

Task 38: Greenhouse Gas Balances of Biomass and Bioenergy Systems

Approaches for inclusion of harvested wood products in future GHG inventories under the UNFCCC, and their consistency with the overall UNFCCC inventory reporting framework¹

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Preparation of the IPCC 2006 Guidelines (GL) for national greenhouse gas inventories under the UNFCCC has begun. Methods for estimating and reporting of Harvested Wood Products (HWP)² are included in Volume 4, Agriculture, Forestry and Other Land Use (AFOLU), of its Table of Contents (IPCC 2003b), but this work cannot be carried out without mutual understanding and decisions of the choice of approach. A workshop on HWP will be organized by the UNFCCC in August of 2004. This note aims to provide technical information on the consistency of different HWP approaches with IPCC Inventory Guidance, and is thus relevant for the discussions at this workshop. The scope of this paper encompasses approaches for including HWP in future UNFCCC national GHG inventories (based on the 2006 IPCC Guidelines), which may eventually also serve as the basis for negotiating an international “Kyoto-like” agreement beyond 2012. The paper does not attempt to interpret whether and how HWP should be included in UNFCCC inventories based on the 1996 IPCC Guidelines, or in GHG inventories in the Kyoto Protocol first commitment period (based on the 2003 IPCC Good Practice Guidance for LULUCF).

Key conclusions of our note are as follows:

- 1) Guidance on the choice of the HWP approach is needed from the Subsidiary Body for Scientific and Technological Advice (SBSTA) in the near future if reporting of HWP in UNFCCC national inventories is to be facilitated by the IPCC 2006 Guidelines.
- 2) The choice of the approach cannot be made without consideration of other parts of the inventory guidance, as the approach must be consistent with the whole reporting framework.
- 3) The mandate and boundaries of the *national* greenhouse gas (GHG) inventories should be considered when choosing the approach.
- 4) The preferred placement of HWP reporting in the 2006 GL should be discussed, e.g., during preparation of the IPCC 2006 Guidelines.

¹ This note has been drafted by the authors stated above and has benefitted from discussions within IEA Bioenergy Task 38 “Greenhouse Gas Balances of Biomass and Bioenergy Systems”, a network of experts on issues related to bioenergy, carbon sequestration and global climate change. For further information on Task 38 see www.joanneum.at/iea-bioenergy-task38. This paper does not reflect all opinions of experts / countries participating in IEA Bioenergy Task 38.

² By HWP we mean all wood-based material removed from forests. Harvesting residues left at logging sites are excluded from this definition of HWP.

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Choice of the approach

Three alternative approaches (stock-change approach, production approach and atmospheric-flow approach)³ for reporting harvested wood products (HWP) in the national GHG inventories under the UNFCCC have been discussed and assessed internationally (IPCC Expert Group meeting in Senegal: see Brown et al. 1998, Apps et al. 1997, Winjum et al. 1998, Lim et al. 1999, UNFCCC 2003). In the recently published IPCC (2003a) Good Practice Guidance for Land Use, Land-Use Change and Forestry (GPG LULUCF), the alternative approaches for HWP reporting are discussed in an Appendix and some potential estimation methods are outlined. Preparation of the new IPCC 2006 Guidelines has begun and Volume 4 will include Agriculture, Forestry and Other Land Use (AFOLU). Its Table of Contents includes HWP in a separate category “*Other*” (IPCC 2003b). The second authors/experts meeting of Volume 4 was held in early June 2004. The acute problem is as follows: progress on writing guidelines for HWP reporting under the future UNFCCC inventories will be difficult without a choice of the approach, and thus guidance from the SBSTA is required. Such guidance could be adopted late in 2004⁴, based on the technical workshop organized by the SBSTA in August 2004. However, a prerequisite for the inclusion of HWP reporting in the 2006 Guidelines is its consistency with the other parts of the national inventory and reporting framework. In this technical note we will discuss how the alternative approaches fulfill this condition of consistency.

IPCC reporting framework of LULUCF and alternative approaches

The HWP approaches differ from each other in terms of their system boundaries. For consistency, i.e. to avoid double counting or exclusion of emissions, the same approach must be applied in all countries. When each of the approaches is applied to all countries, the same global carbon balance for HWP results.

The relevant biomass carbon pools and associated carbon flows to be considered are illustrated in Figure 1. The stock changes of the forest pools are estimated in each of the land-use categories defined in Chapter 2 of the GPG LULUCF. In national UNFCCC inventories, any net decrease in the sum of carbon stocks in all these forest pools is reported as the equivalent increase in the carbon stock of the atmosphere pool, that is as CO₂ emissions to the atmosphere, and any net increase in the sum of the forest pools is reported as the equivalent CO₂ removal from the atmosphere. Carbon stock changes are converted to CO₂ emissions and removals by multiplying the net carbon stock change by 44/12 and reversing the sign: a decrease in carbon stocks (negative sign) is counted as an emission to the atmosphere and vice versa. This way of reporting carbon balance in forests is also agreed in the Kyoto Protocol and Marrakesh Accords.

Current approach for HWP

The basic reporting philosophy in the LULUCF sector was established in the 1996 Guidelines (IPCC 1997) and specified in the GPG LULUCF (IPCC 2003a). Reporting of CO₂ emissions is based on estimation of carbon stock changes in several carbon pools, namely above-ground

³ Note here the distinction between the approach – defining the basic system boundaries and framework of reporting – and the estimation method, which is applied to obtain numerical estimates on the carbon balance of wood products. The “approach” talks about *what* we are interested in (the change in stocks, the exchange of carbon with the atmosphere, etc.). Whereas it is the “method”, that determines *how* we estimate this quantity of interest (either by direct measurement, or by indirect inference), i.e. various alternative estimation methods can be applied within each approach.

⁴ Due to the time required to develop guidelines a further delay in decision would probably lead to exclusion of HWP from the 2006 GL.

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biomass, below-ground biomass, dead wood, litter, and soil organic matter (defined in Table 3.1.2 in the GPG LULUCF (IPCC 2003a)). The IPCC 1996 Guidelines contain the default assumption that the amount of carbon in HWP is not changing. Thus, the input of wood from the forest to the HWP pool is as large as the output from the HWP pool caused by losses such as decay or retirement to landfills. When the HWP pool is unchanging, the flux out of the wood products pool can be replaced by the equal flux out of the forest (i.e., harvested biomass can be considered oxidized in the year of harvest), without introducing error⁵. However, the Guidelines also give flexibility to report carbon stock changes in HWP, in cases where, because the HWP pool is not constant, oxidation at the time of harvest is not an appropriate approximation. To the extent that the pool of harvested wood products is changing, the current approach does not accurately report the change in the stock of CO₂ in the atmosphere.

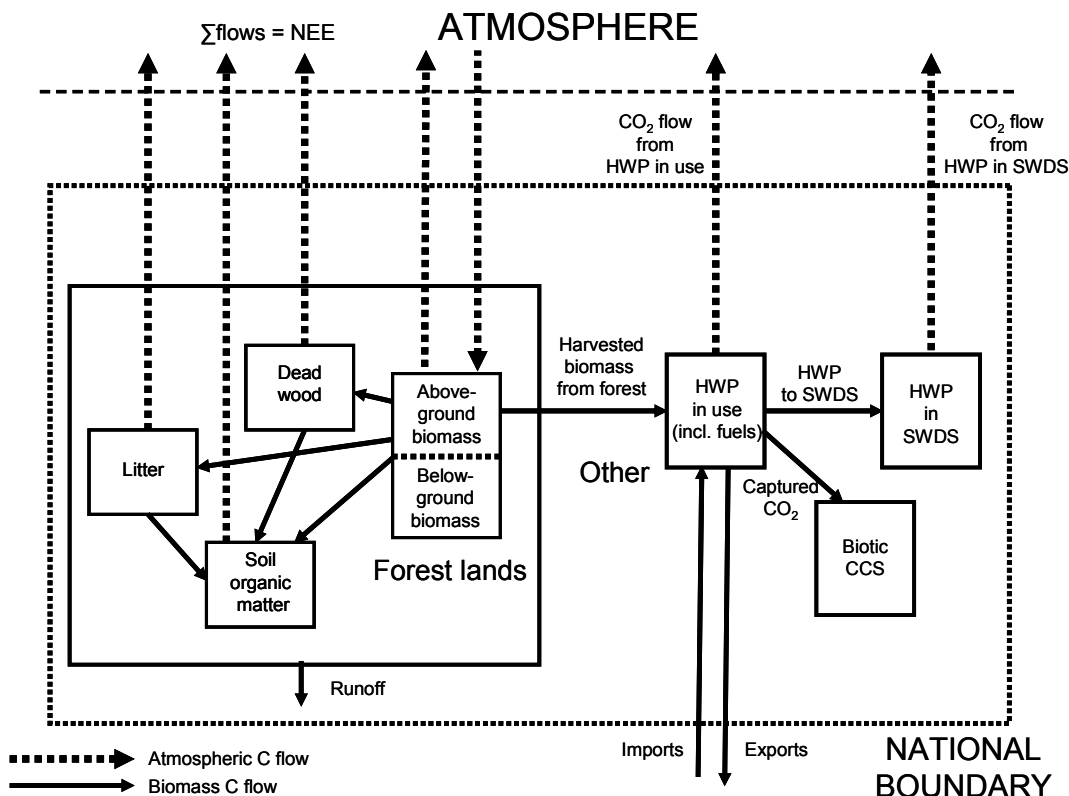


Figure 1. The five biomass-based pools in national reporting of C balance in *Forest lands* (IPCC 2003a). The Figure also shows the optional new HWP pool(s) under the category *Other* in the AFOLU sector of the IPCC 2006 GL (IPCC 2003b). The associated carbon flows and their principal directions are shown with arrows. Substantial amounts of C can be transported from forest lands through harvesting and runoff. (NEE = Net ecosystem exchange of C; SWDS = Solid waste disposal sites incl. landfills and open dumps; Biotic CCS = Carbon capture and permanent storage from biofuel combustion, injected e.g. into deep saline reservoirs.)

Currently HWP reporting is not fully established as a part of national GHG reporting. In the 1996 Guidelines (IPCC 1997, Reference Manual, Box 5, p. 5.17⁶) optional reporting of HWP was outlined using the stock-change approach. In the GPG for LULUCF (IPCC 2003a) the alternative

⁵ The wording on this issue is somewhat unclear in the 1996 GL, Box 5 of the Reference Manual. Note that in the stock-change based approaches in later IPCC Guidance harvesting is not considered an emission, but a "loss" for the pool. The carbon leaving the 5 pools in *Forest lands* in Fig.1 can go to another pool, perhaps to water bodies by runoff (leaching), to HWP, or oxidize to the atmosphere.

⁶ Link <http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch5ref1.pdf>

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approaches were further discussed in Appendix 3a.1. If, however, the HWP pool or pools are included in the basic national inventory system, they must be adapted to the same reporting framework with the present five pools (Figure 1), stated also in the Terms of Reference and Table of Contents of the IPCC 2006 Guidelines (IPCC 2003b). There are three mutually exclusive alternatives for the reporting system:

Stock Change Approach for HWP

The carbon stock changes in HWP, when summed with the stock changes in the forest carbon pools will be reported as emissions/removals in the country where they occur. The HWP stock change in a country could be estimated using either ‘transfers into and out of the HWP pool’ or the difference between the carbon stock of HWP at times 1 and 2, as outlined for dead wood in Chapter 3 of the GPG. Stock changes are reported within national boundaries. Carbon stocks in products that are exported and used in another country will be considered in the calculation of the GHG inventory of that other country.

Atmospheric Flow Approach for HWP

Another conceptual alternative would be reporting based on atmospheric flows in which the exchange of carbon dioxide between the forest (including HWP) pools, and the atmosphere is considered, as illustrated in Figure 1 as dashed lines. A net CO₂ flow from the pools to the atmosphere would be reported as the equivalent emission and a net flow in opposite direction as the equivalent removal. This, however, has to be applied to all pools not only to HWP.⁷ To reiterate, the HWP approach cannot be chosen independently from the general inventory framework, i.e. a similar approach has to be applied both to HWP and the other pools in the LULUCF/AFOLU sector.

Although the stock change and atmospheric flow of a single pool are not the same (because transfers between pools are not recorded in the atmospheric flow approach), summing up the stock change of all biosphere and HWP carbon pools globally would give the same result as summing up the atmospheric flows to these pools. The basic historical reason for reporting stock changes instead of atmospheric flows is that it is in general easier and more relevant to estimate the carbon stock than atmospheric carbon exchange of the pool. For instance, forests go through a large exchange of CO₂ with the atmosphere through photosynthesis and respiration, but our focus is on the net change over time of the forest biomass and the carbon contained in it. Similarly, HWP receive significant inputs from forests at harvest, and HWP release significant outputs of CO₂ to the atmosphere when they decay or are burnt, but our real interest is in the net gain or loss of HWP over time.

However, what is essential in this connection is that the atmospheric flow approach would necessitate a fundamental revision of the reporting frameworks reflected in the 1996 Guidelines and the 2003 GPG LULUCF, as well as in the Terms of Reference of the 2006 IPCC Guidelines (IPCC 2003b), which are all based on changes in carbon stocks.

⁷ The current practice in national inventories is to report stock changes in forests. Consider a country A that operates a “sustainable forest” (which is in equilibrium with respect to its biomass carbon stocks) and exports to country B which burns the biomass as fuel. Country A reports a zero balance, and country B reports a zero balance. The total impact on the atmosphere is zero.

Should the atmospheric flow approach be adopted for HWP, while the stock change approach is retained for forests (because it is inscribed into the Kyoto Protocol, Marrakech Accords and 2003 GPG LULUCF), then country A would report a zero balance, and country B would report an atmospheric flow of 1 unit. In total, the countries would report a release to the atmosphere of 1 unit, which does not occur in reality: Conservation of mass is violated. Thus, one would have to adopt either the atmospheric flow or the stock change approach for **both** forests and HWP, in order to maintain a constant mass balance.

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Production Approach for HWP

The third option for HWP reporting – the production approach – is also based on reporting of stock changes but, in contrast to the stock-change approach, the wood growing country would report the stock changes in HWP resulting from their forests, regardless of the location of the HWP stock (domestic or exported). Because it is based on stock change, this approach could be adopted within the existing reporting framework. However, for an exporting country, there are likely to be technical difficulties for national reporting systems in estimation of stock changes that occur in the importing country, especially when the country wants to use more sophisticated methods and data, such as statistics on use / fate of wood products. Development of methods based on direct inventories of national wood product stocks, applied already in some countries, would also not be possible.

In addition, the production approach would lead to inconsistencies in the GHG inventories, for instance, in case of geological sequestration of CO₂ (carbon capture and storage = CCS) from flue gases in energy production. CCS is being considered as a measure to reduce emissions from fossil fuel combustion, and it can also be applied to a fossil-fuel plant with biomass co-firing, or to a biomass-only plant (“biotic CCS” in Figure 1). The permanent CCS from fossil fuels would be reported as an emission reduction in the country where the carbon is sequestered, whereas the permanent CCS from biomass fuels would be reported as a removal in the country where the wood was grown. For example, in case of co-firing of fossil fuels and biomass fuels, only the fossil portion of CCS would be credited to the country that applies CCS, not the biotic portion, which would be inconsistent. This inconsistency would be avoided best by using the stock-change approach for HWP. In this case biotic CCS would be reported as a positive stock change of the permanent CCS pool (i.e. a removal) in the country where the CCS occurs, not where the wood was grown, which is consistent with reporting of fossil CCS.

Also, note that a precedent for carbon storage in long-lasting products other than HWP has already been set by the inclusion of carbon storage in bitumen, lubricants and other products in the country that *uses* these products (IPCC 1997, Reference manual, page 1.9). What the calculation actually does is to take the total *consumption* of these petroleum products, and to estimate the fraction of current-year consumption that is represented by current year oxidation – i.e. what fraction of current-year consumption ends up increasing the stock. In essence, current inventory practice uses the stock-change approach (as defined above) for other types of carbon-containing products than HWP⁸.

The question is thus whether countries should report carbon pools that are outside a national boundary, as is the case in the production approach, or whether they should only report changes to carbon pools within their own boundaries, as is the case in current inventory practice.

Simple decay⁹ calculation method: One Annex I country has recently submitted a proposal for what they have referred to as the “simple decay approach” (UNFCCC 2004). Our perception is that this is not a completely new approach but is effectively a calculation method within the production approach (hence we will refer to it below as the simple decay method). This method retains HWP

⁸ In essence the method uses a flow approach for fuel uses of petroleum combustion that releases CO₂ to the atmosphere, and a stock-change approach for long-lived petroleum products like lubricants and asphalt. The reason this works is that there is only one “box” or reservoir containing long-lived carbon. As soon as there is more than one reservoir (e.g., various components of the forest system), with carbon being transferred between them, the approach has to be consistent across the different reservoirs, i.e., they have to be treated similarly in the reporting.

⁹ The term “decay” should not be read to imply that all products decay when they leave the HWP pool. The losses from the HWP pool can also be due to other reasons: retirement of the product and disposal in landfills or incinerators, etc.

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in the accounts of the country where the HWP were produced and assumes linear retirement of those wood products regardless of where they happen to reside, i.e. even if they have been exported to another country. In essence wood products remain a part of the forest in which they were produced until the time of their decomposition.

This method, and any other method or approach discussed above, will only result in an accurate estimate of global emissions / removals if the “inherited retirement” of old HWP is accounted for. If old wood products are not included, the increase of carbon in HWP will be overestimated, or the decrease underestimated. Such over/underestimation would not be consistent with “good practice”¹⁰.

The simple decay calculation method can also be applied under the stock-change approach. In this case it is the wood consumption of a country, rather than the wood harvested in a country, that is subjected to the simple decay calculation. With this, the approach and method is essentially identical to that for lubricants and other carbon-containing materials mentioned above.

Placement of HWP in the 2006 Guidelines

A further issue that should be discussed and decided is the placement of the HWP in the reporting framework. Such placement should help avoid double counting or exclusion of certain emissions or removals to the extent possible. Thus, sectoral reporting of *HWP in use* under the AFOLU sector seems sensible. *HWP in solid waste disposal sites* (SWDS) could be reported under the Waste sector together with other wastes and *biotic CCS* under the Energy sector if fossil-based CCS is also reported there¹¹.

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¹⁰ “Good practice guidance assists countries in producing inventories that are accurate in the sense of being neither over nor underestimates so far as can be judged, and in which uncertainties are reduced as far as practicable.” (IPCC 2003a).

¹¹ In a footnote to the “Energy Sector” in the TORs for the 2006 Guidelines it says: “It is recognised that CO2 capture and storage is an important emerging issue in inventory development. The coverage of CO2 storage in this report will be closely coordinated with progress on IPCC SR on CO2 capture and storage. CO2 capture activities will be integrated as appropriate into the methods presented for source categories where it may occur.”