consumed domestically or exported, in accordance with paragraph 27 in annex 1 of section II of document FCCC/KP/AWG/2010/CRP.4/rev.4, the so called Production approach. The IPCC default Tier 1 method as described in equation 12.1 of 2006 IPCC Guidelines (IPCC 2006) was used. A first-order decay approach is assumed, i.e. it is proportional to the pool and the annual produced amount, and is calculated using the half-life (number of years until 50% of the carbon content remains within the product) of the product as input variable. Half-lives of two years for paper, 25 years for wood panels, and 35 years for sawn wood were used in the calculations. The same half-lives were used for products (domestically produced) consumed domestically as for products consumed by importing countries.

Input data arise from FAO (FAOSTAT) based on statistics of production and trade of primary and semi-finished products during 1961-2007. In addition data on production and trade from the Swedish Forest Agency (www.skogsstyrelsen.se) and Statistics Sweden (www.scb.se) was used. The input data used in the calculation is available in Wikberg 2011.

Projection

Carbon pool changes and other emissions

Projected net removals in Living biomass above and below ground and Dead organic matter (including dead wood and coarse litter) for 2015 and 2020 have been estimated using the HUGIN modelling tool (Lundström & Söderberg 1996). The model simulates the future development of the forests on the basis of assumptions on how they are managed and harvested over a hundred-year period.

Detailed assumptions for growth and harvest are the same as in the reference scenario for the long term forest state calculations made by the Swedish forest agency in 2008, SKA-VB 08 (Claesson et. al. 2008) and used in the projections and sensitivity analysis presented in the report of a government commission in 2009 (SLU 2009). The calculations refer to living trees on productive forest land. Productive forest land encompasses all kinds of forests such as forests for timber production, forests in national parks, forests in nature reserves and forests for habitat protection. Most growth and stock is found in productive forests and the exclusion of non-productive forests is assumed to have minor influence in practice.

The total area for Forest management is about 28.2 million ha, according to the FAO-definition. 23.4 million ha (including production areas as well as protected forests) is classified as productive forest and is the area included in the simulations. In the scenarios present forest management practices are assumed, including measures in forestry and environmental policy aimed at preserving biological diversity. This means that a total of 956 000 ha is set aside for nature conservation through legal

protection and 2 030 000 ha is set aside through nature conservation measures in production areas and through voluntary set aside by forest owners.

The forest area in the model is fixed, which means that some areas of Afforestation/Reforestation and Deforestation are included in the simulation results. This assumption mainly has three different implications for the projected reference level:

1. Areas afforested/reforested from 1990 until the time of the simulation are included although they should have been excluded. This causes an overestimation of net removals in Forest Management (FM).

2. Emissions on areas being deforested during the commitment period are included although they should have been excluded. This causes an underestimation of net removals in FM.

3. The area under Forest Management wrongly includes areas deforested from the time of the simulation until 2020, which leads to an overestimation of the Forest Management area that accumulates over time. This causes an overestimation of net removals in FM.

Available information in NIR and assuming continued constant deforestation levels until 2020, indicates that the inclusion of A/R and D in the simulation results in a overall minor overestimation of net removals in the reference level.

Improductive forests (average annual growth less than 1 m^3) are not presently included in the HUGIN model tool. Therefor a fixed annual value of net removals in biomass carbon pools for these areas has been added based on the observed trend in the stock on these areas (2 million ton CO_2 annually).

The structure of the standing stock at the start of the model simulation is based on the Swedish NFI which also forms the base for the annual reporting under the UNFCCC and the Kyoto protocol. Annual felling is assumed to be at the level of what is regarded as sustainable in the long term, i.e. set to the highest possible without decreasing the future standing stock while excluding areas for nature conservation and volumes not available for harvesting in production areas due to environmental legislation. The results points out that the possible harvest during the period 2010-2030 sums up to approx. 93 million m^3 annually. The average timber stock continues to increase, from 133 m^3 per ha in 2010 to 143 m^3 per ha in 2030.

In the scenario a climate effect is included, based on the B2 scenario which was regionalized at the Rossby centre at the Swedish Meteorological and Hydrological Institute, SMHI (Kjellström et. al. 2005). This gives a positive effect on the annual gross increment by 2 % 2010-2020 and by 6 % 2020-2030.

The starting point for the sub-pool of forest residues is estimated using historical harvest data and an assessed decomposition rate (15 % per year). The inflow to the sub-pool is a direct consequence of the harvest rate. In addition, the recent trend of increased removal of forest residues has been included. Based on the long term projection for bioenergy made by the Swedish energy agency applying climate and energy policies at that time (Energimyndigheten 2009) the use of forest residues is assumed to increase from 8 TWh in 2005 up to 15 TWh in 2030 (table 2).

Table 2. The assumed increase in removal of forest residues and stump harvest.

	2010	2015	2020	2025	2030
Forest residues [TWh]	8.0	10.5	13.0	14.0	15.0
Stumps [TWh]	0.6	2.3	3.0	-	-
Stump harvest area [1000 ha]	4.8	17.5	23.4	-	-

The initial stump system carbon pool in the projection was estimated using historical harvest data and an assumed oxidation rate (4.6 % per year) as described for the historical data (1990-2009). The projected inflow to the pool is a direct effect of the harvest rate and the self-thinning of trees in the SKA-VB 08 reference scenario. In addition, the recent trend of stump harvest has been included (Swedish Forestry Board 2009). The stump harvest is set to increase up to 3 TWh in 2020 which means that about 23 000 ha (approximately 10 %) of the clear felled area is affected by stump harvest (table 2).

The initial dead wood pool (above ground) was estimated from the NFI. The development of the carbon pool is affected of the inflow due to natural wastage, the assumed harvest of dead wood (approx. 2.1 million m^3) and an assumed decomposition rate (4.6 % per year).

The remaining part of the dead organic matter pool (annual litter fall and the soil O-horizon) as well as the soil organic carbon pool is based on the mean value between 2000 and 2009 (Swedish EPA 2011). To the mean value the future effect on the soil organic carbon pool of the sustained trend of increased use of forest residues, using the Q-model (Agren et. al. 2007) has been added. Other emissions, such as biomass burning and nitrogen fertilization, are based on the mean values for 2000-2009.

HWP

Emissions and removals from harvested wood products in the projection were calculated using the same methodology as described for the historical data. Calculations were based on the projected harvest for 2015 and 2020 where the harvest for intermediate years (2010-2014 and 2016-2019) was interpolated. To be consistent with the interpolation of Forest management the interpolation of harvest was based on the mean value of 2005-2009 and the 2015 value. The distribution among different product groups and the trade of HWP was assumed to be equal to the current distribution (average of 2005-2009).

Calculating the reference level

The forest management reference level without HWP is calculated using the average net removals for Forest management without HWP for 2005-2009 (representing 2007) according to reported Forest management (Swedish EPA 2011) and projected Forest management for 2015 and 2020. Intermediate years (2008-2014, 2016-2019) are interpolated to get annual values for Forest management. Annual HWP values are based on observed and projected harvest data as described above.

The reference level is calculated as the average net removal for the period 2013-2020 (table 1).

The basis for the calculation of the reference level is found in table 3. Data on pool level can be found in Appendix A to this submission.

Table 3. Reported (Submission 2011) and projected removals for Forest management and HWP and calculated reference level for 2013-2020. Note that the sum in column three does not always equal the sum of the two first columns due to rounding.

[million ton CO_2] Year	Forest management	HWP	FM including HWP
1990	-47.5	-4.5	-52.0
1995	-42.6	-5.5	-48.0
2000	-44.1	-6.8	-50.0
2005	-39.6	-8.1	-47.7
2006	-37.7	-9.3	-46.9
2007	-36.9	-9.5	-46.4
2008	-37.9	-6.6	-44.4
2009	-44.5	-4.0	-48.5
Average of 2005-2009	-39.3	-7.5	-46.8
2015	-37.1	-5.6	-42.6
2020	-34.2	-4.7	-38.8
2013-2020	-36.1	-5.3	-41.4

Uncertainties

The uncertainty for Forest management, in case of instant oxidation approach for harvested wood products, is +/- 4 million ton CO_2 per year. Additional information on uncertainty for historical data is given in national Annexes in EU data submissions during 2009[1]. The uncertainty in the estimation of HWP using the production approach has not been quantified but arises from uncertainties in the assumed product half-lives, the size of the historical pool and on the available production statistics, but is assumed to be much lower in absolute terms than the total uncertainty for the other pools of Forest management.

The overall uncertainty in the projection originates from the uncertainty in relation to historical data, as well as from uncertainty related to the simulation. Important uncertainties related to the simulation arise from the applied climate effect that in turn affects several factors that are of major importance for the development of the forest (increment, disturbances, increased forest area etc.).

Sensitivity analysis

The projected removals are based on the assumption that the available annual growth in the production areas is harvested. This harvesting level constitutes the result of investments made by forest owners available for harvest until 2020 given present forest management practices, while maintaining the standing stock.

However, since it is foreseen that the demand for bioenergy (also from other countries, partly as a result of the EU energy and climate package) will increase due to the introduction of climate change policies in the energy sector, the harvest rate may increase above this level during the coming decade. A sensitivity analysis assuming an increased harvest rate by 10 % to 2030, everything else

[1] http://unfccc.int/files/kyoto_protocol/application/pdf/awgkplulucfdataeu051109.pdf, http://unfccc.int/files/kyoto_protocol/application/pdf/eululucf300909.pdf and http://unfccc.int/files/kyoto_protocol/application/pdf/awgkplulucf_eu151209.pdf

unchanged, indicated a decrease in annual net removals in Living biomass by 17 million ton CO_2, and a total decrease in annual net removals by 14,5 million ton CO_2 including all pools (the decrease in Living biomass is compensated by an increase in HWP and stump systems). A long term increase of the use of forest residues by an additional 10 TWh (up to 25 TWh in 2030) reduce the net removal in Dead organic matter by 1.5 million ton CO_2 compared to the scenario used in the reference level estimation. Increased harvest rate would call for reinforced silvicultural investments to increase the yield, or restrictions limiting the fellings, if the standing stock in the production forests is to be maintained.

5. Description of construction of reference levels

In this section information is provided on how the elements in paragraphs 9 of Part I of Annex II to the Cancun LULUCF Decision is considered.

9 (a) Area under Forest management

The historical Forest management area and the projected Forest management area is displayed in table 4. Historical data has been reported in the National inventory report, NIR (Swedish EPA 2011). According to reporting practices the area for Forest management decreases due to deforestation during the reported period. The area for Forest management used in the model system for the projection is constant over the projected period.

Table 4. Historical and projected area for Forest management.

[million ha]	1990	1995	2000	2005	2015	2020
FM area	28.24	28.18	28.12	28.10	28.18	28.18

9 (b) Emissions and removals from Forest management

This section is provided to describe the relationship between Forest management and forest land remaining forest land as shown in GHG inventories and relevant historical data.

Kyoto protocol activity areas are accumulated from the base year and onwards and, normally, do not leave the class. For the UNFCCC-reporting converted land stays in the conversion class for twenty years and is thereafter reported under the land use category it was converted to. The twenty-year accumulation of land under the UNFCCC-reporting may begin long before the base year and is therefore not suitable to, for example, compare ARD under the Kyoto Protocol with Forest land converted to other land use categories or land converted to Forest land. Using conversions to or from Forest land as a "proxy" for ARD has lead to several misunderstandings in the annual review process.

Table 5. Reported net removals for KP-LULUCF (Forest management, AR and D) and reported net removals for UNFCCC-LULUCF (Forest land 5.A and Forest land remaining Forest land 5.A.1) according to the National inventory report, NIR (Swedish EPA 2011).

[million ton CO_2] Year	Kyoto protocol			UNFCCC	
	FM	AR	D	Forest land (5.A)	Forest land rem. forest land (5.A.1)
1990	-47.5	0.0	0.8	-47.4	-47.5
1995	-42.6	-0.1	2.7	-42.6	-42.8
2000	-44.1	-0.3	1.9	-44.5	-44.0
2005	-39.6	-0.7	3.4	-40.5	-40.1
2006	-37.7	-0.8	2.5	-38.7	-36.0
2007	-36.9	-1.0	2.0	-38.3	-34.6
2008	-37.9	-1.3	4.0	-39.7	-34.9
2009	-44.5	-1.0	3.5	-46.0	-44.0

9 (c) Forest characteristics and related management

Age class structure

Data on historical age class structure (figure 1) represents official forest data according to the Swedish NFI (www-nfi.slu.se/Resultat/Alder.htm). Projected age class structure is the result of the simulations described above.

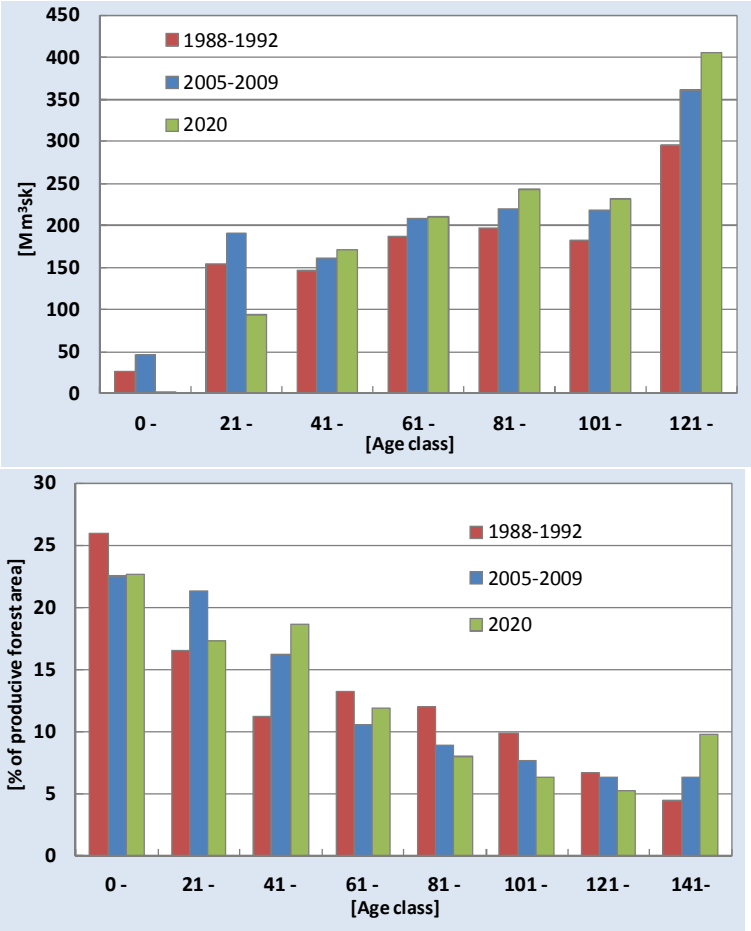

Figure 1. Age class structure representing the historical situation (1988-1992 and 2005-2009) as well as the projected situation (2020), for area and volume respectively.

Increment

Data on historical increment, which shows a gradually increasing annual increment, represents official forest data according to the Swedish NFI[2] (table 6 and figure 2). Projected increment is the result of the simulations described above. The slight decrease projected between 2015 and 2020 is mainly an effect of changes in the age class distribution.

Note that the historical data on gross increment (1990-2009) are for information purpose. Sweden calculates net removals for the annual reporting to the UNFCCC using the stock change method and is not using these increment data for the reporting.

Table 6. Gross increment for Forest management (1990-2007) according to the NFI and according to the projections for 2020 described above.

[million m^3]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total	101	99	105	102	100	99	101	104	105	110
[million m^3]	2000	2001	2002	2003	2004	2005	2006		2015	2020
Total	111	124	120	118	121	118	124		125	123

Rotation length

The minimum stand age when final felling is allowed is regulated by the Forestry Act and is dependent on site fertility and dominating species. A rule of thumb is that forest companies normally harvest at the minimum age for final felling plus 10 years. The normal length of the rotation period is between 45 and 90 years in southern Sweden and between 65 and 100 years in northern Sweden. Note also that normal forestry practices include thinning of the forest two to four times during a rotation period.

Other relevant information, including information on forest management activities under 'business as usual'

There is currently no more information to provide in addition to what's already presented above.

9 (d) Harvesting rates

Historical and future harvesting rates

Total harvest 1990-2009 (table 7 and figure 3) represents gross fellings, which is the amount of wood annually supplied to the forest industry and the energy sector in Sweden and other countries. Data is given in the unit m^3sk (stem volume over bark including the top). The conversion factor from m^3sk to m^3roundwood over bark, which is used in the table in section 1, is 0.95. This supply have domestic origin and import is not included. Annual data on gross fellings is compiled by the Swedish forest agency[3]. The development of harvest levels over time are interlinked with silvicultural investments, forest growth, industry capacity and business cycles. Since 1990, harvesting levels have increased steadily although the last few years show some fluctuations because large storms in 2005 and 2007 created peaks and the years after the storms showed decreased harvesting levels (see section 5/9f

[2] http://www.slu.se/en/webbtjanster-miljoanalys/forest-statistics/growth/growth-tables/

[3] http://www.skogsstyrelsen.se/Myndigheten/Statistik/Amnesomraden/Avverkning-och-virkesmatning/Tabeller--figurer/

for additional information on natural disturbances). Preliminary statistics for gross felling for 2010 indicate a level close to 90 million m^3.

Table 7. Gross fellings (1990-2009) according to the Swedish Forestry board and according to the projections described above. Includes fellings on all land and trees left in the forest. (m^3sk: stem volume over bark including the top)

[million m^3]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Gross fellings	66	64	66	67	69	78	70	74	75	72	78
[million m^3]	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2015**	**2020**
Gross fellings	78	82	83	87	122	80	96	87	80	93.5	92.4

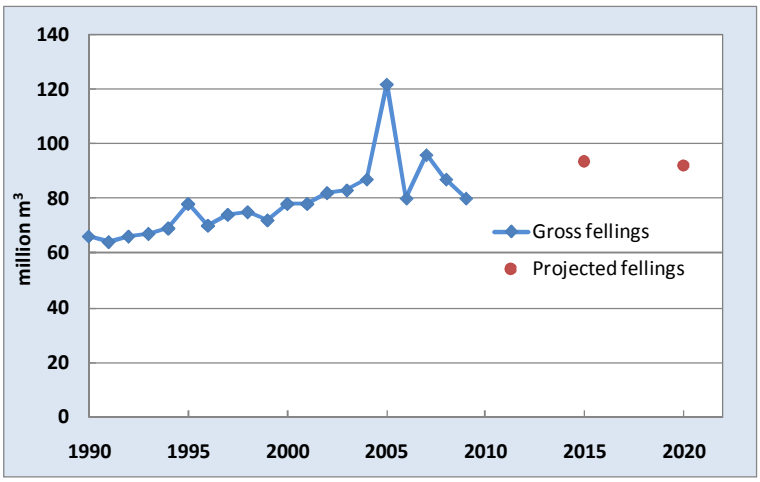

Figure 3. Gross fellings (1990 - 2009) as well as projected fellings (2015 and 2020). (m^3sk: stem volume over bark including the top)

Note that the historical data (1990-2009) on gross fellings are presented here only for information purpose. Sweden calculates net removals for the annual reporting to the UNFCCC using the stock change method and is not using these harvest data for the reporting.

Annual harvest in the projection for 2015 and 2020 (table 7 and figure 3) is the result of the simulation where the harvest is assumed to be at the level of what is regarded as sustainable in the long term i.e. a level that will maintain the standing stock in the production forests, also taken into account present nature conservation measures. The resulting level is approximately at the same level as the average gross felling for the period 2005-2009, but is somewhat below the level that could be assumed using the historical trend from 1990.

9 (e) Harvested wood products

Emissions and removals from harvested wood products (table 8) were calculated for wood removed from forests in Sweden and that was consumed domestically or exported, the so called Production approach. The IPCC default method (equation 12.1 of 2006 IPCC Guidelines) was used with the first order decay function with default half-lives of two years for paper, 25 years for wood panels, and 35

years for sawn wood. The same half-lives were used for products (domestically produced) consumed domestically as for products consumed by the importing country. The calculations are based on production statistics and not on harvest statistics. Therefore we see no risk that wood harvested for bioenergy enter the products pool.

The numbers include HWP data for 3.3-activities. This is consistent with the methodology in the simulation of living biomass, which includes all forest land (for additonal information, see the section on projections in chapter 4).

Table 8. Removals in HWP [million ton CO_2] using half-lives of two years for paper products (P P), 25 years for wood based panels (W B P), and 35 years for sawn wood (S W).

Year	S W	W B P	P P	Total	Year	S W	W B P	P P	Total
1961	-3.195	-0.351	-0.335	-3.881	**1991**	-3.208	-0.075	-0.333	-3.617
1962	-3.030	-0.395	-0.338	-3.763	**1992**	-3.622	0.263	0.343	-3.016
1963	-3.192	-0.439	-1.144	-4.775	**1993**	-3.998	0.252	-0.616	-4.362
1964	-4.096	-0.522	-1.994	-6.613	**1994**	-4.637	0.236	-0.027	-4.427
1965	-4.547	-0.564	-2.021	-7.132	**1995**	-5.384	0.069	-0.141	-5.456
1966	-4.331	-0.866	-1.269	-6.466	**1996**	-4.807	0.124	0.390	-4.292
1967	-4.432	-0.866	-1.632	-6.930	**1997**	-5.670	0.138	-0.464	-5.996
1968	-4.655	-0.930	-1.803	-7.388	**1998**	-5.110	0.022	-0.322	-5.410
1969	-5.038	-0.973	-2.501	-8.513	**1999**	-4.770	0.093	-0.344	-5.021
1970	-5.728	-1.016	-3.012	-9.755	**2000**	-5.646	0.035	-1.234	-6.844
1971	-5.890	-1.039	-1.235	-8.164	**2001**	-5.365	0.180	-0.136	-5.321
1972	-5.882	-1.274	-1.359	-8.515	**2002**	-5.369	0.205	-0.480	-5.644
1973	-6.295	-1.441	-2.727	-10.463	**2003**	-5.756	0.356	-0.911	-6.311
1974	-6.088	-1.519	-1.512	-9.120	**2004**	-5.786	0.378	-0.953	-6.361
1975	-3.934	-1.211	1.407	-3.738	**2005**	-6.835	0.204	-1.475	-8.105
1976	-3.852	-1.308	1.136	-4.024	**2006**	-7.164	0.148	-2.242	-9.258
1977	-3.662	-1.280	2.360	-2.582	**2007**	-7.567	0.098	-2.051	-9.520
1978	-3.610	-1.345	-0.161	-5.116	**2008**	-6.275	0.101	-0.377	-6.551
1979	-3.682	-1.251	-0.455	-5.388	**2009**	-4.991	0.168	0.872	-3.951
1980	-3.663	-1.074	0.420	-4.317	**2010**	-6.197	0.133	-0.507	-6.572
1981	-3.038	-0.801	1.310	-2.529	**2011**	-6.075	0.129	-0.359	-6.305
1982	-3.494	-0.549	1.283	-2.760	**2012**	-5.956	0.126	-0.254	-6.085
1983	-3.900	-0.581	-0.665	-5.146	**2013**	-5.840	0.122	-0.179	-5.897
1984	-4.301	-0.528	-1.321	-6.150	**2014**	-5.725	0.119	-0.127	-5.733
1985	-3.507	-0.406	-0.419	-4.332	**2015**	-5.613	0.115	-0.090	-5.587
1986	-3.490	-0.297	-0.082	-3.869	**2016**	-5.461	0.115	-0.020	-5.367
1987	-3.232	-0.327	-0.397	-3.956	**2017**	-5.313	0.115	0.029	-5.170
1988	-2.996	-0.290	-0.764	-4.051	**2018**	-5.168	0.115	0.063	-4.990
1989	-3.175	-0.281	-0.635	-4.092	**2019**	-5.025	0.114	0.088	-4.823
1990	-3.624	-0.229	-0.647	-4.500	**2020**	-4.885	0.114	0.105	-4.666

9 (f) Disturbances in the context of force majeure

The total effect of two large storms (2005 and 2007), was an short-term increase in harvest by approximately 50 % of an annual harvest thus increasing emissions due to natural disturbances. These emissions are not explicitly displayed in the reported figures since the Swedish system for reporting to UNFCCC includes, but also levels out the effect of storms of this magnitude.

Regarding storms of this magnitude, Sweden will most likely not use the mechanism of Force majeure mainly because most of the damaged wood will be taken care of, as was the case for the two storms in 2005 and 2007. The storms dramatically increased the annual harvesting level for these years as compared to other years. Some of this was balanced out by reduced harvesting levels following years. The biomass for the minor part of the damaged wood that was not taken care of was not immediately oxidized but switched from one carbon pool to another. The assumed additional loss of wood due to the large storm in 2005 was estimated to only 3 million ton CO_2. If the wood is assumed to decompose over several years, starting from 2005, the effect of the storm is a slight decrease in annual net removals over several years. Methods to estimate net effects due to storms are planned to be further developed.

9 (g) Factoring out in accordance with paragraph 1(h) (i) and 1(h) (ii) of decision 16/CMP.1.

The model used is based on empirical data, thus including the effect from both elevated carbon dioxide concentrations and indirect nitrogen deposition. In addition, the scenario used to simulate future net removals include a climate effect, including inter alia an increased effect from elevated carbon dioxide concentrations. Further details and references is given in section 4. Thus, the reference value includes the effect from both elevated carbon dioxide concentrations and indirect nitrogen deposition thereby factoring out these elements from the accounting.

6. Policies included

Pre-2010 domestic policies included

A description of various forest policies as well as other policies affecting the results included in the projection is given in Sweden´s Fifth National Communication on Climate Change (Ministry of Environment 2009) and in the report for Sweden on assessment of projected progress in accordance with article 3.2 under Council Decision No 280/2004/EC (Swedish EPA 2009).

Confirmation of factoring out policies after 2009

No decisions made after December 2009, such as the Climate & energy package, are included in the construction of the reference level.

The projection used to set the reference level is based on the reference scenario in SKA-VB 08 (Claesson et. al. 2008) that were finalized in 2008. It only includes forest management practices and policies present at that time.

7. References

All references listed here can also be found on the webpage for the Swedish LULUCF-reporting team that can be found at:http://www.slu.se/mark/bea/ghg-reporting

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Appendix A

Reported Forest management	1990	2005	2006	2007	2008	2009
Carbon stock change in Living biomass [Gg C]	**9 777**	**5 921**	**5 807**	**5 331**	**5 759**	**8 117**
Living biomass above ground [Gg C]	7 330	4 326	4 278	3 697	4 280	6 083
Living biomass below ground [Gg C]	2 447	1 594	1 529	1 634	1 479	2 034
Carbon stock change in Dead org. matter [Gg C]	**1 670**	**3 373**	**2 955**	**3 188**	**3 042**	**2 415**
Litter [Gg C]	348	392	363	389	396	401
Dead wood [Gg C]	1 322	2 982	2 591	2 799	2 646	2 013
Carbon stock change in Soil org. carbon [Gg C]	**1 540**	**1 527**	**1 562**	**1 570**	**1 588**	**1 633**
Mineral soils [Gg C]	4 001	4 069	4 097	4 108	4 157	4 273
Organic soils [Gg C]	-2 461	-2 542	-2 536	-2 539	-2 569	-2 641
Other emissions [Gg CO_2-eq]	**75**	**84**	**173**	**66**	**207**	**76**
Nitrogen fertilization [Gg N_2O]	0.185	0.082	0.088	0.123	0.158	0.147
Forest fire [Gg CO_2-eq]	18	59	145	28	158	30
[Gg CO_2]	*16.358*	*53.358*	*132.030*	*25.568*	*143.602*	*27.644*
[Gg CH_4]	*0.0714*	*0.2328*	*0.5761*	*0.1116*	*0.6266*	*0.1206*
[Gg N_2O]	*0.0005*	*0.0016*	*0.0040*	*0.0008*	*0.0043*	*0.0008*
Total net removals, excl. HWP [Gg CO_2-eq]	-47 544	-39 592	-37 680	-36 924	-37 887	-44 527
HWP [Gg CO_2]	-4 500	-8 105	-9 258	-9 520	-6 551	-3 951
Total net removals, incl. HWP [Gg CO_2-eq]	-52 044	-47 698	-46 937	-46 444	-44 439	-48 478

Projected Forest management	2015	2020	2013-2020
Carbon stock change in Living biomass [Gg C]	**6 453**	**6 218**	
Living biomass above ground [Gg C]	4 859	4 682	
Living biomass below ground [Gg C]	1 594	1 537	
Carbon stock change in Dead org. matter [Gg C]	**2 149**	**1 630**	
Forest residues [Gg C]	72	-139	
Stumps [Gg C]	1 182	842	
Dead wood (above ground) [Gg C]	592	625	
Fine litter* [Gg C]	303	303	
Carbon stock change in Soil org. carbon [Gg C]	**1 521**	**1 494**	
Other emissions [Gg CO_2-eq]	**94**	**94**	
Nitrogen fertilization [Gg N_2O]	0.085	0.085	
Forest fire [Gg CO_2-eq]	68	68	
Total net removals, excl. HWP[Gg CO_2-eq]	-37 023	-34 159	-36 057
HWP [Gg CO_2]	-5 587	-4 666	-5 279
Total net removals, incl. HWP [Gg CO_2-eq]	-42 611	-38 825	-41 336

*annual litterfall and the humic layer