

Key terms used in greenhouse gas reporting and accounting for the land use, land use change and forestry sector

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IEA Bioenergy is a collaborative network under the auspices of the International Energy Agency (IEA) to improve international co-operation and information exchange between national bioenergy RD&D programmes. IEA Bioenergy Task 38 integrates and analyses information on GreenHouse Gases (GHG), bioenergy, and land use; thereby covering all components that constitute a biomass or bioenergy system. For more information see www.joanneum.at/iea-bioenergy-task38.

This paper has been prepared by IEA Bioenergy Task 38 with the aim of providing an overview of interpretations of key terms related to land use, land-use change and forest, and harvested wood products. It represents a consensus achieved by experts participating in the Task, but does not necessarily represent the views of the countries that participate in the Task.

In addition to the main text, the paper provides an alternative interpretation of key definitions in Box 1, which represents the views of the author listed there.

As with every specialty area, specific terminology has been developed and utilised in communications relating to greenhouse gas reporting and accounting. Some terms have been adopted from common usage but defined differently from their common meanings outside of this context. In some cases, though the same definitions of key term are used, interpretations differ. We have perceived that some discussions, such as deliberations over reporting of harvested wood products in national GHG inventories, have been complicated by different understandings of terminology. This paper collates definitions of key terms commonly used in relation to greenhouse gas reporting and accounting for the land use, land-use change and forestry (LULUCF) sector², and highlights areas of ambiguity and divergent interpretations. Misunderstanding and differences over interpretations of key terminology can be a major barrier to effective communication; our intention is to facilitate clear communication between the many players participating in the various processes dealing with estimation and reporting of greenhouse gas emissions and removals.

The Paper is scoped to collate existing and accepted definitions that apply to the LULUCF sector, constrained to those used under the UNFCCC and related documents, and discussion of key concepts over which there is currently divergence of interpretation. All definitions are written in ***bold italics***; other text is discussion and interpretation.

1. Source documents from which definitions are collated

The definitions collated in this paper are sourced from the following key documents:

- *The United Nations Framework Convention on Climate Change (UNFCCC)* of 1992, the initial international agreement under which parties agreed to take action on climate change (UNFCCC, 1992).

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² National GHG inventories are currently prepared following the Revised 1996 IPCC Guidelines for national Greenhouse Gas Inventories and Common Reporting Formats, in which the Land Use Change and Forestry (LUCF) sector is reported separately from the Agriculture, Energy, Industrial processes and Waste sectors. Later, Agricultural Soils and LUCF were brought together under the Acronym LULUCF, for example in the IPCC Special Report on LULUCF and in the Marrakesh Accords. For the 2006 Guidelines, the the new Acronym AFOLU (Agriculture, Forestry and Other Land Use) is used.

- *The Kyoto Protocol to the Framework Convention on Climate Change*, adopted in 1997, which set binding targets for emission limitation and reduction commitments (UNFCCC, 1997).
- *The Marrakesh Accords (MA)* agreed at the 7th Conference of the Parties (COP7), that provide definitions for LULUCF terms (UNFCCC, 2001)
- *Common Reporting Formats for National Inventory Reporting in LULUCF (UNFCCC CRF)*, accepted by COP11 (UNFCCC, 2005c).
- *Common Reporting Formats for reporting LULUCF activities under Articles 3.3 and 3.4 of the Kyoto Protocol* (UNFCCC, 2005a)
- *Estimation, Reporting and Accounting of Harvested Wood Products* (UNFCCC, 2003)
- Intergovernmental Panel on Climate Change (IPCC) documents. The IPCC, established in 1988 by the World Meteorological Organization and the United Nations Environment Program, cooperates closely with the Convention bodies, producing Guidelines for National Greenhouse Gas Inventories, regular Assessment Reports and various technical papers and special reports upon request from the Subsidiary Body for Scientific and Technological Advice. Of relevance to greenhouse reporting and accounting in the land use sector are:
 - *Revised 1996 Guidelines for National Greenhouse Gas Inventories (1996 Guidelines)* (IPCC 1997);
 - *Special Report on Land Use, Land Use Change and Forestry (Special Report on LULUCF)* (IPCC, 2000b);
 - *Evaluating Approaches for Estimating Net Emissions of Carbon Dioxide from Forest Harvesting and Wood Products* (Brown et al, 1998)
 - *Climate Change 2001: Impacts, Adaptation and Vulnerability* (IPCC, 2001)
 - *Good Practice Guidance for Land Use, Land Use Change and Forestry (GPG LULUCF)* (IPCC 2003)
 - *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (currently in preparation; *Terms of Reference* at <http://www.ipcc.ch/activity/outline2006gl.pdf>) (*2006 Guidelines*)

Definitions quoted from these source documents are identified by italic script, in bold.

2. Key terms for reporting and accounting

Under the UNFCCC, parties have agreed to implement measures to mitigate climate change ‘by addressing anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol’. Parties are required to ‘develop, periodically update, publish and make available to the Conference of the Parties,... national inventories of anthropogenic emissions by source and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol’.

In the preparation of national inventories the phrases “emissions by sources” and “removals by sinks” and their interpretation are of particular interest. The words “emissions”, “source” and “sink” are specifically defined in the UNFCCC:

Emissions means the release of greenhouse gases and/or their precursors into the atmosphere over a specified area and period of time (UNFCCC Article 1, paragraph 4)

Source means any process, activity or mechanism that releases a GHG, an aerosol or a precursor to a GHG into the atmosphere. (UNFCCC Article 1, paragraph 9)

Sink means any process, activity or mechanism that removes a GHG, an aerosol or a precursor to a GHG from the atmosphere. (UNFCCC Article 1, paragraph 8)

There is no explicit definition given in the UNFCCC for “removals”³.

Source and **sink** are *processes*, while emissions and removals are the *outcomes* of the processes. This specific definition for source and sink has led to some misunderstanding. In the land use context, it is often said that a forest is a sink. However, using the UNFCCC definition, it is not the forest *per se* that is a sink; rather, the forest may *act* as a sink while carbon stocks in the forest are increasing. On the other hand a forest can also act as a *source*: for example, a forest that is suffering disease or insect attack may emit more carbon dioxide through respiration and decomposition of organic matter than is sequestered through photosynthesis.

Note that a forest is not just the trees; as clarified in the Marrakesh Accords⁴, five pools must be considered in estimating and reporting emissions and removals from forests: above-ground biomass, below-ground biomass, litter, dead wood and soil organic carbon.⁵ Over a reporting period some forest pools may decrease due to net carbon flow out of the pool, while others increase. The forest is, in fact, a **reservoir**.

Reservoir:

a component or components of the climate system where a greenhouse gas is stored.(UNFCCC Article 1, paragraph 7).

a component of the climate system, other than the atmosphere, that has the capacity to store, accumulate or release a substance of concern eg carbon, a greenhouse gas or precursor. (IPCC 2001)

Use of the word “store” in these definitions is, perhaps, unfortunate, in that “store” is ambiguous: it may mean “to accumulate” or “to contain”. As the TAR definition already includes “accumulate” it is probable that “contain” is the intended meaning of “store”. The TAR definition of reservoir continues: “*Oceans, soils and forests are examples of reservoirs of carbon.*” and further explains that “*Pool is an equivalent term [to reservoir], though “the definition of pool often includes the atmosphere”*”.⁶

The Special Report on LULUCF clarifies the relationship between *sink* and *reservoir*, in the context of a forest:

Sink - *Any process or mechanism which removes a greenhouse gas, an aerosol, or a precursor of a GHG from the atmosphere. A given pool (reservoir) can be a sink for atmospheric carbon if, during a given period, more carbon is moving into it than is flowing out.*

There is an apparent contradiction within this definition: consider the soil organic carbon pool; if carbon moves into the soil pool from the biomass and litter pools at a greater rate than it is lost from the soil pool then the soil organic carbon pool meets the definition of a sink according to the second sentence. However, the soil organic carbon pool does not remove carbon dioxide directly from the atmosphere. The same applies to the below-ground biomass, litter and dead wood pools. It is clear that this definition of “sink” requires that the five forest pools be considered together. That is, a forest comprises five pools; the forest is a sink if there is net flow of greenhouse gases into the forest system, and it is a source if there is a net flow of GHG to the atmosphere from the aggregated forest pools⁷.

³ The GPG LULUCF Glossary defines Removal as “harvesting of forests: Removals are a subset of fellings (the commercial part destined for processing). The ‘Removals’ term should only be used in this forestry context, not as synonym for carbon sink.” This is inconsistent with usage of “removal” in the phrase “removals by sinks” in the UNFCCC and Kyoto Protocol.

⁴ Decision 11/CP.7 “Land use, land-use change and forestry” Annex ‘Definitions, modalities, rules and guidelines relating to land use, land-use change and forestry activities under the Kyoto Protocol’. Report of the conference of the parties on its seventh session Addendum Part two: Action taken by the conference of the parties Volume 1 p62 Marrakesh Accords, paragraph 21 of the Annex to draft decision -/CMP.1 (Land use, land-use change and forestry) FCCC/CP/2001/13/Add.1, p.62

⁵ A Party may choose not to account for a particular pool if it can be demonstrated that it is not a source (Marrakesh Accords FCCC/CP/2001/13/Add.1 p62).

⁶ GPG LULUCF glossary defines reservoir as “Water bodies regulated for human activities (energy production, irrigation, navigation, recreation etc.) where substantial changes in water area due to water level regulation occur. The term should not be used in the context of a carbon reservoir.” This definition is inconsistent with the UNFCCC definition.

⁷ See footnote 4 above

To summarise, *removal* is the result of the *sink* action by the *reservoir*.

It may be a useful analogy to think of a sink as a process analogous (but opposite in effect) to the process of fire - that is, the sink is the action occurring in the forest that causes the CO₂ to be removed from the atmosphere.

The word “sink” has often been used to mean forestry activities or the whole LULUCF sector in general, but that is misleading; forests (and agricultural lands) are reservoirs: they act as a sink if carbon stocks are increasing and as a source if carbon stocks are declining.

The common words “reporting” and “accounting” have specific meanings in the context of preparing inventories and reports under the UNFCCC and Kyoto Protocol:

Reporting: *The action of providing the results of the estimation [of emissions and removals] to the UNFCCC in a standardised manner* (FCCC/TP/2003/7 para. 16; see also GPG-LULUCF Glossary, 2003), usually referring to the submission of national GHG inventories to the UNFCCC.

Accounting : *The rules for comparing emissions and removals, as reported, with commitments assumed by Annex I Parties under the Kyoto Protocol* (FCCC/TP/2003/7 para. 16; see also GPG-LULUCF Glossary)

It is expected that ‘Kyoto reporting’ (to provide information for accounting) will be a subset of UNFCCC reporting, to ensure consistency and minimise additional effort.

3. Key concepts for reporting and accounting

Kyoto Protocol, Article 3.3:

The Kyoto Protocol, under Article 3.3, allows parties to offset emissions from other sectors with carbon removals resulting from eligible forestry activities: “The net changes in greenhouse gas emissions by sources and removals by sinks resulting from direct human-induced land-use change and forestry activities, limited to afforestation, reforestation and deforestation since 1990, measured as verifiable changes in carbon stocks in each commitment period, shall be used to meet the commitments...”.

Article 3.3 provides direction as to the *approach* to be used in the reporting and accounting of emissions and removals from afforestation, reforestation and deforestation. The term *approach* should be defined, and contrasted with *method*:

Approach: “the conceptual framework for estimating emissions and removals of greenhouse gases in inventories”;

Method, by contrast, is the calculation framework within an *approach* for estimating emissions and removals ... of greenhouse gases in inventories (Brown et al 1999 -Dakar report). ‘In practice, method refers to the measurement and estimation of GHG emissions [and removals]’ (FCCC/TP/2003/7, para 15).

That is, the approach defines WHAT is being estimated and reported in an inventory; the method describes HOW the reported values are derived. An approach can make use of any method, and within each approach, there may be more than one method (Brown et al 1999 -Dakar report). Thus, “measured as verifiable changes in carbon stocks” does not indicate that the parties must literally measure the change in carbon stocks, but rather, determine emissions and removals based on changes in carbon stocks. Parties may use any method, such as inventory sampling, modelling, remote sensing, and/or direct measurement of fluxes to and from the atmosphere, to determine stock change. The UNFCCC outlines approaches, and does not prescribe methods; instead the UNFCCC refers to the IPCC for methodological guidance for preparation of inventories (Decision 4/CP.1 (FCCC/CP/1995/7/Add.1) and Kyoto Protocol Art 5.2):

“Methodologies for estimating anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol shall be those accepted by the Intergovernmental Panel on Climate Change and agreed upon by the Conference of the Parties...” (Kyoto Protocol Art 5 para 2).

The phrase “measured as verifiable changes in carbon stocks” describes the *approach* that is to be used to estimate emissions/ removals in the LULUCF sector. Thus, “measured as ...” does not suggest a measurement method, and in fact leaves scope for countries to choose estimation methods (measurements, modelling, or other ways of estimation) in line with IPCC GPG Chapter 4, which describes alternative methods with differing data requirements, under different “Tiers”.

This approach is based on the fundamental concept stated in the 1996 Guidelines and repeated in the GPG-LULUCF: “the flux of CO₂ to or from the atmosphere is assumed to be equal to changes in carbon stocks in existing biomass and soils.” (1996 GL Vol 3 p5.3) That is, from the point of view that carbon accumulated in the terrestrial pools is not in the atmosphere, stock change reflects the impact on the atmosphere. This convention is utilised on the basis that stock change is a practical approximation for emission/removals for LULUCF, because it is generally easier to monitor carbon stock change than atmospheric fluxes.⁸

Note that there is some disagreement over the application of the stock change approach to estimate emissions/removals from LULUCF, especially with reference to reporting for wood products. An alternative interpretation is described in Box 1.

Marrakesh Accords

The Marrakesh Accords provide clarification of the eligible forestry activities and further detail of reporting under Article 3.3. Five pools are to be considered in estimating and reporting emissions and removals from forests: “above-ground biomass, below-ground biomass, litter, dead wood and soil organic carbon”⁹¹⁰. It is not appropriate to consider emissions/removals by individual pools in isolation (unless there is evidence that other pools are not decreasing, and can be omitted while being conservative). Consider the above-ground biomass pool: there is simultaneous atmospheric exchange of CO₂ in both directions through photosynthesis and respiration; these are not removals and emissions; emissions/removals occur when there is a net decrease/increase in C stock across the five pools. Thus, the “net annual carbon uptake/release” equates to the removals/emissions due to stock change resulting from the balance of growth and decay plus harvest, across the forest estate. The significance of this assumption with respect to wood products is considered further in Section 4¹¹.

The stock change in the forest pools provides an approximation of emissions and removals of carbon dioxide as a result of afforestation, reforestation and deforestation (ARD),¹² however, it does not capture the atmospheric exchange of non-CO₂ greenhouse gases resulting from these land use changes. This is addressed in the Marrakesh Accords where the description of the calculation of impacts of ARD on emission targets is expanded to:

“anthropogenic greenhouse gas emissions by sources and removals by sinks measured as verifiable changes in carbon stocks, *and non-carbon dioxide greenhouse gas emissions*” (MA, FCCC/CP/2001/13/Add. 1, page 61).

⁸ Change in carbon stocks in existing biomass and soil reflects atmospheric flux of carbon only if carbon stock in wood products is not changing; changes in the carbon stock in wood products must also be considered when estimating emissions/removals for LULUCF. This is discussed further in Section 4.

⁹ Decision 11/CP.7 “Land use, land-use change and forestry” Annex ‘Definitions, modalities, rules and guidelines relating to land use, land-use change and forestry activities under the Kyoto Protocol’. Report of the conference of the parties on its seventh session Addendum Part two: Action taken by the conference of the parties Volume 1 p62 Marrakesh Accords, paragraph 21 of the Annex to draft decision -/CMP.1 (Land use, land-use change and forestry) FCCC/CP/2001/13/Add.1, p.62]

¹⁰ A Party may choose not to account for a particular pool if it can be demonstrated that it is not a source (Marrakesh Accords FCCC/CP/2001/13/Add.1 paragraph 21 p62)

¹¹ Note that any decline in C stock of the five pools is deemed to be an emission – irrespective of whether the carbon is oxidized to atmosphere, or whether it is instead transferred by leaching or harvest out of the forest. Thus, there are circumstances where this approach is inaccurate, such as with respect to transfer to wood products (See “Carbon in wood products” section)

¹² Although the stock change is not an accurate approximation of emissions/removals where there is lateral transfer out of the biomass pools (see footnote 9 and Carbon in Wood Products Section)

Common reporting formats for reporting under the UNFCCC

The Common Reporting Formats for UNFCCC reporting, accepted at COP11 (UNFCCC 2005c) provide further technical detail of the means by which emissions and removals for the LULUCF sector are to be reported: the tables provide for the calculation of stock change in each of the five forest pools; the emissions and removals are determined after the stock changes in all pools have been summed, and non-CO₂ emissions added. Specifically, UNFCCC 2005c states that “According to the Revised 1996 IPCC Guidelines, for the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+). Net changes in carbon stocks are converted to CO₂ by multiplying C by 44/12 and changing the sign for net CO₂ removals to be negative (-) and for net CO₂ emissions to be positive (+). Note that carbon stock changes in a single pool are not necessarily equal to emissions or removals, because some carbon stock changes result from carbon transfers among pools rather than exchanges with the atmosphere.”

The UNFCCC CRFs are constructed to record carbon stock change in each of six land-use categories, reporting them in aggregate as emissions/removals. The tables also include a land-use category of “Other” that includes a line for optional reporting of “Harvested Wood Products”.

Common reporting formats for LULUCF under the Kyoto Protocol

COP10 adopted the CRFs for LULUCF under the Kyoto Protocol, which build on the GPG-LULUCF Chapter 4 (note that the CRF are independent of the GPG). Parties are encouraged to use these for submission of their “Kyoto Article 3.3 and 3.4 accounts” for the 2005 inventory year which is due in April 2007.

2006 Guidelines

The 2006 Guidelines for national greenhouse gas inventories are being developed to replace the 1996 Guidelines and the GPG LULUCF 2003. The LUCF and Agriculture sectors will be combined into the Agriculture, Forestry and Other Land Use (AFOLU) sector. Consequently, some issues associated with the stock change approach, that have been raised with respect to wood products, are applicable also to the whole AFOLU sector. See section 4.2.

4. Carbon in wood products

Wood products are defined as all wood-based material transported from the forest at harvest (GPG-LULUCF; IPCC 2003a); that is, slash left in the forest is excluded. Wood products are sometimes referred to as a ‘carbon sink’, but should be considered as a carbon reservoir: they constitute a carbon sink, through their linkage to the above ground biomass pool, if the carbon stock in wood products is increasing over time¹³, or a source if the carbon stock in wood products is decreasing. In this way, the wood product pool is similar to the below ground biomass, litter, dead wood and soil organic matter pools.

This section explores how wood products are considered in inventory reporting, and accounting under the Kyoto Protocol.

4.1 Wood products in national inventory reporting

The *1996 Guidelines* suggest the default assumption¹⁴ that “all carbon removed in wood and other biomass from forests is oxidised in the year of removal” (IPCC 1996 Vol 3 p5.17). The Guidelines acknowledge, further, that ‘this is clearly not strictly accurate in the case of some forest products, but is considered a legitimate conservative assumption’. The wording of the default assumption is perhaps unfortunate, and has caused considerable confusion and disagreement. The default assumption is “based on the perception that stocks of forest products in most countries are not increasing significantly on an annual basis.” (IPCC 1996 Vol 3 p5.17 Box 5). It is the net change in stocks of forest products which should be the best indicator of a net removal of carbon from the atmosphere, rather than the gross amount of forest products produced in a given year.” Though a proportion of the carbon in harvested biomass is likely to be retained in wood products past the year of harvest, the assumption is an accurate reflection of emissions/removals from the

¹³ Note that under the alternative interpretation described in the Box wood products can not constitute a sink.

¹⁴ This default assumption has been referred to as the IPCC default *approach*, but according to the definitions of approach and method, the IPCC default assumption actually constitutes a simple estimation *method*.

combined forest plus wood products pools if carbon stocks in wood products are unchanging, because the flow from forest to wood products equals the oxidation of previously harvested wood products to atmosphere. Put simply, the default assumption is that stock of wood products is not changing, so the outflow from the wood products pool can be measured from the inflow. Therefore, in a situation where stocks *are* changing, the default assumption *does not* accurately represent the net exchange of carbon with the atmosphere.

The 1996 Guidelines recommend the inclusion of carbon storage in wood products in the national inventory in situations where stocks are increasing¹⁵ and sufficient data are available (IPCC 1997 Vol 3 page 5.17, Box 5). Limited methodological guidance is given:

“Changes in forest and other woody biomass stocks may be either a source or a sink for carbon dioxide for a given year and country or region. The simplest way to determine which, is by comparing the annual biomass growth versus annual harvest, including the decay of forest products and slash left during harvest.” (IPCC 1997 Vol 3 p5.17).

“It is the net change in stocks of forest products which should be the best indicator of a net removal of carbon from the atmosphere, rather than the gross amount of forest products produced in a given year.” (IPCC 1997 Vol 3 p5.17 Box 5)

“If data permit, one could add a pool to Equation 1 (1) in the changes in forest and other woody biomass stocks calculation to account for increases in the pool of forest products. This information would, of course, require careful documentation, including accounting for imports and exports of forest products during the inventory period.” (IPCC 1997 Vol 3 p5.17 Box 5)

Four countries, *viz.* Australia, Canada, United Kingdom and USA, include reporting of the wood products pool in their national inventories.

The UNFCCC CRFs, in which emissions and removals are determined from the aggregate of the five forest pools, reflect the default assumption that the wood products pool is unchanging. However, as indicated above, there is allowance for optional inclusion of net emissions/removals in “Harvested Wood Products” under the land-use category “Other”. In this framework, the wood products pool is a separate entity; estimation of this pool will include transfer from biomass to wood products, and will thus be closely linked with estimation of the forest pools¹⁶. Inclusion of wood products under “Other”, which recognises the delayed oxidation of wood products, will increase the scientific accuracy of reporting for situations where the stock of wood products is changing.

The GPG-LULUCF describes, in an Appendix to Chapter Three, a range of approaches and estimation methods (for future consideration by IPCC Plenary and SBSTA) by which emissions/removals due to wood products can be estimated on the basis of service life category (GPG-LULUCF Appendix.3a.1). A decision by the COP on the treatment of traded wood products is required to guide parties that include wood products in their national inventory: the issues relate to the system boundary, that is, which country reports the stock change or oxidation of wood products (that is, the exporter or the importer), and when emissions/removals occur. Several alternative approaches have been proposed. Under the “Stock Change Approach”, a party would report change in stock of the total wood products pool within its national borders, considering all additions from harvest and import, and losses including export. Alternatively, a party could be required to report stock changes in wood products that have originated from that country, tracking the stock changes of domestically consumed and exported wood products (known as the “Production Approach”). A third approach focuses on reporting the atmospheric flux rather than the stock change, and thus emphasises the timing of oxidation (the “Atmospheric Flow Approach”). These three alternative approaches are further described by Brown et al (1999). A subsequent proposal (Ford-Robertson 2003) describes a “Simple Decay Approach”, under which a party reports the atmospheric flux

¹⁵ The 1996 Guidelines state that a country may report on carbon in wood products if it can document that stocks of wood products are *increasing*. The situation of *decreasing* carbon stock in wood products is not mentioned in the 1996 Guidelines, but it is clear that it must also be covered, in that loss of C stock in wood products indicates a flux of CO₂ to atmosphere that should be acknowledged in calculating emissions/removals from the LULUCF sector.

¹⁶ Note that wood products may also be produced from other land categories besides forest, for example low density agro-forestry that occurs within the grassland or cropland categories.

from wood products produced in that country, whether consumed domestically or exported.¹⁷ These approaches are discussed and compared in Technical Paper FCCC/TP/2003/7 (UNFCCC, 2003). The 2006 Guidelines will include methods for estimation of Harvested Wood Products under each of the approaches.

If the Stock Change Approach is applied to the forest pools, and the Atmospheric Flow Approach to wood products, then an adjustment to allow for exports and imports must be applied in calculating the emissions from the sector, as described in the equations of the draft IPCC 2006 Guidelines.

To summarise, under the “default assumption” for inventory reporting, carbon flux out of the forest pool due to harvest is assumed to equal oxidation flux from the wood products pool, so the wood products pool is not reported. If the national wood products pool is constant, the default assumption is suitable^{18, 19}. Where national wood products stock is changing it is more accurate to include the change in stock of wood products in the calculation of emissions/removals; the UNFCCC CRF has provision for reporting on “Harvested Wood Products” under the land-use category “Other”. Methods for reporting harvested wood products will be included in the 2006 Guidelines.

4.2 Cross-boundary movements of carbon through mechanisms other than HWP trade.

The issue of transboundary carbon flows has broader relevance than to wood products alone; lateral transfer of carbon from national biomass pools due to trade in agricultural products, and erosion and leaching from agricultural land, lead to transboundary carbon fluxes, in some cases of greater magnitude than the flux due to trade of wood products. As with wood products, emissions/removals of CO₂ calculated from stock changes of biomass carbon from agricultural lands do not equal the national atmospheric C fluxes. Considering the five biomass pools as a whole will not solve this basic contradiction, neither will the choice of the HWP reporting approach. The existing practice is to consider stock change of the C pools within national borders as a measure for emissions/removals. In theory, the exclusive alternative would be to consider solely atmospheric fluxes within national borders, but this should then be applied to all biomass – i.e. across the whole AFOLU sector.

¹⁷ The Simple Decay Approach has the same system boundary as the Production Approach at the national scale, but reports fluxes rather than stock changes (2006 IPCC Guidelines)

¹⁸ The boundary of the “national wood products pool” is dependent on the approach used: under the Stock Change approach, the national wood products pool is the wood products within the national boundary, whereas in the Production and Simple Decay Approaches, exported products are part of the “national pool” while products imported into the country are not.

¹⁹ Under the Atmospheric Flow approach, even if the wood products pool is constant, exports and imports of wood products must be reported; unlike the other proposed approaches, the “default assumption” cannot be used under the Atmospheric Flow approach.

4.3 Wood products accounting under the Kyoto Protocol

Carbon in wood products is currently excluded from accounting under the Kyoto Protocol: the Marrakesh Accords specify that “each Party ... shall account for all changes in the following carbon pools: above-ground biomass, below-ground biomass, litter, dead wood, and soil organic carbon” (Decision 11/CP.7: FCCC/CP/2001/13/Add. 1 page 62).

That is, wood products are not included in the Marrakesh Accords Definitions, modalities, rules and guidelines relating to LULUCF activities under the Kyoto Protocol. In accordance with this, the CRF for LULUCF under the Kyoto Protocol provide for calculation of emissions/removals from carbon stock change in the five forest pools. Decision 11/CP.7 includes specific mention of wood products, effectively deferring decision on inclusion of wood products: “The Conference of the Parties...Decides that any changes to the treatment of harvested wood products shall be in accordance with future decisions of the Conference of the Parties” (FCCC/CP/2001/13/Add.1 page 55). Because a decision on inclusion of wood products has not yet been taken, Chapter 4 of the GPG-LULUCF, which relates to accounting for LULUCF under the Kyoto Protocol, does not include mention of wood products. There is potential that wood products may be included in a subsequent commitment period; the 2006 Guidelines will consider methods for reporting of wood products, from which accounting methods are likely to be derived if there is a future decision by the COP/MOP to include the wood products pool in a future commitment period.

Because emissions/removals are calculated from stock change in the five forest pools and there is no allowance for transfer to a wood products pool, all harvest is deducted from stock change and thus increases the overall emission or reduces the overall removal. While it is clear that carbon sequestered through reforestation is not immediately returned to the atmosphere if it is retained in wood products, it is a complex matter to determine the extent to which newly produced wood products contribute to net removal: these products may add to the total wood products pool, but may also be used to replace products that are then discarded – thus they can not be assumed to increase the wood products pool by the total quantity of carbon in those products. Some discarded products may be deposited in landfill, where a large proportion of the carbon is stored permanently (Gardner et al, 2002). Thus, development of methods for accounting for wood products under the Kyoto Protocol second commitment period (or any future climate change agreement) will need to overcome the complexities presented by trade, as outlined in section 4.2, and additional difficulties presented by the possible need to distinguish emissions/removals attributable to wood products produced by specific parties, activities or projects.

Box 1: Alternative Interpretation of the requirements for reporting and accounting of emissions from wood products *Kimberly Robertson*

This interpretation defines “emissions” and “removals” from LULUCF differently from the first section of the paper. The definitions focus on gross atmospheric fluxes rather than stock changes: a flux to the atmosphere is an emission, and a flux from the atmosphere is a removal.

Wood products in National Inventory Reporting

Under the UNFCCC, parties have agreed to implement measures to mitigate climate change ‘by addressing anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol’. Parties are required to ‘develop, periodically update, publish and make available to the Conference of the Parties,... national inventories of anthropogenic emissions by source and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol’. This indicates that what is of interest for inventory reporting is emissions and removals of greenhouse gases due to human activity.

Figure 1 presents a simple overview of the stocks and flows in the forest industry. Wood products can be seen to extend the time before carbon is returned to the atmosphere. The assumption that the stock change of a forest or products pool represents atmospheric exchange is false in some situations: the stock change approach applied to the forest pool, combined with the default assumption of oxidation in the year of harvest, assumes that the carbon transfer from the forest due to harvest is equivalent to the oxidation flux from the wood products pool. If, alternatively, a wood products pool is specifically included in reporting, the stock change of all six pools is assumed to equal an exchange with the atmosphere due to LULUCF activities in a country. Both assumptions are incorrect for situations where the pool changes due to lateral transfer, either from forest to products pool, or between product pools in different countries as a result of international trade.

According to the UNFCCC definition of sink, interpreted in this Box to apply to direct flux from the atmosphere, wood products can not be a sink as they do not remove GHG’s from the atmosphere²⁰. They can only prolong the time until carbon dioxide is returned to the atmosphere.

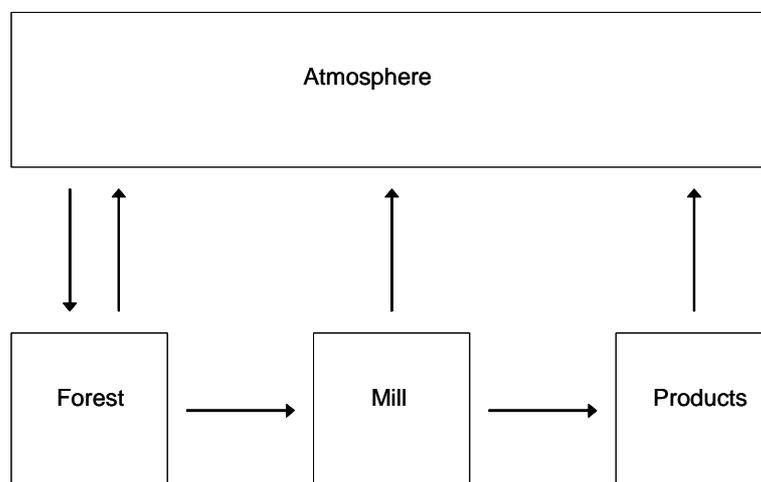


Figure 1. Major forest industry carbon stocks and flows. Only the forest can be a sink under UNFCCC definition (downward arrow)²¹. After harvest, decay or combustion of harvesting residues, processing residues and wood products return carbon to the atmosphere (upward arrows). Transfers also occur between the forest, mill and wood products (horizontal arrows).

²⁰ In the interpretation described in Section 2, any pool that increases in size is a “sink”.

²¹ Of the forest pools, only the above-ground biomass pool can be a sink, as it is the only pool that receives a gross flux from the atmosphere

Box 1 cont'd: Alternative interpretation *Kimberly Robertson*

The IPCC 1996 Guidelines default recommendation is for Parties to report oxidation of all carbon in biomass removed from the forest in the year and country that harvesting occurs, while also omitting the inherited oxidation flux from wood in products and landfills. This is recognised to be not strictly accurate if stocks of wood products are changing, but an adequate assumption for initial calculations. As an alternative to the default, wood products could be assumed to oxidise over time, as suggested in the IPCC 96 GL, in much the same way as residues left in the forest can be assumed to decay over time.

The 96 GL state that ‘the net flux to or from a particular site will always be reflected in the change of carbon stocks on site and/or in the products pool associated with the site.’ This indicates that the link between forest and wood products associated with that forest should be maintained, and in doing so the stock change of the 5 forest pools and associated products is equal to emissions and removals. Thus, if the oxidation of carbon in wood products is to be included in inventory reporting, then it is the “wood products associated with the site” that should be considered, with the “particular site” in this case being the national estate. Currently Parties include in the calculation of their inventory oxidation of wood harvested in their country; some use the default assumption while others report emissions from wood products produced in previous years. For example, the United Kingdom (Baggott et al 2005, p284) and Australia (AGO 2005, p7) report oxidation of domestically harvested biomass, assuming that wood products decay over time, and include the inherited oxidation flux from wood products produced in previous years.

If the wood products pool is included in national reporting and the wood products produced are consumed domestically, then the emissions/removals from the 6 pools²² estimated as atmospheric fluxes (Atmospheric Flow or Simple Decay approaches) will yield the same result as emissions/removals determined by stock change.

However, the distinction between the interpretation of emissions used in this Box and that described in the first part of the paper becomes significant when there are lateral transfers out of a terrestrial pool such as occur through international trade of wood products. Under the “Stock Change Approach”, an exporting country will report an emission if wood products stocks decline, and the importing country will report a removal if wood product stocks increase. Including the stock change of the forest pools and the entire wood products pool consumed in a country (delinking the forest and wood products) does not reflect the ‘net flux to or from a particular site’ and therefore does not reflect emissions and removals from domestically harvested wood.

Both the Atmospheric Flow and Simple Decay approaches provide for the more accurate timing of emissions from harvested biomass compared with the Default Approach, and the Stock Change approach when wood products are traded internationally. Under the Atmospheric Flow Approach, the producing country will not report an emission when wood is exported; emissions will be reported by the importing country as the wood products are oxidised.

In the Simple Decay Approach, the focus is also on reporting emissions over time as products are oxidised, but all emissions are reported by the producing country including for products that are exported; emissions are estimated when but not where they occur if wood products are traded. In that a party reports emissions from domestically harvested wood, whether consumed locally or exported, the Simple Decay approach corresponds with the 1996 Guidelines.

Under the definition of “emission” used in this Box (i.e. an emission being a gross flux to the atmosphere), and the interpretation that it is domestically-produced wood products that should be considered in a national inventory, the Simple Decay approach is suitable for inventory reporting of emissions from wood products, while the Stock Change approach is not suitable for inventory reporting in situations where wood product carbon stocks change due to international trade.

²² Five forest pools plus the wood products pool

Box 1 cont'd: Alternative interpretation *Kimberly Robertson*

Wood products in the Kyoto Protocol

Neither the Kyoto Protocol nor the Marrakesh Accords provide explicit direction on accounting for emissions from wood products, and therefore this has been interpreted by many as meaning that accounting for wood products is excluded from the Kyoto Protocol. However, the interpretation below explains how wood products could be included in accounting under the Kyoto Protocol.

The Kyoto Protocol Article 3.3 defines WHAT is to be measured: 'The net changes in greenhouse gas emissions by sources and removals by sinks resulting from direct human-induced land-use change and forestry activities, limited to afforestation, reforestation and deforestation since 1990'. This indicates that what is of interest are emissions by sources and removals by sinks linked to a limited set of forestry activities.

Decision CMP1, adopted at the first meeting of the parties in Montreal (2005), states, *inter alia*:

- 'that each Party ... shall account for all changes in the following carbon pools: above-ground biomass, below-ground biomass, litter, dead wood, and soil organic carbon (Decision CMP1, http://unfccc.int/files/meetings/cop_11/application/pdf/cmp1_02_lulucf.pdf), that
- 'consistent methodologies be used over time for estimation and reporting' and
- 'that a reversal of a removal due to LULUCF activities be accounted for at the appropriate time.'

In Decision 11/CP 7, but not included in decision CMP 1, and thus not part of the Kyoto Protocol rulebook, is the statement that:

- 'any changes to the treatment of harvested wood products shall be in accordance with the future decisions of the Conference of the Parties'.

Thus Parties must account for changes in the five forest pools including aboveground biomass, associated with eligible afforestation, and reforestation, and deforestation. A decline in the aboveground biomass pool can result from the transfer of carbon offsite at harvest. According to the CRF for the Kyoto Protocol, Parties account for this transfer as the change in the stock of the forest pools. This implies an assumption that the carbon is immediately oxidised at harvest and only recognises the possibility of carbon transferred to wood products, if this flux equals the oxidation flux from wood products to the atmosphere. However, the Marrakesh Accords indicates that accounting under the Kyoto Protocol should be consistent with "methodologies used for estimation and reporting", and therefore it should be consistent with the 1996 Guidelines for estimating LUCF sector emissions and removals, including estimation of emissions and removals associated with wood products. Furthermore, the Marrakesh Accords statement that "any changes to the treatment of harvested wood products shall be in accordance with the future decisions of the Conference of the Parties" is here interpreted to confirm that the methods for wood products from the 1996 Guidelines are applicable for accounting (although, as stated above, the reference to "wood products" in the Marrakesh Accords is not part of the "Kyoto Protocol rulebook"). In addition, the Marrakesh Accords instruction that a "reversal of a removal be accounted for at the appropriate time" is interpreted with respect to the oxidation of carbon sequestered in an eligible forestry activity, to imply that this should be accounted for at the time that the oxidation occurs – ie when the wood products decay.

For Kyoto Protocol accounting, Parties estimate emissions/removals attributable to a limited set of forestry activities; if Parties are permitted to include wood products associated with these activities in their accounting, the approaches proposed for inventory reporting may be considered. Using the definition of "emission" given on page 2 of this document and its interpretation in this Box, the stock change of the forest pools and wood products in a country does not give an accurate estimate of emissions from wood products derived from eligible forestry activities, nor does it provide an accurate estimate of the timing of emissions if wood products are exported²³. The need to distinguish products from specific activities could make some approaches difficult to apply, however, the Simple Decay approach could present a workable solution.).

²³ Note that accounting for LULUCF activities under the Kyoto Protocol, as described in GPG 2003 Chapter 4, was not intended to include HWP; instead, as required under the Marrakesh Accords, it assesses stock change of the five forest pools.

5. Conclusions

This paper has demonstrated existing interpretations of several key terms related to reporting and accounting of land land-use change and forestry at the national level, under the UNFCCC and its Kyoto Protocol. The intention was to elaborate on areas where confusion and misunderstandings have arisen in the past. Many of these misunderstandings are rooted in diverging interpretations of the terms “emissions” and “removals” in the context of land use and wood products derived from land use.

One set of interpretations sees emissions and removals to be approximated by a change in carbon stocks in a number of selected carbon pools. These carbon pools can include or exclude harvested wood products. If wood products are excluded from the national GHG inventory, the result is the IPCC default approach. If wood products are included, there are two sub-options: the reported changes in stocks in wood products can be constrained to wood products produced by a country (production approach), or to those consumed by a country (stock-change approach).

Another set of interpretations views emissions and removals as gross fluxes between the atmosphere and the land / wood products system. In particular, this interpretation, which is detailed in Box 1, views the flux from the atmosphere to the biosphere (forest growth flux) as a removal, and the flux of carbon to the atmosphere as an emission. If wood products are assumed to oxidise at harvest, and the oxidation of decaying wood products from previous harvests is omitted in exchange, the result is the IPCC default approach. If wood products are not assumed to oxidise instantly there are two sub-options: the reported oxidation flux from wood products can be constrained to wood products produced by a country (simple decay approach), or to those consumed by a country (atmospheric flow approach).

For all five approaches (IPCC default, stock change, production, simple decay and atmospheric flow) the IPCC 2006 Guidelines for national GHG inventories elaborates methodologies and formulae for estimation, monitoring and reporting.

It is hoped that the paper in hand will aid the future discussion and implementation of greenhouse gas reporting for the land-use sector.

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