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Item 5 (a) of the provisional agenda
Methodological issues under the Convention
Harvested wood products

Information on harvested wood products contained in previous submissions from Parties and in national greenhouse gas inventory reports

Note by the secretariat

Summary

This information previously submitted from Parties on harvested wood products (HWP) was compiled in response to a request by the Subsidiary Body for Scientific and Technological Advice (SBSTA) at its twenty-first session and is meant to facilitate consideration of issues relating to HWP at the body's twenty-third session.

CONTENTS

I. Introduction

A. Mandate

1. The Subsidiary Body for Scientific and Technological Advice (SBSTA), at its twenty-first session, requested the secretariat to compile information on harvested wood products (HWP) contained in previous submissions from Parties specifically on HWP, and in national greenhouse gas (GHG) inventory reports, for its consideration at its twenty-third session.[1]

2. At the same session, the SBSTA invited Parties included in Annex I to the Convention (Annex I Parties) that had not done so to provide to the secretariat, by 1 August 2005, available data and information on changes in carbon stocks and GHG emissions from HWP, in a transparent manner. It also invited Annex I Parties to submit to the secretariat, by 1 August 2005, updated data and information on HWP and on experiences with the use of the Intergovernmental Panel on Climate Change (IPCC) *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* and the *Good Practice Guidance for Land Use, Land-Use Change and Forestry*[2] to generate such data and information.[3] These submissions are contained in FCCC/SBSTA/2005/MISC.9 and Add.1.[4]

3. The SBSTA also noted the need to further analyse the socio-economic and environmental implications, impacts on forest carbon stocks and emissions in Annex I Parties and in Parties not included in Annex I to the Convention (non-Annex I Parties), impacts on sustainable forest management and biomass use, impacts in countries that import and export wood, and impacts on trade, of reporting GHG emissions resulting from the production, use and disposal of HWP, including those arising from the application of the accounting approaches discussed at the workshop on HWP held in Lillehammer, Norway, from 30 August to 1 September 2004.[5] The SBSTA decided to continue the consideration of this issue at its twenty-third session.[6]

B. Approach

4. Information on HWP contained in 30 previous submissions from Parties is contained in FCCC/SBSTA/2001/MISC.1, FCCC/SBSTA/2003/MISC.1 and Add.1–2 and FCCC/SBSTA/2004/MISC.9 and Add.1. The Parties that provided submissions are listed in chapter II of this note.

5. Excerpts of data and information on HWP contained in national inventory reports (NIRs) by Annex I Parties are presented in annexes I–IV of this note. The secretariat extracted these excerpts of

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[1] FCCC/SBSTA/2004/13, paragraph 33.

[2] These publications by the Intergovernmental Panel on Climate Change (IPCC) are referred to in this document using various abbreviated titles. In chapters I–III, the former is referred to as the Revised 1996 IPCC Guidelines and the latter as IPCC good practice guidance for LULUCF.
In annex II, excerpts from Canada refer to the latter in references to "… current IPCC default methodology (IPCC, 2003) …" and the "IPCC report on good practice guidance for the LULUCF sector (IPCC, 2003)".
In annex III, excerpts from the United Kingdom of Great Britain and Northern Ireland refer to the former as "IPCC 1996 Guidelines" and the latter as "GPG LULUCF (IPCC, 2003)".
In annex IV, excerpts from the United States of America refer to the former as "Revised 1996 IPCC Guidelines" and the latter as "LULUCF Good Practice Guidance (IPCC, 2003)".

[3] FCCC/SBSTA/2004/13, paragraph 32.

[4] The secretariat received five submissions on data and information on changes in carbon stocks and emissions of GHG from HWP and experiences with the use of relevant guidelines and guidance of the IPCC, which represented views of a total of 29 Annex I Parties.

[5] FCCC/SBSTA/2004/INF.11.

[6] FCCC/SBSTA/2004/13, paragraph 31.

data and information from the latest NIRs, submitted by Annex I Parties in 2005,[7] which are considered the most up-to-date source of information from Parties. Parties that report on consumption of biomass from stocks as CO_2 emissions from "harvested wood",[8] but which in their NIRs do not provide data and information on HWP according to the Revised 1996 IPCC Guidelines, are not included in this note.

C. Possible action by the Subsidiary Body for Scientific and Technological Advice

6. The SBSTA may wish to initiate consideration of the information in this note, referring to previously submitted information on HWP contained in the miscellaneous documents identified in chapter II and data and information on HWP from NIRs in annexes I–IV, and in FCCC/SBSTA/2005/MISC.9 and Add.1. The SBSTA may wish to provide guidance on this matter.

II. Information on harvested wood products from previous submissions from Parties

A. Issues relating to emissions from forest harvesting and wood products

7. At its eleventh session, the SBSTA invited Parties to submit, by 15 March 2001, their views on approaches for estimating and accounting for emissions of carbon dioxide from forest harvesting and wood products, taking into account the report of the IPCC expert meeting on that subject held in Dakar, Senegal, from 5 to 6 May1998.[9] The secretariat received 10 such submissions, which were compiled in FCCC/SBSTA/2001/MISC.1. The SBSTA took note of these submissions by Parties at its fourteenth session and decided to consider this matter further at its fifteenth session.[10] The following Parties provided submissions in 2001: Australia, Canada, Japan, New Zealand, Norway, Russian Federation, Samoa (on behalf of the Alliance of Small Island States), Sweden (on behalf of the European Community and its member States), Switzerland and United States of America.

B. Good practice guidance and other information on land use, land-use change and forestry: implications of harvested wood products accounting

8. The SBSTA, at its fifteenth session, invited Parties to submit, by 15 January 2003, their views on the implications of HWP accounting, including views on different approaches and methodologies,[11] for consideration at its eighteenth session. The secretariat received 12 such submissions. These submissions are contained in FCCC/SBSTA/2003/MISC.1 and Add.1–2. The SBSTA, at its eighteenth session, took note of views contained in submissions by Parties and decided to continue consideration of issues relating to HWP at its nineteenth and subsequent sessions.[12] The following Parties provided submissions in 2003: Argentina, Australia, Canada (2 submissions), Denmark (on behalf of the European Community and its member States, and of Croatia, Lithuania, Estonia, Latvia, Slovakia, Czech Republic, Hungary, Poland, Slovenia), Japan, Mexico, New Zealand (2 submissions), Samoa (on behalf of the Alliance of Small Island States), United States of America and Uruguay.

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[7] The NIRs submitted by Annex I Parties in 2005 can be downloaded from <http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/2761.php>.

[8] Under "Changes in forest and other woody biomass stocks" (category 5.A, subcategory 5.A.5) in table 5 of the common reporting format for land use change and forestry; FCCC/CP/2002/8, page 57.

[9] FCCC/SBSTA/1999/14, paragraph 69.

[10] FCCC/SBSTA/2001/2, paragraphs 19–21.

[11] FCCC/SBSTA/2001/8, paragraph 29 (k).

[12] FCCC/SBSTA/2003/10, paragraph 26 (e).

C. Issues relating to harvested wood products

9. At its nineteenth session, the SBSTA invited Parties to submit to the secretariat, by 15 April 2004, their views on issues relating to HWP, taking into account the information contained in FCCC/TP/2003/7 and Corr.1, and the appendix, on HWP, to the IPCC good practice guidance for LULUCF. It noted that these submissions could include national data and methodological and other information on changes in carbon stocks and emissions of GHGs relating to HWP, stating the approach or approaches used for this purpose.[13] The secretariat received eight such submissions and these are contained in FCCC/SBSTA/2004/MISC.9 and Add.1. The SBSTA took note of the information contained in these submissions at its twentieth session.[14] The following Parties provided submissions in 2004: Australia, Canada, India, Ireland (on behalf of the European Community and its member States and supported by the acceding States and candidate countries Latvia, Slovenia and Romania), Japan, New Zealand, Switzerland and United States of America.

III. Information on harvested wood products in national inventory reports

10. The Revised 1996 IPCC Guidelines[15] provide an outline of how harvested wood could be treated in national GHG inventories. The guidelines recommend that storage of carbon in forest products be included in a national inventory only in the case where a country can document that existing stocks of long-term products are in fact increasing. Such an increase in carbon stocks in the pool of forest products can be included in the estimates of changes in forest and other woody biomass stocks. In the IPCC good practice guidance for LULUCF, guidance on estimation and reporting on HWP is based on the Revised 1996 IPCC Guidelines and includes information on approaches and estimation methods.[16]

11. Parties do not have to prepare estimates for HWP according to the UNFCCC reporting guidelines on annual inventories.[17] They may do so if they wish and report in row 5.G Other in table 5 (sectoral report for LULUCF) of the common reporting format for LULUCF.[18] This may explain why only a few Parties provided data and information on HWP in their NIRs.

12. Four Annex I Parties reported emissions and removals relating to HWP in their NIRs: Australia, Canada, United Kingdom of Great Britain and Northern Ireland, and United States of America. Excerpts of information and data on HWP contained in their 2005 NIRs are presented in annexes I–IV.

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[13] FCCC/SBSTA/2003/15, paragraph 27 (e).
[14] FCCC/SBSTA/2004/6, paragraph 20.
[15] Volume 3, Reference Manual, page 5.17 and box 5.
[16] Appendix 3a.1 Harvested wood products: Basis for future methodological development, pages 3.257–3.272.
[17] FCCC/SBSTA/2004/8: "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories (following incorporation of the provisions of decision 13/CP.9)".
[18] Refer to FCCC/SBSTA/2004/8, page 59.

Annex I

Information from Australia

NIR title: Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2003: Land Use, Land-Use Change & Forestry;[*] May 2005

Chapter: 5.A.1 Forest Land Remaining Forest; *pages 5–13*

". . .

"In Australia, the annual loss of carbon from the terrestrial biosphere to the atmosphere due to forestry occurs in three ways:

1. Harvesting of commercial native hardwood forests for wood products,
2. Harvesting of plantation (eucalypt and coniferous) forests for wood products, or
3. Collection and burning of fuelwood.

"The wood harvested in Australia is processed for timber products or woodchips, both of which may be exported. The IPCC suggests a disaggregated product approach where stocks of forest products are increasing, and so it is applied here with harvested timber divided into four pools of carbon release.

". . .

"**CARBON LOSS**

"For the estimation of carbon loss, the following methodology is applied. Harvested timber decaying in the inventory year is divided among four pools with different rates of decay:

1. short term (decaying in the year of harvest) - paper, etc,
2. short-medium term (decaying over 10 years) - panel products eg fibreboard,
3. medium-long term (decaying over 25 years) - sawn timber eg packing crates, furniture, and
4. long term (decaying over 50 years) - building, construction and fence posts.

"To calculate the total quantity of carbon associated with timber harvesting, the decay of associated slash on site also needs to be considered. As for the clearing of forests for agriculture, aboveground residue is assumed to decay over a ten year period. Sawmill residues and fuelwood must also be accounted for.

"To a first approximation there will be a storage of carbon corresponding to the product of the rate of increase of timber production times the average delay before decay. Thus, differences in decay rates will affect emissions only when there are significant changes in the stocks of long term forest products. In Australia, the proportion of the total wood harvest which is in the short-term and short-medium term decay pools, ie decaying in less than 10 years, has been increasing. All wood harvested in Australia is included in calculations of emissions but an accurate accounting for exports and imports of forest products during the inventory period would be required to account for changes in the stocks of forest products.

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[*] Australia's National Greenhouse Gas Inventory 2003 (May 2005) was compiled using the methods described in the *Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2003* series, which are considered as part of the Australian NIR. These are available from the Australian Greenhouse Office web site <http://www.greenhouse.gov.au/inventory>.

"As the use of wood products changes over time, the fractions of the total timber products assumed for each decay pool have been calculated separately for each year and for each State. This requires forest product data for each inventory year and for the 50 previous years. Data on round wood removal and end use category were taken from ABARE Quarterly Forest Product Statistics publications for years back to 1972. For years earlier than 1972, the quantity of long-term wood products was constant. Wood products were assigned to the four decay pools described above to determine the ratio for each State and the fraction of the total timber harvest in each decay pool calculated for each year. The total timber harvest was estimated as the round wood removal adjusted for sawmill residue (ABARE Quarterly Forest Product Statistics), and includes timber used for woodchips.

"**Total Annual Biomass Loss**

"The volume of timber products and slash generated at the time of harvest is given by:

$$H_i = f_1 H_{1i} + f_{10} H_{10i} + f_{25} H_{25i} + f_{50} H_{50i} + (E - 1) H_{10si} \qquad (5A\_1)$$

Where: H_i is the total volume of wood decaying in the inventory year (m^3/y) for the wood class, **i** (either broadleaf or coniferous),
f_1 is the fraction of the annual timber harvest entering the 1 year decay pool,
H_{1i} is the volume of wood of class i in the inventory year,
f_{10} is the fraction of annual timber harvested entering the 10–year decay pool;
H_{10i} is the average volume of wood in class i over the 10 years up to and including the inventory year,
f_{25} is the fraction of annual timber harvests entering the 25–year decay pool,
H_{25i} is the average volume of wood of class i over the 25 years up to and including the inventory year,
f_{50} is the fraction of annual timber harvests entering the 50–year decay pool,
H_{50i} is the average volume of wood of class i over the 50 years up to and including the inventory year,
E is the expansion factor to include slash (= 1.9),
H_{10si} is the average volume of wood of class i harvested over the 10 years up to and including the inventory year.

"To the above must be added the volume of forest residue from sawlog harvest, $\boldsymbol{R}_s$ (m^3/y), and allowance made for the slash associated with it, so that the associated decaying volume of wood, ***Hs***, is given by:

$$H_s = ER_s \qquad (5A\_2)$$

Where: H_s is the volume of wood associated with sawmill residue (m^3/y); $\boldsymbol{E}$ is the expansion factor (= 1.9),
R_s is the volume of sawmill residue produced in the inventory year (m^3/y).

"The equation for calculating the gross annual biomass carbon conversion is:

$$H = \sum_i H_i D_i + H_s D_s \qquad (5A\_3)$$

Where: H is the gross annual biomass carbon loss from harvesting timber for wood products (fuelwood not included here) of class **i** (broadleaf or coniferous) (t C/y),
H_i is the total volume of wood decaying in the inventory year (m^3/y),
D_i is the carbon density of wood in the class (t C/m^3) (see Table 4),
H_s is the volume of wood associated with sawmill residues (allowing for slash) in the inventory year (m^3/y),
D_s is the carbon density of sawmill residues (t C/m^3) (0.3, see Table 4).

". . ."

NIR title: Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2003: Land Use, Land-Use Change & Forestry (Plantations); *page 21*

"***Wood Product Destinations***

"Jaakko Poyry Pty Ltd (1999; 2000) were contracted by the NCAS to develop a life cycle analysis model for forest products. The timber pool descriptions developed (eg. timber framing, furniture, pulp and paper, mill residue) were subsequently incorporated in the *CAMFor* model, and hence *FullCAM*. The pool turnover rates were also incorporated providing a stand based wood product life cycle capacity within *CAMFor* / *FullCAM*.

"The principal limitation of the approach as used is that the turnover rates are estimates with a potentially large variability. A number of factors such as building engineering design life and rates of recycling can affect vastly different turnover rates. Also, only the serviceable life of products has been considered. As yet there is only a very preliminary understanding of the rates of breakdown after disposal.

Table 3 Wood Product Decomposition Rates

Product Type	Decomposition Rate yr^{-1}
Biofuel	1.0
Pulp and paper	0.33
Packing Wood	0.2
Furniture, Poles	0.05
Fibreboard	0.07
Construction Wood	0.02
Mill Residue	1.0

". . ."

Annex II

Information from Canada

NIR title: Canada's Greenhouse Gas Inventory 1990–2003; Initial Submission, 15 April 2005

Chapter: 7 LAND USE, LAND-USE CHANGE AND FORESTRY (CRF Sector 5);
pages 148–165

Section: New Reporting Format; *page 151*

". . .

"Table 5 of the CRF allows reporting estimates of emissions or removals from harvest wood products (HWP) that presumably are additional to the Forest Land estimates. Canada considers that this reporting format is not compatible with its understanding of HWP as an integral component of the Forest Land category. Alternative estimates of delayed emissions due to carbon storage in HWP are provided in Annex 3.2.

". . ."

Section: 7.1.2 Methodological Issues; *page 153*

". . .

"In keeping with the current IPCC default methodology (IPCC, 2003), emissions from forest management activities comprise all the CO_2-C contained in harvested roundwood and harvest residues. Three alternative approaches, the atmospheric flow, production and the stock-change approaches, have been preliminarily evaluated in Canada to attempt to correctly account for delayed emissions due to long-term carbon storage in harvested wood products (HWPs). These approaches account for carbon storage in HWPs and emissions from the decay of products harvested, imported (stock change, atmospheric flow) or exported (production) in the current and previous years; they are therefore more spatially and temporally realistic than the current default, which does not account for emissions from HWPs where or when they actually occur. They differ with respect to their allocation of emissions and removals. A breakdown and brief discussion of each of the accounting approaches, along with implications for Canada, are contained in Annex 3.2.

". . ."

Section: 7.1.3 Uncertainties and Time-Series Consistency; *page 153*

". . .

"On the methodological side, the main source of uncertainty is the omission from the estimation methodology of important carbon pools such as forest soils, dead organic matter, and harvested wood products. In order to include other forest ecosystem carbon pools (belowground biomass, litter, coarse debris, and soils) without introducing bias, all the carbon exchanges among these pools, and between each one and the atmosphere, should be estimated.

". . ."

Chapter: ANNEX 3: ADDITIONAL METHODOLOGIES

Section: A 3.2.4 Estimation of delayed CO_2 emissions from Harvested Wood Products (HWPs); *pages 270–272*

"In addition to the default method, four alternative approaches for carbon accounting in HWPs have been proposed: stock change, production, atmospheric flow and simple decay. Box A3.2-1 provides a brief description of each approach. Although these approaches yield the same net carbon exchange to the atmosphere on a global level, they differ on a national level in the way in which they account for the time and place of emissions.

"As a basis for comparison, emissions associated with harvested material are estimated for all approaches. These harvested emissions are calculated as follows:

"IPCC default

HE = IRW + Fuelwood + Firewood

"Stock change

HE = IRW + Fuelwood + Firewood - C in domestic long-lived commodity + inherited emissions from domestic long-lived commodity

"Production

HE = IRW + Fuelwood + Firewood - total commodity production + inherited emissions from commodity produced in previous years

"Atmospheric flow

HE = Fuelwood + Firewood + roundwood processing wastes + inherited emissions from long-lived commodity consumed in previous years
and
roundwood processing wastes = total roundwood consumption - commodity production

where:

HE = carbon emitted during the inventory year from material harvested in previous and current years;
IRW = carbon in industrial roundwood harvested in the current inventory year;
Fuelwood = carbon in fuelwood harvested in the current inventory year;
Firewood = carbon in the firewood consumed in the current inventory year;
Consumption = production + imports - exports.

"For Canada, harvest emissions in 2003 vary from 225 Mt CO_2 (IPCC default) to 140 (atmospheric flow), 183 (production), or 208 Mt CO_2 (stock change), depending on the approach selected.

"Note that delay in C emissions due to storage in HWP is taken into acccount only for long-lived (> 5yrs) commodities. The carbon stored in shortlived commodities, including fuelwood and firewood, is assumed

to be emitted upon harvest. To date, the calculations have only included semi-processed commodities, e.g. sawnwood, pulpwood, wood-based panels, paper and paperboard, and other industrial roundwood. It is not feasible at present to develop a system that would monitor the paths of carbon stored in HWP (HWP-C) from harvest to consumer products.

"Further elaboration of these approaches is planned, based on the IPCC report on good practice guidance for the LULUCF sector (IPCC, 2003).

"Box A3.2-1: Overview of approaches to account for C storage in harvested wood products.

In the **IPCC default approach**, only the net change in forest carbon stocks is accounted for. Emissions from harvests are treated as though they are 100% released as CO_2 to the atmosphere in the year and country of harvest. Carbon storage in wood products is not considered.
The **atmospheric flow** approach tracks C emissions and removals associated with the harvest, manufacturing, and consumption of wood products within national boundaries. Its intent is similar to the general methodology for estimating fossil fuel emissions and provides a more accurate reflection of when and where harvest emissions actually occur.
The **stock-change** approach accounts only for the net carbon stock change in the domestic wood product reservoir, e.g. HWP-C in all long-lived commodities within the national territory, after imports and exports. The difference between the stock-change and atmospheric flow accounting lies in the treatment of exported products (which are significant in Canada). In the stock-change, carbon in all exported wood products and commodities exits the domestic stock and hence is considered an emission to the atmosphere.
The **production** approach accounts for the changes in carbon stocks of domestically harvested wood and commodities derived from this domestic wood, regardless of their actual location. The accounting boundaries hence encompass the entire export market.
The **simple-decay** approach also accounts the delayed emissions from all HWP-C from domestically harvested wood, but in a simplified way, by applying decay curves standardized by product categories."

Annex III

Information from the United Kingdom of Great Britain and Northern Ireland

NIR title: UK Greenhouse Gas Inventory 1990 to 2003: Annual Report for submission under the Framework Convention on Climate Change; April 2005

Chapter: 7. Land Use Change and Forestry (CRF sector 5); *pages 109–125*

Section: 7.2 Previous Source Category 5A2, new CRF categories 5A and 5G – Temperate Forests: Changes in Forests and Other Woody Biomass Stocks; *pages 110–112*

Subsection: 7.2.2 Methodological issues; *page 110*

"The carbon uptake by the forests planted since 1920 is calculated by a carbon accounting model (C-Flow) as the net change in the pools of carbon in standing trees, litter, soil and products from harvested material for conifer and broadleaf forests. The method can be described as Tier 3, as defined in the GPG LULUCF (IPCC, 2003). The model calculates the masses of carbon in the pools of new even-aged plantations that were clearfelled and then replanted at the time of Maximum Area Increment.

A detailed description of the method used and emission factors can be found in **Annex 3**, **Section 3.7**."

Subsection: 7.2.7 Equivalent categories in the new CRF; *page 112*

"The data from this Category have been entered in Sectoral Background Table 5.A in the FCCC/SBSTA/2004/8 format. In Table 5.A.2 (Land converted to Forest Land) the data are disaggregated into afforestation of Cropland, Grassland and Settlements and further by a) the four geographical areas of England, Scotland, Wales and Northern Ireland and b) three time periods, 1920–1949, 1950–1979 & 1980 onwards. The removals in this Category due to carbon stock changes in harvested wood products are entered into Sectoral Report Table 5.G (Other) as "Harvested Wood Products" in the FCCC/SBSTA/2004/8 format."

Section: 7.10 Separate reporting of emissions and removals, *page 120–124*

"The UK has also provided data for the entire forest sink together and non-forest emissions and removals from soils in a separate group. This provides a broad separation of sinks and sources within the LUCF sector, **Tables 7.2, 7.3, 7.4a** and **7.4b** show the activities concerned and how they have been combined in different ways. The reported totals for emissions and removals for the LUCF Sector are not affected.

". . .

"**Table 7.3** Emissions and removals of carbon dioxide by activities in Land Use Change and Forestry Sector. The reporting categories used in the National Inventory Report and for the UNFCCC Common Reporting Format are also shown. (IE - Included Elsewhere.)

Activity	**Gg CO_2**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
Temperate forest	Removal	-6014	-6486	-6950	-7215	-7561	-7245	-7137	-6927
Harvested wood	Removal	-1587	-1344	-1130	-1059	-942	-1123	-1098	-1195
. . .									
Activity	**Gg CO_2**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**NIR**	**CRF**
Temperate forest	Removal	-6827	-7171	-6856	-7776	-8916	-9808	*5A2*	*5A2*
Harvested wood	Removal	-1289	-1161	-1314	-743	-133	248	*5A5*	*5A5*
. . ."									

Chapter: A3. Annex 3: Other detailed methodological descriptions

Section: A3.7 Land Use Change and Forestry (CRF Sector 5); *pages 284–297*

Subsection: A3.7.1 Changes in Forest and Other Woody Biomass Stocks - Temperate Forests (5A2); *pages 284–287*

"The carbon uptake by the forests planted since 1920 is calculated by a carbon accounting model (Dewar and Cannell, 1992, Cannell and Dewar, 1995, Milne *et al.*, 1998) as the net change in pools of carbon in standing trees, litter, soil in conifer and broadleaf forests and products. Restocking is assumed in all forests. The method of the IPCC 1996 Guidelines is not used. The UK carbon accounting model forests calculates the mass of carbon in trees, litter, soil and wood products from harvested material in new even-aged plantations that were clearfelled and then replanted at the time of Maximum Area Increment (MAI). Two types of input data and two parameter sets were required for the model (Cannell and Dewar, 1995). The input data are a) areas of new forest planted in each year in the past and b) the stemwood growth rate and harvesting pattern. Parameter values were required to estimate i) stemwood, foliage, branch and root masses from the stemwood volume and ii) the decomposition rates of litter, soil carbon and wood products.

". . .

". . . Variation from year to year in the reported removals to woody biomass, soils and harvested products reflect the changing pattern of afforestation over the period of available data. For example, there are increases in removals to harvested products about 50 years (the conifer forest rotation cycle) after a period of increased planting of conifers. It can be shown that if forest expansion continues at the present rate, removals of atmospheric carbon will continue to increase until about 2005 and then will begin to decrease, reflecting the reduction in afforestation rate after the 1970s.

". . .

"The mass of carbon in a forest was calculated from volume by multiplying by species-specific wood density, stem to branch and root mass ratios and the fraction of carbon in wood (0.5 assumed). The values used for these parameters for conifers and broadleaves are given in **Table A3.7.2**.

Table A3.7.2 Main parameters for forest carbon flow model for species used to estimates carbon uptake by planting of forests of Sitka spruce (P. sitchensis and beech (F. sylvatica) in the United Kingdom (Dewar and Cannell, 1992)

	P. sitchensis	***P. sitchensis***	***F. sylvatica***
	YC12	**YC14**	**YC6**
Rotation (years)	59	57	92
Initial spacing (m)	2	2	1.2
Year of first thinning	25	23	30
Stemwood density (t m-3)	0.36	0.35	0.55
Maximum carbon in foliage (t ha-1)	5.4	6.3	1.8
Maximum carbon in fine roots (t ha-1)	2.7	2.7	2.7
Fraction of wood in branches	0.09	0.09	0.18
Fraction of wood in woody roots	0.19	0.19	0.16
Maximum foliage litterfall (t ha-1 a-1)	1.1	1.3	2
Maximum fine root litter loss (t ha-1 a-1)	2.7	2.7	2.7
Dead foliage decay rate (a-1)	1	1	3
Dead wood decay rate (a-1)	0.06	0.06	0.04
Dead fine root decay rate (a-1)	1.5	1.5	1.5
Soil organic carbon decay rate (a-1)	0.03	0.03	0.03
Fraction of litter lost to soil organic matter	0.5	0.5	0.5
Lifetime of wood products	57	59	92

". . .

"It is assumed in the carbon accounting model that harvested material from thinning and felling is made into wood products. These products are then assumed to decay over a period equal to the rotation of the forest, conifer or broadleaf as appropriate, since products from broadleaves (e.g. furniture) will decay more slowly than those from conifers (e.g. paper, building timber). The net change in the carbon in this pool of wood products is reported in Category 5A. Calculated in this way, that part of the total wood products pool from UK forests is presently increasing due to continuing expansion in forest area. Dewar and Cannell (1992) and Cannell and Dewar (1995) provided a detailed description of all the assumptions in the model.

". . ."

Annex IV

Information from the United States of America

NIR title: Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2003; 15 April 2005

Chapter: 7 Land Use Change and Forestry; *pages 229–259*

Section: 7.1. Forest Land Remaining Forest Land; *pages 231–241*

"Changes in Forest Carbon Stocks (IPCC Source Category 5A1)

"For estimating carbon (C) stocks or stock change (flux), C in forest ecosystems can be divided into the following five storage pools (IPCC 2003):

- Aboveground biomass, all living biomass above the soil including stem, stump, branches, bark, seeds, and foliage. This category includes live understory.
- Belowground biomass, all living biomass of coarse living roots greater than 2 mm diameter.
- Dead wood, including all non-living woody biomass either standing, lying on the ground (but not including litter), or in the soil.
- Litter, including the litter, fumic, and humic layers, and all non-living biomass with a diameter less than 7.5 cm at transect intersection, lying on the ground.
- Soil organic carbon (SOC), including all organic material in soil to a depth of 1 meter but excluding the coarse roots of the above pools.

"In addition, there are two harvested wood pools also necessary for estimating C flux, which are:

- Harvested wood products in use.
- Harvested wood products in landfills.

". . .

"The net change in forest C is not equivalent to the net flux between forests and the atmosphere because timber harvests do not cause an immediate flux of C to the atmosphere. Instead, harvesting transfers C to a "product pool." Once in a product pool, the C is emitted over time as CO_2 when the wood product combusts or decays. The rate of emission varies considerably among different product pools. For example, if timber is harvested to produce energy, combustion releases C immediately. Conversely, if timber is harvested and used as lumber in a house, it may be many decades or even centuries before the lumber decays and C is released to the atmosphere. If wood products are disposed of in landfills, the C contained in the wood may be released many years or decades later, or may be stored almost permanently in the landfill.

"This section quantifies the net changes in C stocks in the five forest C pools and two harvested wood pools. The net change in stocks for each pool is estimated, and then the changes in stocks are summed over all pools to estimate total net flux. Thus, the focus on C implies that all C-based greenhouse gases are included, and the focus on stock change suggests that specific ecosystem fluxes are not separately itemized in this report. . . .

"Forest C storage pools, and the flows between them via emissions, sequestration, and transfers, are shown in Figure 7-1. In the figure, boxes represent forest C storage pools and arrows represent flows

between storage pools or between storage pools and the atmosphere. Note that the boxes are not identical to the storage pools identified in this chapter. The storage pools identified in this chapter have been altered in this graphic to better illustrate the processes that result in transfers of C from one pool to another, and emissions to the atmosphere as well as uptake from the atmosphere.

". . .

". . . In addition to forest regeneration and management, forest harvests have also affected net C fluxes. Because most of the timber harvested from U.S. forests is used in wood products, and many discarded wood products are disposed of in landfills rather than by incineration, significant quantities of C in harvested wood are transferred to long-term storage pools rather than being released rapidly to the atmosphere (Skog and Nicholson 1998). The size of these long-term C storage pools has increased during the last century.

"Changes in C stocks in U.S. forests and harvested wood were estimated to account for an average annual net sequestration of 832 Tg CO_2 Eq. (227 Tg C) over the period 1990 through 2003 (Table 7-5, Table 7-6, and Figure 7-2). In addition to the net accumulation of C in harvested wood pools, sequestration is a reflection of net forest growth and increasing forest area over this period, particularly before 1997. . . .

Table 7-5. Net Annual Changes in Carbon Stocks (Tg CO_2 Eq. yr^{-1}) in Forest and Harvested Wood Pools

Carbon Pool	**1990**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Forest	**(739)**	**(638)**	**(599)**	**(537)**	**(537)**	**(537)**	**(537)**	**(537)**
. . .								
Harvested Wood	**(210)**	**(213)**	**(206)**	**(215)**	**(211)**	**(214)**	**(214)**	**(216)**
Wood Products	(48)	(58)	(52)	(62)	(59)	(59)	(59)	(60)
Landfilled Wood	(162)	(155)	(154)	(153)	(152)	(155)	(155)	(155)
Total Net Flux	**(949)**	**(851)**	**(806)**	**(752)**	**(748)**	**(751)**	**(751)**	**(753)**

Note: Parentheses indicate net C sequestration (i.e., a net removal of C from the atmosphere). Total net flux is an estimate of the actual net flux between the total forest C pool and the atmosphere. Forest estimates are based on interpolation and extrapolation of inventory data as described in the text and in Annex 3.12. Harvested wood estimates are based on results from annual surveys and models. Totals may not sum due to independent rounding.

Table 7-6. Net Annual Changes in Carbon Stocks (Tg C yr^{-1}) in Forest and Harvested Wood Pools

Carbon Pool	**1990**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Forest	**(202)**	**(174)**	**(163)**	**(146)**	**(146)**	**(146)**	**(146)**	**(146)**
. . .								
Harvested Wood	**(57)**	**(58)**	**(56)**	**(59)**	**(57)**	**(58)**	**(58)**	**(59)**
Wood Products	(13)	(16)	(14)	(17)	(16)	(16)	(16)	(16)
Landfilled Wood	(44)	(42)	(42)	(42)	(41)	(42)	(42)	(42)
Total Net Flux	**(259)**	**(232)**	**(220)**	**(205)**	**(204)**	**(205)**	**(205)**	**(205)**

Note: Parentheses indicate net C sequestration (i.e., a net removal of C from the atmosphere). Total net flux is an estimate of the actual net flux between the total forest C pool and the atmosphere. Forest estimates are based on interpolation and extrapolation of inventory data as described in the text and in Annex 3.12. Harvested wood estimates are based on results from annual surveys and models. Totals may not sum due to independent rounding.

". . .

Table 7-7. Carbon Stocks (Tg C) in Forest and Harvested Wood Pools

Carbon Pool	1990	1997	1998	1999	2000	2001	2002	2003	2004
Forest	**39,498**	**40,812**	**40,986**	**41,149**	**41,296**	**41,442**	**41,589**	**41,735**	**41,882**
. . .									
Harvested Wood	**1,915**	**2,307**	**2,365**	**2,421**	**2,480**	**2,537**	**2,595**	**2,654**	**2,713**
Wood Products	1,134	1,232	1,248	1,262	1,279	1,295	1,311	1,327	1,344
Landfilled Wood	781	1,074	1,117	1,159	1,200	1,242	1,284	1,327	1,369
Total Carbon Stock	**41,414**	**43,119**	**43,351**	**43,570**	**43,775**	**43,979**	**44,184**	**44,389**	**44,594**

Note: Forest C stocks do not include forest stocks in Alaska, Hawaii, or U.S. territories, or trees on non-forest land (e.g., urban trees). Wood product stocks include exports, even if the logs are processed in other countries, and exclude imports. Forest estimates are based on interpolation and extrapolation of inventory data as described in the text and in Annex 3.12. Harvested wood estimates are based on results from annual surveys and models. Totals may not sum due to independent rounding. Inventories are assumed to represent stocks as of January 1 of the inventory year. Flux is the net annual change in stock. Thus, an estimate of flux for 2003 requires estimates of C stocks for 2003 and 2004.

". . .

"**Methodology**

"The methodology described herein is consistent with *LULUCF Good Practice Guidance* (IPCC 2003) and the *Revised 1996 IPCC Guidelines* (IPCC/UNEP/OECD/IEA 1997). Estimates of net C flux from Land-Use Change and Forestry, including all pools except harvested wood, were derived from periodic and annualized inventories of forest stocks. Net changes in C stocks were interpolated between survey years. Carbon emissions from harvested wood were determined by accounting for the variable rate of decay of harvested wood according to its disposition (e.g., product pool, landfill, combustion).[3] Different data sources were used to estimate the C stocks and stock change in (1) forests (aboveground and belowground biomass, dead wood, and litter), (2) forest soils, and (3) harvested wood products. **. . .**

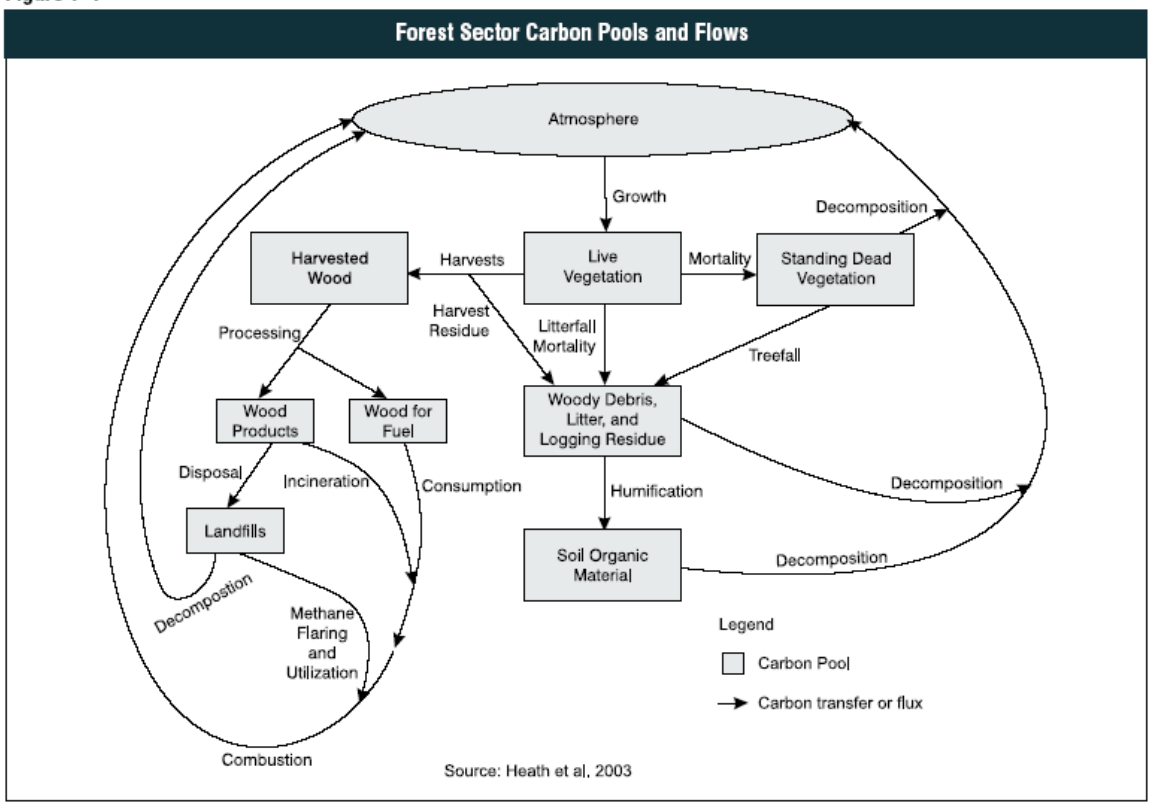
3 The wood product stock and flux estimates presented here use the production approach, meaning that they do not account for C stored in imported wood products, but do include C stored in exports, even if the logs are processed in other countries. This approach is used because it follows the precedent established in previous reports (Heath et al. 1996).

". . .

"Harvested Wood Carbon

"Estimates of C stock changes in wood products and wood discarded in landfills were based on the methods described by Skog and Nicholson (1998). Carbon stocks in wood products in use and wood products stored in landfills were estimated from 1910 onward based on historical data from the USDA Forest Service (USDA 1964, Ulrich 1989, Howard 2001), and historical data as implemented in the framework underlying the North American Pulp and Paper (NAPAP, Ince 1994) and the Timber Assessment Market and the Aggregate Timberland Assessment System Timber Inventory models (TAMM/ATLAS, Haynes 2003, Mills and Kincaid 1992). Beginning with data on annual wood and paper production, the fate of C in harvested wood was tracked for each year from 1910 through 2003, and included the change in C stocks in wood products, the change in C in landfills, and the amount of C emitted to the atmosphere (CO_2 and CH_4) both with and without energy recovery. To account for imports and exports, the production approach was used, meaning that C in exported wood was counted as if it remained in the United States, and C in imported wood was not counted.
". . .

Figure 7-1



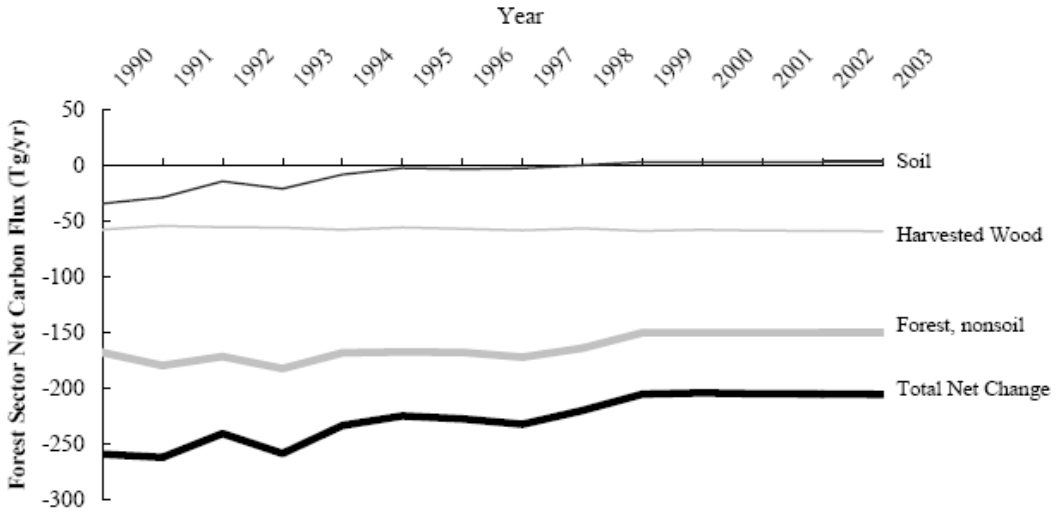


Figure 7-2: Estimates of Net Annual Changes in Carbon Stocks for Major Carbon Pools

Note: Estimates for harvested wood are based on the same methodology and data as the previous U.S. Inventory (EPA 2004). Estimates for all pools are based on measured forest inventory data as described in the text. Total Net includes all forest pools: biomass, dead wood, litter, forest soils, wood products, and landfilled wood.
"..."

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