Framework for the development of

Carbon Footprints

For paper & board products

Appendices

September 2007

CEPI - Confederation of European Paper Industries

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Table of contents

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Appendix A. What is a carbon footprint?

William Rees, a Canadian ecologist and professor at the University of British Columbia, is often credited with having first used the term "ecological footprint" in a paper he published in 1992.[1] In Dr. Rees' framework, "ecological footprint" is essentially the amount of land required by a given population to produce its goods and services on a continuing basis. Since 1992, the concept of ecological footprint has gained broad recognition. Recently, a group of individuals and organizations active in the area, working the Global Footwork Network, issued "Ecological Footprint Standards." [2]

The Ecological Footprint Standards indicate that "carbon footprint" is synonymous with "CO_2 area," which is defined as "the demand on biocapacity required to sequester (through photosynthesis) the carbon dioxide (CO_2) emissions from fossil fuel combustion." For a number of reasons, this concept of a carbon footprint is seldom used. First, it requires converting estimates on value chain emissions and sequestration, which are reasonably accurate, into equivalent land areas based on CO_2 sequestration rates whose estimation is much more uncertain. Second, the application of the approach to non-carbon greenhouse gases is problematic because non-carbon gases are not sequestered by photosynthesis. Finally, and perhaps most important, expressing value chain emissions in terms of land area equivalents will be difficult for stakeholders to interpret because it is not what they conceive a carbon footprint to be. Nonetheless, it is worth noting that Ecological Footprint Standards specifically developed for organization- and product-level ecological footprints are expected from the Global Footprint Network later in 2007.

In common usage, the terms "carbon footprint," "climate footprint" and "greenhouse gas emissions footprint" are commonly used, but poorly defined. The WRI/WBCSD GHG Protocol, Corporate Accounting and Reporting Standard - Revised Edition (hereafter called simply the GHG Protocol) uses the term "emissions footprint" without definition, but with the clear implication that it is a term intended to extend corporate inventories to include parts of the value chain that are not included in normal corporate greenhouse gas inventories.[3] The ISO 14064 series of standards on greenhouse gas accounting uses the term only once and without definition. IPCC does not use the term, nor would it be expected to, because its work is focused on national accounting rather than corporate- or product-level estimates.

The word footprint is not used, but ADEME's Le Bilan Carbone ® intends to support the quantification of all GHG emissions that are caused by a certain activity or human organisation.

A carbon footprint has been prepared by the EPD®system for Cascades Inc. In the case of the Cascades footprint, bar graphs are presented showing the transfers to the atmosphere of both fossil fuel CO_2 and biomass CO_2, and in the case of biomass CO_2, uptake in the forest.(Cascades Climate Declaration, http://www.environdec.com/reg/epde31e.pdf.)

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[1] William Rees (1992) 'Ecological footprints and appropriated carrying capacity: what urban economics leaves out' Environment and Urbanisation Vol 4 no 2 Oct 1992

[2] The Global Footprint Network Standards Committee (2006). "Ecological Footprint Standards 2006". http://www.footprintstandards.org/

[3] The GHG Protocol requires corporate inventories to include direct emissions (termed Scope 1 in the GHG Protocol) and indirect emissions associated with purchased power (Scope 2). The term "emissions footprint" appears to describe corporate inventories that have been expanded to include Scope 3 emissions, which are indirect emissions other than those associated with purchased electricity.

An examination of the range of definitions offered by various organizations suggests that, at a minimum, a carbon (or climate or greenhouse gas emissions) footprint is a balance sheet of greenhouse gas emissions and removals (transfers to and from the atmosphere). In some cases, it may also include offsets, i.e. removals accomplished outside the boundaries of the analysis but "owned" by the reporting entity. Because these balance sheets usually cover more than CO_2, the units of reporting are usually CO_2 equivalents.

Because "carbon footprints" are often assumed to be equivalent to greenhouse gas balance sheets, stakeholders may be confused by including non-balance sheet information in a format that is called a carbon footprint. Therefore, an alternative term to "carbon footprint" may be needed to describe assessments that are more complex. Some possible alternative terms are "greenhouse gas and carbon profile," or "greenhouse gas product declaration." Non-balance sheet information is especially important to the forest products industry because many of the connections between the industry and the global carbon cycle are difficult to quantify but nonetheless important to understanding the greenhouse gas and carbon attributes of forest products.

Appendix B. Officially recognized guidelines or standards

The International Organization for Standardization (ISO) has developed what are probably the most widely accepted guidelines for conducting lifecycle studies.[4] While the ISO lifecycle guidelines are quite specific on the types of documentation that should accompany the results of lifecycle studies, especially those used in comparative assessments, they allow a range of practices consistent with the intended scope and goal of individual studies. In principle, there is nothing in the ISO standards that would preclude the industry's developing a footprint framework that is consistent with ISO lifecycle study requirements. The ISO standards would, however, require transparency in methods, boundaries, assumptions, etc.

Some of the issues associated with footprint-type studies are dealt with in the ISO standards for environmental labels and declarations, especially ISO 14025 on Type III environmental declarations.[5] ISO 14025 outlines principles for developing Type III Environmental Declarations to communicate lifecycle environmental information along the supply chain, primarily in business-to-business communication. Environmental Declarations must comply with specific and transparent methodologies because it is understood that different declarations might be compared. To deal with the different inherent environmental performance attributes of different product groups, so-called Product Category Rules (PCRs), are sometimes developed to complement general calculation guidelines and to ensure consistency in the calculation methods. Such consistency is critical to allowing LCA-based information to be added up through the supply chain and allowing different Environmental Declarations to be compared. Product
Category Rules (PCR) for preparing Environmental Declarations have been developed by the European Tissue Symposium and the Nordic Tissue Association within the EPD (Environmental Product Declaration) program.[6] The EPDs according to that PCR are lifecycle-based, including the phases of manufacturing, use and disposal. Greenhouse gases are among the parameters included. The EPD system has also introduced Climate Declarations.[7]

There are a number of other programs that use methods similar to those described in the PCRs for tissue, but they often involve boundaries that are not as comprehensive, especially regarding the end-of-life elements of the value chain. Among these are the Canadian Environmental Choice program[8], the Paper Working Group's EPAT [9], and the EU Ecolabel.[10] Some, like the Paper Profile, focus almost entirely on manufacturing operations.[11] It is important to note that ISO 14025 allows Type III environmental declarations based on boundaries that do not include all the stages of the lifecycle, but the standard requires justification and transparency in cases where lifecycle phases are excluded.[12]

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4 ISO 14040:2006, 14044:2006, ISO/TR 14047 and 14049, and ISO/TS 14048
5 ISO 14025:2006, "Environmental labels and declarations -- Type III environmental declarations -- Principles and procedures"
6 http://www.environdec.com/page.asp?id=110&menu=1,1,5&group=21
7 see http://www.environdec.com/page.asp?id=331
8 http://www.environmentalchoice.com/
9 https://www.epat.org
10 http://ec.europa.eu/environment/ecolabel/index_en.htm
11 http://www.paperprofile.com/
12 ISO 14025 states, "Type III environmental declarations shall be based on the life cycle of the product, unless information on specific stages (e.g. the use and end-of-life stages of the product) is not available and reasonable scenarios cannot be modelled, or these stages may reasonably be expected to be environmentally insignificant. Only under these circumstances can the specific stages be excluded.

An abbreviated lifecycle approach for calculating carbon footprints has been developed by the Carbon Trust, an organization established by the UK government to assist in meeting the country's Kyoto Protocol commitment.[13] As a government sanctioned organization, the Carbon Trust's activities represent one of the few "official" efforts to define and develop guidelines for "carbon footprints" for products. According to the Carbon Trust, the carbon footprint of a product is "the total emission of greenhouses gases (GHGs) in carbon equivalents from a product across its lifecycle from the production of raw material used in its manufacture, to disposal of the finished product (excluding emissions during use of the product)." The Carbon Trust intends that "the methodology will enable business to quantify the emissions across the product supply chain. Through the development of a carbon footprint label to be displayed on products, it will also provide consumers with information on the carbon footprint of a product, which could be used by them to inform their purchasing decision."

In many respects, the Carbon Trust methodology is similar to other lifecycle-based Environmental Declarations. Because of the growing interest in the Carbon Trust methodology, however, it is appropriate to highlight some especially notable aspects of the methodology.

- It does not explicitly consider carbon sequestration, although it may be possible to define the assessment boundaries so that this is included.
- It excludes emissions occurring during product use, even though the use phase may be the life cycle phase contributing most to emissions of greenhouse gases for many products.[14]
- It does not allow offsets.
- In several places, the methodology makes clear that raw materials do not include "emissions from the initial manufacture of a recycled material used as a raw material input…" In other words, there is zero allocation of virgin emissions forward to recycled production.
- The methodology contains a discussion of allocation options for co-products but identifies this as an area needing further work.
- The Carbon Trust notes that additional effort is needed to ensure that the methodology is consistent with guidance issued by ISO and the GHG Protocol.

Although the WRI/WBCSD GHG Protocol is not government sanctioned, it is so widely accepted that it can be included among the "officially recognized" protocols. Although the GHG Protocol does not define "footprint," it contains an example corporate greenhouse gas balance sheet. The example balance sheet tracks "GHG assets and instruments" against "GHG emissions."[15] In concept, carbon sequestration in forests and products could be included as a "GHG asset." The GHG Protocol contains a discussion of forest and product carbon sequestration issues but observes that, at the time the revised GHG Protocol was

[13] "Carbon footprint measurement methodology – Version 1.3", published by the Carbon Trust, 15 March 2007

[14] The exclusion of emissions occurring during the use of the product is a departure from normal practice in lifecycle studies. The Carbon Trust rationalizes this exclusion by explaining, "supply chain companies have limited influence in changing use behavior, and [emissions during use] are highly variable depending on the user of the product." Of course, a similar statement could be made about emissions occurring after the product is no longer in use, but the Carbon Trust guidelines include waste management emissions nonetheless.

[15] An unfortunate, and likely accidental, aspect of the example is that is implies that biomass CO_2 is included in corporate greenhouse gas totals. This is not consistent with the general guidance in the GHG Protocol which requires biomass CO_2 to be reported but specifically indicates that these releases are not added to corporate greenhouse gas emissions totals.

issued, consensus methods had not yet been developed for including forest carbon and product carbon sequestration in corporate inventories.

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Appendix C: Letter from SETAC Europe LCA Steering Committee to ISO on harmonisation efforts in the area of carbon footprints

Page 1 of 3

Letter of the SETAC Europe LCA Steering Committee[1] on recent standardisation efforts around measurement of greenhouse gases and "carbon footprinting"

Background:
Recently, due to concerns over climate change, a variety of stakeholders have called for ways to measure greenhouse gas (GHG) emissions associated with (consumer) products and services, and several approaches for "carbon footprinting" (CF) are under discussions. The background of activities around CF can be seen in searching for simplifications of the more comprehensive Life Cycle Assessment (LCA) method and is driven by the need to assess a large number of products in a short time frame. The Life Cycle Assessment Steering Committee of the Society of Environmental Toxicology and Chemistry Europe (SETAC Europe LCA SC) acknowledges the importance of simplified and practical methods. However, the SETAC Europe LCA SC also wants to express its concern that oversimplified methods may misinform stakeholders about the environmental implications of products and services and thereby lead to counterproductive results for the environment.

Has the case been made for a new standard?
Before embarking on a new standardisation effort, the case for the new standard needs to be made.

The SETAC Europe LCA SC notes the current differences in carbon footprinting methodologies seem extremely wide and diverse. The situation regarding CF resembles that of the discussions around LCA in the late eighties and early nineties with several approaches being proposed which might or might not lead to the same or similar result depending on the chosen methodology. In the UK, the Carbon Trust™ together with the UK Government Department for Environment, Food and Rural Affairs (DEFRA) are sponsoring the British Standard Institute to develop a Publicly Available Specification (PAS) for the measurement of the embodied greenhouse gases (GHGs) in products and services to come to an agreement on the method. There seems to be a benefit to the harmonization of different approaches and the SETAC Europe LCA SC acknowledges the importance of addressing GHG emissions on a product/service level in a consistent way.

However, the SETAC Europe LCA SC wonders whether there is the need to embark on a new standardisation effort or whether clear reference to the existing ISO standards would sufficiently address the aspects of greenhouse gas emissions originating from products and services.

As existing ISO standards, we are referring here especially to:

- ISO 14040:2006: Environmental management — Life cycle assessment — Principles and framework
- ISO 14044:2006: Environmental management - Life cycle assessment - Requirements and guidelines
- ISO 14025:2006: Environmental labels and declarations — Type III environmental declarations
- ISO 14064-3:2006 Greenhouse gases, Specifications with guidance for the validation and verification of greenhouse gas assertions

[1] The LCA community working within the Society of Environmental Toxicology and Chemistry (SETAC) has been instrumental in leading the discussions around the harmonization of different approaches to Life Cycle Assessment (LCA) in the early and mid nineties amongst others with the workshops leading to the SETAC LCA "Code of Pratice" (Sesimbra 1993). The SETAC work was fed as an important input into the development of the ISO guidelines on LCA released in their first version from 1997 to 2000 (ISO 14040-43). The ISO guidelines on LCA can be seen as a great success and have undergone their first revision in 2006 (ISO 14040/14044).

GHG emissions originating from product and services are covered by the ISO LCA standards and their potential impact on climate change is seen as a key indicator in LCA alongside other environmental indicators of relevance. Both life cycle inventories and life cycle impact assessment for greenhouse gases are well established and broadly accepted. Today, GHG impacts from products/services are routinely covered in LCAs.

To ensure balanced environmental product declarations based on LCA, the ISO 14025 describes ways to ensure comparability within product categories. The SETAC Europe LCA SC would like to stress that the functional unit approach is crucial to the enabling of comparisons between different products that fulfil the same function on a common basis. Other measures such as mass or volume are not sufficient for comparisons, particularly if the same function can be achieved by very distinct means, e.g. concentrated versus non concentrated products or disposable versus reusable products.

GHG emissions at the company or facility level are captured in a different set of standards (e.g., in ISO 14064:1–3, providing guidance for the validation and certification of greenhouse gas assertions).

Overall, the SETAC Europe LCA SC comes to the conclusion that the existing ISO standards should be sufficient to address the environmental impacts due to GHG emissions from products/services in a consistent and comprehensive way.

Key requirements for a potential new GHG standard:
In case other considerations let it seem to be appropriate to have a separate standardisation effort for GHG emissions from products and services, the SETAC Europe LCA SC would like to ensure that appropriate reference is given to existing ISO standards covering the GHG emissions and its potential impacts on the environment. The SETAC Europe LCA SC would like to emphasize the importance of the following aspects which need to be addressed by any potential new standard on GHG emissions on a product/service level in a way that does not put the new standard into conflict with existing relevant ISO standards:

1. Coverage of relevant environmental impacts
   For product categories and services that are known or expected to have significant environmental impacts other than GHG emissions, those other potential impacts should be covered in a LCA complementing the GHG assessment to avoid problem shifting.
2. Functional Unit approach
   If GHG assessments are to be used for comparisons between different products or services, an appropriate functional unit needs to be defined to ensure that comparisons are made on a common basis.
3. Coverage of life cycle stages
   The GHG assessment should cover all stages of the lifecycle in a comprehensive way in a first step. Decisions to omit specific life cycle stages, such as use or disposal, can only be made on a case by case basis based on a good understanding of the relevance of the various life cycle stages. If GHG assessments are to be used for comparisons between different products, all life cycle stages have to be included unless they are the same for all evaluated products.
4. Coverage of greenhouse gases
   The GHG assessment should cover all relevant greenhouse gases in a comprehensive way in a first step. Decisions to omit specific greenhouse gases can only be made on a case by case basis based on a good understanding of the relevance of the various greenhouse gases.
5. Level of depth
   If GHG assessments are to be used for comparisons between different products or services, an appropriate level of depth and thoroughness throughout the assessment needs to be ensured.
6. Transparency and reporting
   A transparent and comprehensive way of reporting needs to be ensured especially if results are intended to be used as "comparative assertions disclosed to the public" (environmental claim regarding the superiority or equivalence of one product versus a competing product).

Page 3 of 3

7. Access to report
   Access to the report to third parties to which results are communicated or those who could be affected by the results needs to be ensured.
8. Critical review
   If results are intended to be used as "comparative assertions disclosed to the public", a thorough critical review process needs to be put in place to ensure credibility and verify that the requirements for methodology, data, interpretation and reporting are met and whether a study is consistent with the principles provided in the standard.
9. Generation of comparable data
   If the standardisation effort was to cover the generation of comparable data sets (e.g., to provide "default data" for GHG emissions of processes or materials), comparable system boundaries, allocation methods and requirements regarding data quality related to age and regional and technological coverage have to be ensured, undergoing an external peer review.

We are happy to discuss any of the above aspects in more detail.

Yours sincerely,

Rana Pant

Rana Pant (on behalf of the SETAC Europe Life Cycle Assessment Steering Committee)
Strombeek-Bever, Belgium, July 18, 2007

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Appendix D. "Tools" for developing carbon footprints

While carbon footprints are widely discussed (an internet search on the phrase "carbon footprint" returns about one million hits), there are very few examples of credible carbon footprints or protocols/guidelines for developing them. At one end of the credibility spectrum is a large number of very simple on-line calculators for characterizing personal (not product) carbon footprints.

In addition, there are a few web-based calculators aimed at the corporate user. Many of these are sponsored by companies offering consulting services, selling offset credits or offering carbon footprint certification. These corporate footprint tools also tend to be very simple and are not examined herein unless they have adequate technical content and have achieved recognition as a result of involvement by important stakeholders, especially governments and major ENGOs.

Several of the science-based ENGOs have carbon footprint calculators. WRI's Safe Climate Net website defines carbon footprint as "a representation of the effect you, or your organization, has on the climate in terms of the total amount of greenhouse gases you produce (measured in units of carbon dioxide)." [16] The Safe Climate Net carbon footprint calculator includes "CO_2 emissions for energy use and transportation, and for organizations' paper use," but indicates that a person's or organization's footprint will usually be much larger than this.

Another example is the work of the Climate Neutral Network, a non-profit organization "dedicated to helping companies, communities, and consumers achieve a net-zero impact on the Earth's climate." The Environmental Advisory Board includes many of the major ENGOs and the list of "participating" companies includes Weyerhaeuser Corporation. The Network has a spreadsheet-based tool for estimating "Metrics for Calculating an Enterprise GHG Footprint." [17] It covers CH_4 from waste disposal, direct emissions of the six major greenhouse gases, and indirect emissions associated with purchased electricity.

The US Postal Service, the US EPA and Environmental Defense (formerly the Environmental Defense Fund) have developed a web-based calculator called The Paper Calculator.[18] The Paper Calculator allows users to compare the lifecycle environmental attributes of different types of paper. The calculator includes a number of environmental parameters besides greenhouse gases. More useful than the calculator are the life cycle studies that contain the documentation for the calculator. They are discussed later in this report.

The European Commission has a simple web-based calculator that examines opportunities for reducing emissions but does not calculate a footprint. The EU calculator web page has links to footprint calculators in Germany, France, Lithuania, Poland, Poland, Spain, Sweden, Sweden and Switzerland.

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16 http://go.ucsusa.org/calculator.html
17 http://climateneutralnetwork.org/downloads/Metrics_version_9.xls
18 http://www.ofee.gov/recycled/descript.htm

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Appendix E. Important examples of carbon footprint or lifecycle studies

In looking to lifecycle studies for examples of carbon and greenhouse gas footprints, it is important to understand that product lifecycle studies are conducted for a variety of reasons, e.g. improvement of the production process or entire life cycle of a product, selecting the preferred recovery/waste options or comparing alternative products. As a result, different studies have differing goals and scopes, which dictate different methodologies and boundaries. While such considerations complicate the comparison of lifecycle studies, it is nonetheless useful to examine some of these studies to obtain insights into the factors to consider in developing a framework for carbon and greenhouse gas footprints.

NCASI and the University of Washington have examined the carbon and greenhouse gas profile of the global forest products industry.[19] The profile is not at the product-level so it is not reviewed here.

A carbon footprint has been prepared by the EPD®system for Cascades Inc. In the case of the Cascades footprint, bar graphs are presented showing the lifecycle transfers to the atmosphere of both fossil fuel CO_2 and biomass CO_2, and in the case of biomass CO_2, uptake in the forest.(Cascades Climate Declaration, http://www.environdec.com/reg/epde31e.pdf.)

The UK-based retailer Tesco has announced an initiative to calculate its direct greenhouse gas emissions footprint and to examine its "indirect carbon footprint – the emissions created by [its] suppliers and customers – so [Tesco] can work with them to reduce [its] overall impact on the environment."[20] The emissions covered in the footprint study include direct emissions from fossil fuel combustion and refrigerant losses and indirect emissions associated with purchased electricity. An examination of the footprint by a consultant retained by Tesco identifies opportunities for improvement by including more emission sources and improving the accuracy of estimates. The methods do not address carbon sequestration.

Timberland Inc., a US-based outdoor clothing retailer, developed a carbon footprint that included direct and indirect emissions from its retail operations, distribution centres, offices and manufacturing operations as well as employee transportation.[21] The single largest contributor to the footprint was employee transportation, representing over one-third of all footprint emissions. Waste management and carbon sequestration were not addressed.

Friends of the Earth performed a carbon footprint study of Exxon which included CO_2 and CH_4 emissions from the company's operations as well as emissions resulting from the use of the company's products (fuel).[22] The study was performed without the company's involvement so the data are largely from secondary sources and as a result, the study is necessarily narrow in scope.

In addition to studies that are labeled as "footprint studies" or "profile studies," there are a large number of life cycle studies that have included greenhouse gas and carbon within their

[19] "A carbon and greenhouse gas profile of the global forest products industry," NCASI Special Report 07-02, http://www.ncasi.org/publications/Detail.aspx?id=2952

[20] http://www.tesco.com/climatechange/carbonFootprint.asp

[21] http://cleanair-coolplanet.org/documents/Timberland.pdf

[22] http://www.foe.co.uk/resource/reports/exxons_climate_footprint.pdf

scope. These studies represent, in the extreme, what some stakeholders might expect in a “footprint” study so they provide important insights into the issues that accompany the development of a footprint. There are far too many lifecycle studies to examine here, but several high visibility studies warrant mentioning.

In the 1990s, the Paper Task Force (PTF) worked with Environmental Defense (then the Environmental Defense Fund) to develop a series of lifecycle studies of different types of paper.[23] The Paper Task Force effort was (and remains) significant because it involved some of the most environmentally active paper purchasers in North America. The PTF currently includes Bank of America, Starbucks Coffee Company, McDonald's, Staples, Inc., Nike, Inc., Time Inc., Toyota Motor Sales USA, Hewlett-Packard Company, FedEx Kinko's Office and Print Services, Norm Thompson Outfitters, and Cenveo. The PTF lifecycle reports include all phases of the lifecycle except for forest carbon and carbon sequestration in products.

The Paper Task Force’s recent efforts are especially significant. The group is now working with Metafore Inc. to develop a product-level reporting tool, based on a partial lifecycle approach, for characterizing the environmental attributes (including greenhouse gas emissions) of paper products. The tool, the Environmental Paper Assessment Tool or EPAT, includes direct emissions from fossil fuel combustion, indirect emissions from purchased electricity, indirect emissions associated with purchased pulp, and transport emissions associated with carrying product from the mills to a distribution point or converter. Carbon sequestration is not addressed. The tool is currently primarily a mill-based reporting tool rather than a product-level tool, but the Paper Task Force has indicated that it intends to evolve the tool to accommodate product-level reporting.[24]

In addition to the lifecycle studies from the Paper Task Force, the European Environment Agency recently reviewed eight other major studies from around the world that examined the paper value chain from a lifecycle perspective.[25] These and other lifecycle studies known to the authors will be helpful in (a) identifying key methodological issues that a carbon footprint framework will need to address, and (b) narrowing the scope of an industry framework to the sources and activities in the paper value chain that are most important from an emissions and sequestration standpoint.

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[23] http://www.environmentaldefense.org/documents/815_PTFsynopsis.pdf

[24] The North American industry is engaged in this process through contact with members of the PTF, through the work of the Forest Products Association of Canada (and to a smaller extent, the American Forest and Paper Association), through direct interaction with Metafore, and via technical consultations between Metafore and NCASI. Some companies have expressed concerns about the complexity of the EPAT as well as the requirement to share energy and process information with market pulp customers, which may also be competitors.

[25] EEA (2006) “Paper and cardboard - recovery or disposal? Review of life cycle assessment and cost-benefit analysis on the recovery and disposal of paper and cardboard” EEA Technical Report No. 5/2006

Appendix F: Characterizing the effects of forests, biomass fuels and forest products on the atmoshpere

Carbon sequestration and the use of biomass fuels are important attributes of the forest products value chain. There are a number of approaches for characterizing these attributes. Some of these approaches generate estimates of net sequestration (or net emissions) that can be used in greenhouse gas balance sheets while others are useful primarily as tools for educating stakeholders. Several approaches for characterizing the effects of biomass carbon are discussed here.

Developing information that can be used in greenhouse gas balance sheets.

In the forest, CO_2 is removed from the atmosphere. Much of this carbon is returned to the atmosphere at various points along the value chain. If the uptake in the forest is exactly matched by the transfers to the atmosphere along the value chain, biomass carbon has no effect on atmospheric CO_2. In reality, of course, forest uptake is not exactly matched by biomass carbon transfers to the atmosphere. In most developed countries, transfers of biomass carbon to the atmosphere are more than offset by the update of CO_2 in forests and by carbon storage in products, with the net result being a net sequestration of atmospheric carbon in the forest products value chain.

It is the net balance between forest uptake and transfers of biomass carbon to the atmosphere that determines the effect on atmosphereic CO_2. If you consider only transfers of biomass-derived CO_2 to the atmosphere, for instance due to burning biomass fuels, you learn nothing about overall impacts of forest biomass on the atmosphere. This is why CO_2 emissions associated with burning biomass are never combined with CO_2 emissions from fossil fuels but are reported as “additional information”.

There are two primary approaches for depicting the effects of biomass carbon on the atmosphere; atmospheric flow accounting (or flow accounting) and stock change accounting. Atmospheric flow accounting calculates the net transfers of biomass carbon to (or from) the atmosphere by adding up all of the flows of carbon to and from the atmosphere along the value chain. Stock change accounting calculates net transfers of carbon to (or from) the atmosphere by adding up all of the changes in stocks of biomass carbon along the value chain. When applied to the complete value chain, the methods give the same result.

Flow accounting highlights the role of forests in removing carbon from the atmosphere but depicts biomass fuels and products as releases of carbon to the atmosphere. Stock accounting obscures the role of forests in removing carbon from the atmosphere, but highlights the importance of carbon storage in products.

With either approach, it is not possible to know the overall net effects on the atmosphere without including the entire value chain. Assessments that include only portions of the value chain can, however, be used to demonstrate that the transfers to or from the atmosphere are less than or greater than a certain value.

Below, a number of hypothetical scenarios are used to illustrate how the two accounting approaches can be used in different situations. Because it reflects an analysis of the complete value chain, the “net sequestraton” value in the examples below can be used in balance sheets – i.e. it can be added/subtracted to emissions from fossil fuel combustion.

Scenario 1:

- Boundaries: Cradle to Gate – i.e. no knowledge of fate of carbon during product use or end-of-life
- Wood is from sustainably managed forest and the company assumes that harvest equals net forest growth.
- The harvest attributable to the product contains 100 units of carbon. The product contains 25 units of carbon. The rest of the harvested carbon is contained in fuels used in manufacturing.

Changes in Biomass Carbon Stocks (plus sign indicates growth of carbon stocks)			Net Sequestra-tion
Forest	Products In-Use	Products End-of-Life	
0	≥ 0	≥ 0	≥ 0

Flows of Biomass Carbon (plus sign indicates flow to the atmosphere)			Net Sequestra-tion
Forests	Manufactur-ing	End-of-Life	
-100	75	≤ 25	≥ 0

Scenario 2:

- Boundaries: Cradle to Grave
- No storage during use (i.e. a short-lived product)
- All carbon in the product is returned to the atmosphere at end-of-life.
- Wood is from sustainably managed forest and the company assumes that harvest equals net forest growth.
- The harvest attributable to the product contains 100 units of carbon. The product contains 25 units of carbon. The rest of the carbon is contained in fuels used in manufacturing.

Changes in Biomass Carbon Stocks (plus sign indicates growth of carbon stocks)			Net Sequestra-tion
Forest	Products In-Use	Products End-of-Life	
0	0	0	0

Flows of Biomass Carbon (plus sign indicates flow to the atmosphere)			Net Sequestra-tion
Forests	Manufactur-ing	End-of-Life	
-100	75	25	0

Scenario 2 is similar to the approach used in the carbon footprint prepared by the EPD®system for Cascades Inc. In the case of the Cascades footprint, bar graphs were presented for both fossil fuel CO_2 and biomass CO_2.(Cascades Climate Declaration, http://www.environdec.com/reg/epde31e.pdf.)

Scenario 3:

- Boundaries: Cradle to Grave
- The product is long-lived and stores 20% of its carbon (5 units) for at least 100 years, allowing the 5 units to be considered a net removal of carbon from the atmosphere.
- All carbon in product is returned to atmosphere at end-of-life.
- Wood is from sustainably managed forest and the company assumes that harvest equals net forest growth.

- The harvest attributable to product contains 100 units of carbon. The product contains 25 units of carbon. The rest of the carbon is contained in fuels used in manufacturing.

Changes in Biomass Carbon Stocks (plus sign indicates growth of carbon stocks)			Net Sequestration
Forest	Products In-Use	Products End-of-Life	
0	5	0	5

Flows of Biomass Carbon (plus sign indicates flow to the atmosphere)			Net Sequestration
Forests	Manufacturing	End-of-Life	
-100	75	20	5

Scenario 4:

- Boundaries: Cradle to Grave
- The product is long-lived and stores 20% of its carbon (5 units) for at least 100 years, allowing the 5 units to be considered a net removal of carbon from the atmosphere.
- At end-of-life, the 20 units of product carbon that is not in long term storage in products-in-use is sent to a landfill where 10% (2 units) is stored for at least 100 years, allowing the 2 units to be considered a net removal of carbon from the atmosphere.
- Wood is from sustainably managed forest and the company assumes that harvest equals net forest growth.
- The harvest attributable to product contains 100 units of carbon. The product contains 25 units of carbon. The rest of the carbon is contained in fuels used in manufacturing.

Changes in Biomass Carbon Stocks (plus sign indicates growth of carbon stocks)			Net Sequestration
Forest	Products In-Use	Products End-of-Life	
0	5	2	7

Flows of Biomass Carbon (plus sign indicates flow to the atmosphere)			Net Sequestration
Forests	Manufacturing	End-of-Life	
-100	75	18	7

Scenario 5:

- Boundaries: Cradle through Product Use
- The product is long-lived and stores 20% of its carbon (5 units) for at least 100 years, allowing the 5 units to be considered a net removal of carbon from the atmosphere.
- End-of-life management is not known.
- Wood is from sustainably managed forest and the company assumes that harvest equals net forest growth.
- The harvest attributable to product contains 100 units of carbon. The product contains 25 units of carbon. The rest of the carbon is contained in fuels used in manufacturing.

Changes in Biomass Carbon Stocks (plus sign indicates growth of carbon stocks)			Net Sequestration
Forest	Products In-Use	Products End-of-Life	
0	5	≥ 0	≥ 5

Flows of Biomass Carbon (plus sign indicates flow to the atmosphere)			Net Sequestration
Forests	Manufacturing	End-of-Life	
-100	75	≤ 20	≥ 5

Scenario 6:

- Boundaries: Cradle through Product Use
- The product is long-lived and stores 20% of its carbon (5 units) for at least 100 years, allowing the 5 units to be considered a net removal of carbon from the atmosphere.
- End-of-life management is not known.
- Wood is from sustainably managed forest and the company knows that forest grown exceeds harvest by 3 units of carbon per 100 units of carbon in the harvest.
- The harvest attributable to product contains 100 units of carbon. The product contains 25 units of carbon. The rest of the carbon is contained in fuels used in manufacturing.

Changes in Biomass Carbon Stocks (plus sign indicates growth of carbon stocks)			Net Sequestra-tion
Forest	Products In-Use	Products End-of-Life	
3	5	≥ 0	≥ 8

Flows of Biomass Carbon (plus sign indicates flow to the atmosphere)			Net Sequestra-tion
Forests	Manufactur-ing	End-of-Life	
-103	75	≤ 20	≥ 8

Characterizing the carbon benefits of maintaining land in forest to supply the industry with wood for products.

Another important impact of the forest products industry on the global carbon cycle is its role in keeping land in forest. When forests are converted to other types of land use, large amounts of carbon are usually transferred to the atmosphere. A way of highlighting the important carbon benefits attributable to the maintenance of forested land to supply the industry with wood is to show the amount of forest carbon that must be maintained in the forest to keep a supply of wood for products.

For example, one can calculate the average carbon stocks per hectare over a rotation in a forest used to provide wood to manufacture a product of interest. By dividing the average carbon per hectare by the quantity or number of products produced from wood from that area over a rotation, you can calculate the carbon in the forest that must be maintined to produce a single product (or unit quantity of product) on a sustainable basis. While this is not information that can be used in a balance sheet, it can be useful as a communication tool to help customers and stakeholders understand a difficult to communicate, but important impact of the industry on the global carbon cycle.

Appendix G. Relationship with the Paper Profile

- Text still to be made with the PP Management -

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Appendix H: Sources of information and data for carbon footprints

Sources of information and data	System boundaries	Allocation rules	Cut-off criteria	Organizing to reflect control	Footprint comparisons	Emissions calculation methods	Sequestration calculation methods	Sources of data
IPCC Guidelines for National Greenhouse Gas Inventories:2006						X	X	X
EU Emissions Trading Scheme Documents				X		X		X
WRI/WBCSD GHG Protocol – Corporate Accounting Standard Revised 2004	X		X	X				
WRI/WBCSD GHG Protocol - Calculation Tools for Greenhouse Gas Emissions from Pulp and Paper Mills (2005) and Wood Products Facilities (2005)	X		X	X		X		X
U.S. Department of Energy Guidelines for Voluntary Reporting under the 1605b Program (2007)			X			X	X	X
ISO 14040:2006 and ISO 14044:2006 on Lifecycle assessment	X	X	X		X			
ISO 14064:2006 on greenhouse gas accounting	X		X	X				
ISO 14025:2000 on Type III environmental declarations	X				X			
ISO/TR 14047 - Examples of the mandatory elements of LCIA: Example 3 — Impacts of greenhouse gas (GHG) emissions and carbon sinks on forestry activities	X						X	
Miner (2005), "The 100-Year method for forecasting carbon sequestration in products in use", in Mitigation and Adaptation Strategies for Global Change published on-line May 22, 2006							X	X
The UK Carbon Trust Carbon Footprint Measurement Methodology, 15 March 2007	X	X	X	X		X		
Determination of the Impact of Waste Management Activities on Greenhouse Gas Emissions: 2005 Update" prepared for Environment Canada and Natural Resources Canada,						X	X	X
The "Waste Reduction Model" or "WARM" developed by the US Environmental Protection Agency						X	X	X
FEFCO 2006, "European Database for Corrugated Board Life Cycle Studies"	X	X		X		X		X
NCASI 2005, "Tools for estimating carbon stored in products in use,"							X	X
NCASI 2003, "Characterizing carbon sequestration in forest products along the value chain."							X	X
EPER/EPRTR (emissions from installations) www.eper.cec.eu.int/eper								X
CEPI and other trade associations								X
Switzerland- BUWAL 132, 250-300 and ETH-ESU lifecycle database								X
Germany UBA lifehycle database								X
IVAM and now the European LCA Platform								X
LCA Consultants: KCL, Chalmers, PE-Europe, Ecoinvent, Ecobilan	X	X	X	X	X	X	X	X
UNEP/SETAC Life Cycle Initiative								X
European Commission European Reference Life Cycle Data System								X
FEFCO, GEO and ECO LCA gate-to-gate database for corrugated		X						X
CEPI Eurokraft and EUROSAC on kraft paper and paper sacks report LCI data (cradle-to-gate) for the production of sack paper and for the production of paper sacks.								X
ETS on tissue, and ACE, Pro Carton and PaperPlus are developing their databases on beverage cartons, cartonboard and speciality paper respectively.								X
KCL EcoData is a database for forest industry specific eco-balance calculations and life-cycle assessment studies								X
Ecoinvent Life Cycle Inventory Data								X
National LCI Databases - Denmark: EDIP - Germany : ProBas, German Network of Life Cycle Inventory Data - Netherlands : IVAM (UVA), IDEMAT (TU Delft) - Sweden: SPINE, CPM								X
EPD Guidelines at http://www.environdec.com	X	X	X		X			

Available environmental data(bases) for the Euorpean paper industry

Environmental databases have, in most cases, been developed in isolation resulting in databases that are not completely comparable in terms of system boundaries and general assumptions. Within the paper and board industry several databases already exist and new are to be established.

"Total" data European

EPER/EPRTR (total emissions from installations above thresholds, year 2004)

- The authorities have addressed this issue: The European Pollutant Emission Register (EPER) requires installations covered by the IPPC Directive to report on their total emissions (if they are above a certain threshold amount), which is then openly available in the internet www.eper.cec.eu.int/eper covering practically all pulp, paper and board mills but not converting plants. The data are collected by the Member States from the installations. Presently there are data for 2004. These data can not be used when specific data are required because the mills only have too report when they have more emissions than a certain threshold value and production volume is not reported.

Associations

- CEPI environment database covers **total** production-related environmental data on pulp and paper production. This means that nothing can be said about the emission related to manufacturing of different products. These data are collected each year.
- CEPI and other paper Associations report **recycling rates** (European declaration on Paper Recycling).

LCA Databases/datasets

There is a comprehensive list on the website of the European Commission website, http://lca.jrc.ec.europa.eu/lcainfohub/directory.vm in the LCA Resources Directory. This directory contains metadata information about life cycle thinking related services, tools and databases and the corresponding developers and vendors.

LCA is a tool to quantify the environmental impacts of a product throughout its life cycle including raw material extraction.
Since the late 1980's databases with several datasets for basic materials (starting point was packaging and a little bit later buildings) and other "background data" (energy, transport, waste treatment) have been created by

- Governments/Institutes: e.g. Switzerland- BUWAL 132, 250-300 and ETH-ESU data, Germany UBA Database, IVAM and now the European LCA Platform
- Consultants/LCA software providers: KCL, Chalmers, PE-Europe, Ecoinvent, Ecobilan

These databases include data on several grades of pulp and paper, recovery routes and waste treatments (landfill and incineration of paper products, paper collection and sorting).
Some are free of charge, but the most up-to-date databases are commercialized: they come as part of the LCA software or a license is needed to get access.

The databases include (or refer to) datasets developed by Industry Associations. The datasets published by e.g. FEFCO-GO-ECO, Plastics Europe, IISI, EAA are well known and cited. These

databases represent “European average” datasets. But they may also contain data that were collected for a specific purpose.
When updates or new databases are developed, they may use data from “old” databases (which then seem “new”), or only update certain aspects of the data (e.g. recent electricity mix).

The problem is that for a user, it is often difficult to assess if the details and the quality of the datasets:
- time-related coverage
- geographical coverage
- technology coverage
- precision (variability)
- consistency (uniform methodology)
- reproducibility (transparency)
- completeness (participation)
- representativeness.

If no data are found that fit the products under study, a user may look to find data that he thinks are representative, e.g. assuming the technology is the same or he may try to collect data he needs directly from producers, but this is a time consuming and costly affair.

UNEP/SETAC Life Cycle Initiative has prepared a summary report on Global LCI sources in 2006. According to this report there are many university-based and consultancy based databases which characterize particular industrial sectors and product groups in Europe. These are generally very diverse and fragmented, with a poor level of harmonisation, due to many countries and many actors involved. Countries such as Germany or Switzerland have been active in LCI development for a number of years.

European Commission European Reference Life Cycle Data System (ELCD)
The European Commission’s Integrated Product Policy (IPP) Communication of 2003 identified the remaining need to further promote Life Cycle Thinking through improved credibility, hence acceptance, of the associated tool Life Cycle Assessment (LCA). While LCA should be understood as one tool in a wider tool-box of complementary methods, it is considered by the Commission the best available tool for the assessment of the environmental impacts related to products (goods and services). Responding to this need, the Commission launched the European Platform on LCA (EPLCA) in 2005. This project is co-ordinated and implemented directly by the Commission services DG Joint Research Centre, IES in collaboration with DG Environment, involving a number of further Directorates and reporting to Member States.

This project will deliver, in 2008, the European Reference Life Cycle Data System (ELCD). The first version of the ELCD database is already available at http://lca.jrc.ec.europa.eu. The reference database ELCD will support LCA work by housing and promoting high quality reference Life Cycle Inventory data from industry for core materials, energy carriers, transport and waste treatment services. These reference inventory data sets will be complemented with application-oriented, recommended impact assessment factors for calculating life cycle sustainability indicators, building on existing achievements and on-going activities. The European Platform on LCA is also developing a series of technical guidelines on LCA method and review, aiming at best-attainable consensus. All deliverables will consider the needs of the various life cycle based policies and applications, aiming at providing a solid basis for harmonised LCA work, realising synergies and avoiding conflicting methods, data, and reporting needs.

The deliverables of the European Platform on LCA are developed considering the needs and advice of industry via the project's European Business Advisory Group of front-running industry associations.

The work is supported by the know-how of the LCA Tool and Database Developers Advisory Group and the Life Cycle Impact Assessment Method Developers Advisory Group (see http://lca.jrc.ec.europa.eu/EPLCA/stakeholder.htm). Recognising the global dimension of a product's life cycle, including the need for improved inter-comparison of data provided globally, these developments are further supported through agreements with National LCA projects and links to various communities, such as to the UNEP/SETAC Life Cycle Initiative.

<u>Datasets from/for the paper industry</u>

- **FEFCO, GEO and ECO** have a well-established **LCA gate-to-gate** database on corrugated board and base paper production. This database is updated every three years. Last update contains data for 2004. The data should only be used for Life Cycle studies and recommends a closed-loop approach for dealing with recycling.

- **CEPI Eurokraft and EUROSAC** on kraft paper and paper sacks report LCI data (cradle-to-gate) for the production of sack paper and for the production of paper sacks. The data were updated in 2005. The objective of the study is to present updated European average LCI data for kraft sack paper, cradle-to-gate, from the forest to the gate (finished sack paper) at the paper mills. The study is partly an update of a previous life cycle assessment (LCA) study (Rydberg et al, 2000). The report (and an analogous report for paper sacks) is available for members of CEPI Eurokraft and Eurosac and their business networks. The data in this report should only be used for LCI/LCA purposes, or similar environmental studies.

- **Pre' Consultants database**

- **ETS** on tissue, and **ACE, Pro Carton and PaperPlus** are developing their databases on beverage cartons, cartonboard and speciality paper respectively.

  KCL EcoData is a database for forest industry specific eco-balance calculations and life-cycle assessment studies. KCL EcoData has been created at the beginning of the 1990's for the needs of the Finnish forest industry. The database covers the data for pulp, paper and board products' value chain. At the moment the public database contains over 200 data modules, which are divided into the following groups: forest **grow**th and harvesting, transport, pulp, paper and board production, deinking, chemicals, energy generation, plastics, waste management, and printing. Each group contains several different unit processes, called modules. The data has been gathered as a project work in KCL projects and it is updated continuously in a similar way. The datasets can be purchased.

- **Ecoinvent Life Cycle Inventory Data** (version 1,2, September 2006)
  The Swiss Centre for Life Cycle Inventories has combined and extended different LCI databases. The goal of the project was to provide a set of unified and generic LCI data of high quality. The data are mainly investigated for Swiss and Western European conditions. The data can be seen at process module level and LCI level (system). Allocation for by-products from pulp and paper production was not made and the by-products are not mentioned (e.g. energy, tall oil).

The ecoinvent data contains international industrial life cycle inventory data on energy supply, resource extraction, material supply, chemicals, metals, agriculture, waste management services, and transport services. It contains the following paper data:

- Market pulp: sulphate (ECF, TCF, unbleached), sulphite (CTMP, TMP, SGW)
- Graphical paper: newsprint, (fresh fibre, recycling), LWC, SC, wood free (coated, uncoated)
- Packaging paper (bleached, unbleached)
- Corrugated board: base paper (SCF, KL, TL, WS), board (single, double wall/fresh fibre, mixed, recycling)
- Cartonboard: folding box board, white lined chipboard, solid bleached board, solid unbleached board.

Delivery data are included based on information provided by CEPI. The FEFCO data from 2000 are used for corrugated board and base paper production. The data for several other pulp and paper grades, based on datasets provided by KCL 2002 and sometimes including information from some European production sites (either direct or Company environmental reports), IPPC BREF pulp and paper 2000, Swiss studies and/or National EA (Sweden, Germany).

The ecoinvent data is sold in more than 40 countries worldwide and is included in the leading LCA software tools as well as in eco-design tools for building and construction.
The ecoinvent data is used for data needs in Integrated Product Policy (IPP), Environmental Product Declaration (EPD), Life Cycle Assessment (LCA), Life Cycle Management (LCM), Design for Environment (DfE). The data will be updated in 2007.

- **Skogforsk data on emissions from forestry operations and other lifecycle data**

- **Other databases in LCA software.**
  Most LCA software have paper datasets that come with the software. These data are from BUWAL 250/300 (Swiss Bundesamt für Umwelt, Wald und Landschaft) report from 1996, but based on data from BUWAL 132, 1991. with data for paper production dating back to 1990. These data can be found in the following LCA softwares: Gabi, LCAiT, Simapro, Team. Simapro also contains Franklin (US) and Idemat (Netherlands) databases. Softwares have user groups, where people can ask other users for information about certain data they need for a study.

- **National LCI Databases**
  Denmark: EDIP
  Germany : ProBas, German Network of Life Cycle Inventory Data (includes a building working group)
  Netherlands : IVAM (UVA), IDEMAT (TU Delft)
  Sweden: SPINE, CPM

- **Other data sources**
  Data are collected for LCA studies and sometimes later used in other databases. The source of these data can be collected directly from industry or based on Company environmental reports, Association statistics, legislation and/or literature.
  Some companies give environmental information by using Paper Profile, an environmental product declaration designed for paper and board.

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Appendix I: Calculation approaches for the Ten Toes of the Carbon Footprint of Forest Products

Toe 1 – Characterizing biomass carbon in forests

Introduction

Toe 1 provides information on the importance of forest carbon. Forests sequester carbon while providing raw materials for industry, important environmental services and employment. The industry's use of wood fiber provides an incentive to keep land in forest. Biomass carbon sequestration and storage are attributes that are missing from the value chains of most other industries, but are central features of the value chain of the forest products industry. While forests are critical to the environmental attributes of paper products, it is often difficult to determine the precise effect of an individual product on forest carbon. Therefore, Toe 1 allows companies to use various types of information, ranging from quantitative to descriptive.

Toe 1 does NOT include;

- Emissions associated with harvesting or forest management (included in Toe 4)

Some Toe 1 emissions and sequestration may be under the control of the company while some will not be.

The ability to include Toe 1 emissions and sequestration in balance sheets will depend on (a) the system boundaries used in the footprint, and (b) whether the fate of carbon within those boundaries can be characterized accurately enough to meet the intended use of the footprint. These considerations are discussed in more detail below.

Calculation steps

At a minimum, a footprint should explain how a company's forest management practices and wood procurement practices are helping to ensure that the product is not causing forest carbon stocks to be depleted. Where companies are interested in making quantitative estimates, the calculations can be done as follows (Described in more detail in Appendix F.)

1. Identify biomass carbon within system boundaries.
2. Select a method to characterize the effect of the product (per functional unit) on biomass carbon within system boundaries. These are a number of methods that can be used to perform these analyses. These often rely on a forest inventory data and models. Some of the methods yield estimates that are suitable for use in balance sheets while others do not. Considering the intended use of the footprint and the system boundary conditions, estimate the effects of the product on biomass carbon stocks (or on net transfers of biomass carbon to the atmosphere).
   – In many cases, the "estimates" will involve only explaining how a company's forest management practices are helping to ensure that the product is not causing forest carbon stocks to be depleted and no claim will be made regarding the rate of accumulation of carbon in the forest or the significance of the CO_2 uptake accomplished by the forest.
3. If needed to satisfy the objectives of the footprint, divide the emissions and sequestration in to two categories based on control.
4. Record the greenhouse gas emissions attributable to the functional unit of the product in the appropriate reporting form.

– In some cases, this may be limited to (a) an entry showing “zero” impact in the forest based on sustainable forest management, and (b) information on the role of sustainable forest management practices that justifies an assumption of zero impact. ▪ In other cases, the results may show the growth in the amount of carbon sequestered in the forest per unit of product, if it is calculated by a method that the company can explain and support. See Appendix F for a discussion of approaches for integrating Toes 1 and 2 and information on biomass CO_2 emissions to present a picture of net sequestration along the value chain that can be netted against fossil fuel CO_2 emissions in a balance sheet.
Special Companies often obtain fibre from a number of sources, many of which they do not own or control. While companies may be able to influence landowners to use sustainable forest management practices, they will often not be able to convince these landowners to spend the money needed to quantify carbon stocks over time. Allocating forest carbon stock changes to individual products is very difficult and the allocation is often arbitrary, even when the company owns the land supplying fibre for the product.
Sources of data and emission factors IPCC’s 2006 Revised Guidelines for National Greenhouse Gas Inventories USDOE 1605b Guidelines for Reporting Voluntary Reductions in Greenhouse Gas Emissions Guidelines issued by other government agencies NCASI 2005, “Tools for estimating carbon stored in products in use,” NCASI 2006, “The 100-year method for forecasting carbon stored in forest products in use” NCASI 2003, “Characterizing carbon sequestration in forest products along the value chain.” Lifecycle databases

Toe 2 – Characterizing the significance of carbon in products

Introduction

Toe 2 includes information on the importance of the carbon in forest products to the footprint of the forest products value chain. Although not widely understood, the largest carbon impacts from sustainably managed forests are usually not due activities in the forest, because forest carbon stocks in these forests remain relatively stable. More important are effects related to (a) carbon stored in products (in this Toe), and (b) avoided emissions related to substitution of many forest products for more greenhouse gas intensive alternatives (discussed in Toe 10).

Toe 2 does NOT include;

- Effects on carbon sequestration in the forest
- Emissions from stocks of carbon in products during use (Toe 8) or at end-of-life (Toe 9).

Calculation steps

1. Methods for characterizing the fate of biomass carbon in products have been developed by IPCC for use in national greenhouse gas inventories. These methods are not well suited, however, to corporate inventories, lifecycle studies or carbon footprints. Alternative approaches have been developed for corporate carbon accounting and lifecycle assessment that involve modeling the fate of the carbon in products over time.

- One option is to consider aperiod of time long enough to ensure that that all degradable biomass carbon returns to the atmosphere. In this case, there is no carbon sequestration in the value chain. While this option is simple, it does not give a very accurate picture of the effects of carbon in products over more reasonable lengths of time (except for short-lived products that are recycled or disposed of at end-of-life by burning for energy).
- A second option is to assume that over long time periods, all of the carbon in products returns to the atmosphere except for the in carbon in landfilled products that is non-degradable under anaerobic conditions.
- A third option is to estimate the amount of carbon that remains sequestered in products for a long enough period of time to be important to the atmosphere. A 100-year period has been used in several instances. See, for instance, ISO/TR 14047:2003 – Example 3, the US Department of Energy 1605b Guidelines for Reporting Voluntary Reductions in Greenhouse Gas Emissions, and "The 100-year method for forecasting carbon stored in forest products in use" in Mitigation and Adaptation Strategies for Global Change, published on-line 20 May 2006.

2. All of these options require that the products that enter commerce be modeled to estimate their time in use. At the end of the time-in-use, the products are discarded and then modeled using appropriate end-of-life models. The discard rates used to estimate changes in carbon stocks associated with products in use should be the same as used to estimate inputs to the end-of-life calculations (both carbon stored in landfills and releases from landfills of CH_4). The decay rates used to determine carbon storage in landfills should be the same as used to estimate the releases of CH_4 from landfills.

- Although biomass carbon is critical to the carbon footprint of the forest products industry, the lifecycle estimates for biomass carbon are inherently uncertain, especially for the post-use phase. This is because;

- The product manufacturer has no control over, or special knowledge of, when and where a product will be discarded.
- The conditions of use and disposal are extremely important to the results yet these are highly site specific.
- Estimating the fate of the carbon while the product is in use can be done with more accuracy because the time period is shorter, the location of use may be more accurately known than the point of discard, and the use of the product is generally more predictable since it is dictated by the product design (something controlled by the manufacturer).

3. There are several types of product carbon information that can be entered into a carbon footprint.

- At a minimum, a company should show the amount of carbon in the product as it enters commerce. This is useful information for stakeholders and provides a starting point for considering the role of carbon in products. This should not be netted against emissions, however, since without additional analysis, one does not know how much of this carbon will return to the atmosphere relatively quickly.
- If the system boundaries extend through the product-in-use phase and if it is consistent with the intended use of the footprint, the company may model the amount of carbon expected to remain in the products in long-term storage (100 years is recommended) and may be able to report this as a net removal against emissions.
- If the system boundaries extend through the end-of-life phase (e.g. if the footprint includes CH_4 from landfills), and if it is consistent with the intended use of the footprint, the amount of product carbon expected to remain in long term storage in the landfill may also be calculated and netted against emissions. Again, a 100-year period is recommended. The calculations should be performed so as to avoid double counting of carbon in the product-in-use and end-of-life phases.
- See Appendix F for information on how to integrate the assessments of forest carbon, product carbon and biomass CO_2 emissions to develop an estimate of net sequestration that can be used in balance sheets to offset fossil fuel emissions.

Special: Comparing national accounting and corporate accounting

IPCC has issued methods for nations to use in accounting for carbon in harvested wood products in use and in landfills. These methods require that the nation reconstruct a historical record of forest products production, consumption and disposal of all products back to 1900. The calculations are performed based on estimated year-to-year changes in the accumulated stocks, considering new additions to stocks and retirement and disposal of old products. This dynamic calculation is extended back to 1900 because during the early years of the calculations, there are no old products in the calculations, so the changes in stock consist only of additions of new production. This “start up effect” results in unrealistically high growth in stocks during the early years of the calculations, until enough old products are in the calculations that the amounts coming out of use help to balance the amounts going into use in new production.

This approach is not suited to corporate- or product-level accounting because companies cannot reconstruct inventories back to 1900. In addition, for product-level footprints, it is only the fate of the new product that is important whereas the national inventory calculation method is greatly affected by products that were put into use many years ago.

The 100-year method was developed to allow companies to characterize the amounts of carbon in products likely to remain in long-term storage, representing removals of carbon from the atmosphere. It is suitable for use in carbon footprints. If it is used, however, a consistent approach should be used for estimating end-of-life carbon sequestration and CH_4 emissions associated with products in landfills.
Sources of data and emission factors – IPCC's 2006 Revised Guidelines for National Greenhouse Gas Inventories – USDOE 1605b Guidelines for Reporting Voluntary Reductions in Greenhouse Gas Emissions – ISO/TR 14047:2003 – Example 3 – NCASI 2005, "Tools for estimating carbon stored in products in use," – NCASI 2006 "The 100-year method for forecasting carbon stored in forest products in use" – NCASI 2003, "Characterizing carbon sequestration in forest products along the value chain."

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Toe 3 - Calculating greenhouse gas emissions from forest product manufacturing facilities

Introduction

- Toe 3 includes CO_2 emissions from fossil fuel combustion at manufacturing facilities that make forest products, both primary manufacturers (e.g. paper mills) and final manufacturing or converting facilities (e.g. box plants). This includes all facilities involved in converting wood fibre or recovered fibre into final products regardless of who owns them. Chipping of wood is included in this toe whether it is done at a mill or off-site.
- Toe 3 does NOT include;
  - CO_2 emissions from burning biomass (included as additional information and may be used in characterizing biomass carbon sequestration along the value chain as described in Appendix F)
  - Emissions associated with chemicals, additives and other non-wood fibre raw materials (included in Toe 5)
  - Emissions associated with purchased electricity, steam or heat (included in Toe 6)
  - Emissions associated with growing and harvesting wood and processing recovered fibre (included in Toe 4).
  - Emissions associated with transporting wood,recovered fibre or other raw materials or wastes (included in Toe 7)
- Depending on the intended use of the footprint, it may be necessary to divide these emissions according to whether the company preparing the footprint has control over them.
- Toe 3 emissions can usually be included in a greenhouse gas balance sheet.

Calculation steps

1. Determine products and co-products
2. Determine the functional unit(s) for reporting.
3. Estimate emissions from manufacturing facilities within the system boundaries of the footprint.
4. If needed to satisfy the objectives of the footprint, divide the emissions in to categories reflecting the degree of company control
5. Allocate greenhouse gas emissions to products and co-products as determined in step 1. Allocation should be made according to ISO 14044:2006.
6. Record the greenhouse gas emissions attributable to the product being studied in the appropriate reporting form.

Special: Table from: WRI/WBCSD Calculation tools for estimating greenhouse gas emissions from pulp and paper mills.

Table 1. Emission Factor Ranges Useful in Identifying Significant and Insignificant Sources of GHGs

	Units	Fossil-CO_2	CH_4 (CO_2-equiv.)*	N_2O (CO_2-equiv.)*	Tables in Report Containing Default Values
Natural gas used in boilers	kg CO_2-equiv./TJ	56,100 – 57,000	13 – 357	31 – 620	2, 4, 5
Residual oil used in boilers	kg CO_2-equiv./TJ	76,200 – 78,000	13 – 63	93 – 1550	2, 4, 5
Coal used in boilers	kg CO_2-equiv./TJ	92,900 – 126,000	15 – 294	155 – 29,800[⊕]	2, 4, 5
Bark and wood waste fuel	kg CO_2.equiv./TJ	0	<21 – 860	<310 – 8060	8
Black liquor	kg CO_2-equiv./TJ	0	42 – 630	1550	8
Lime kilns	kg CO_2-equiv./TJ	depends on fuel	21 – 57	0[ψ]	2, 6
Lime calciners	kg CO_2-equiv./TJ	depends on fuel	21 – 57	1550[λ]	2, 6
Pulp mill make-up $CaCO_3$	kg CO_2/t $CaCO_3$	440	0	0	7
Pulp mill make-up Na_2CO_3	kg CO_2/t Na_2CO_3	415	0	0	7
Diesel fuel used in vehicles	kg CO_2-equiv./TJ	74,000 – 75,300	82 – 231	620 – 9770	2, 9
Gasoline in non-road mobile sources and machinery – 4-stroke engines	kg CO_2-equiv./TJ	69,300 – 75,300	84 – 30,900	93 – 2580	2, 9
Gasoline in non-road mobile sources and machinery – 2-stroke engines	kg CO_2-equiv./TJ	69,300 – 75,300	9,860 – 162,000	124 – 861	2, 9
Anaerobic wastewater treatment	kg CO_2-equiv./kg COD treated	0	5.25[η]	0	Eqs. 6, 7
Mill solid waste landfills	kg CO_2-equiv./dry ton solid waste	0	3,500[∞]	0	Eqs. 1,3,5; Table 10

* CO_2-equivalents are calculated from IPCC Global Warming Potentials (CH_4 = 21, N_2O = 310).
[⊕] Reported N_2O emission factors greater than 1500 kg CO_2-equiv../TJ are generally limited to fluidized bed boilers.
[ψ] IPCC information suggests N_2O is not likely to be formed in lime kilns in significant amounts.
[λ] Amounts of N_2O, if any, formed in calciners are not known, so the largest factor for fuels normally used in kilns is shown here.
[η] Assumes no capture of gas from the treatment plant.
[∞] Assumes that 50% of landfilled waste is degradable organic carbon, 50% of the degradable organic carbon degrades to gas, 50% of the carbon in the gas is contained in methane, none of the methane is oxidized in the landfill cover or captured, and all is released in the same year that the waste is landfilled. This method is used here only to generate an emission factor for considering whether to include this source in the inventory. More refined methods, which will normally yield lower estimates of emissions, are explained in the calculation tools.

Sources of data and emission factors

- IPCC's 2006 Revised Guidelines for National Greenhouse Gas Inventories
- The Calculation Tools for Pulp/Paper Mills and Wood Products Facilities issued under the WRI/WBCSD GHG Protocol
- Guidelines issued under the EU Emissions Trading Scheme
- Guidelines issued by other government agencies
- Trade associations
- Lifecycle databases

Toe 4 - Calculating greenhouse gas emissions associated with producing and processing fibre (virgin and recovered) for forest product manufacturing facilities

Introduction

- Toe 4 includes greenhouse gas emissions generated in producing wood fibre and recovered fibre. For virgin fibre, this includes forest management and harvesting. For recovered fibre, it includes processing recovered fibre.
- The greenhouse gas emissions associated with producing usable wood fibre from forests or discarded products are usually small compared to emissions associated with manufacturing, purchased electricity and transport emissions. In many cases, therefore, it will be possible to exclude these emissions from the system boundaries or estimate them using generic emission factors rather than detailed company-specific information.
- Toe 4 does NOT include;
    - CO_2 emissions from burning biomass (included as additional information and may be used in characterizing biomass carbon sequestration along the value chain as discussed in Appendix F.)
    - Emissions associated with manufacturing or processing purchased pulp, chips or recovered fibre at the mill (included in Toe 3).
    - Emissions associated with transporting wood or recovered fibre or other raw materials (included in Toe 7)
- The emissions in Toe 4 will often be outside of the control of the manufacturer of the product described in the footprint, especially those involving the processing of mixed waste to produce recovered fibre.
- Toe 4 emissions can usually be included in balances sheets unless the balance sheet includes only emissions within the company's control.

Calculation steps

1. Identify sources of emissions. Use cut-off criteria and knowledge from other studies to decide which sources to include. Some of the sources to consider are;
    - Emissions of N_2O associated with fertilizer use in forests
    - Emissions associated with harvesting equipment.
    - Emissions associated with processing recovered fibre.
2. Estimate emissions associated with the selected sources.
3. If needed to satisfy the objectives of the footprint, divide the emissions into categories reflecting the degree of company control
4. Record the greenhouse gas emissions attributable to the functional unit of the product being studied in the appropriate reporting form.

Special

In some cases, there may be emissions that are related to how the forest is managed, and how the forest/land area has been changed by the forestry. For instance, draining land to convert it into managed forest can affect CH_4 emissions. The decision on whether to include such emissions needs to consider the system boundaries, cutoff criteria and the intended use of the footprint.

Sources of data and emission factors

- IPCC's 2006 Revised Guidelines for National Greenhouse Gas Inventories
- Calculation Tools for various industries issued under the WRI/WBCSD GHG Protocol
- Guidelines issued under the EU Emissions Trading Scheme
- Guidelines issued by other government agencies
- Trade associations
- Environmental declarations from suppliers
- Lifecycle databases

Toe 5 - Calculating Greenhouse gas emissions associated with producing other raw materials and fuels

Introduction

Toe 5 includes greenhouse gas emissions generated during the manufacturing of fuels and non-wood-based raw materials (e.g. chemicals and additives) used in manufacturing forest products. Toe 5 emissions are usually much smaller than emissions from manufacturing, purchased electricity and transport. In many cases, therefore, it may be possible to exclude these from the system boundaries. This also suggests that there is little need to include greenhouse gases other than CO_2 from fossil fuel combustion. If Toe 5 emissions are included, cut-off criteria will be essential in deciding how many inputs to include in the analysis. Past lifecycle and footprint studies may be helpful.

Toe 5 does NOT include;

- CO_2 from burning biomass (included as additional information and may be used to characterize biomass carbon sequestration along the value chain as discussed in Appendix F)
- Emissions associated with manufacturing or processing purchased pulp, chips or recovered fibre (included in Toe 3).
- Emissions associated with purchased electricity, steam or heat (included in Toe 6)
- Emissions associated with growing and harvesting wood or processing mixed waste to produce recovered fibre (included in Toe 4).
- Emissions associated with transporting wood, recovered fibre or other raw materials to a manufacturing facility (included in Toe 7)

The emissions in Toe 5 will normally be outside of the control of the manufacturer of the product described in the footprint.

Toe 5 emissions can usually be included in balances sheets unless the balance sheet includes only emissions within the company's control.

Calculation steps

1. Use cut-off criteria and knowledge from other studies to decide which inputs to include. Some of the inputs to consider are starch, sodium chlorate, purchased oxygen and ozone, caustic, acids, calcium carbonate, titanium dioxide, and clays.
2. Estimate emissions associated with the selected inputs.
   - These will usually include the supplier's direct emissions and its indirect emissions associated with the purchased or electricity and steam.
   - Although not normally required, if necessary, estimate CH_4, N_2O and miscellaneous sources of emissions.
   - Toe 5 can include emissions associated with the production of fuels used at the mill (other than wood-based fuels which are addressed in Toe 4). The decision on whether to include these will depend on the cut-off criteria and the system boundaries.
3. If needed to satisfy the objectives of the footprint, divide the emissions into categories based on controlRecord the greenhouse gas emissions attributable to the functional unit of the product being studied in the appropriate reporting form.

Special

Sources of data and emission factors

In most cases, these inputs are not produced by the company developing the footprint. It may be possible to obtain the needed information (e.g. fuel types and consumption) from the companies selling the materials. In many other cases, however, it will be necessary to use generic information describing emissions associated with manufacturing these inputs. These may be available from the following sources.

- Calculation Tools for various industries issued under the WRI/WBCSD GHG Protocol
- Guidelines issued under the EU Emissions Trading Scheme
- Guidelines issued by other government agencies
- Trade associations
- Environmental declarations from suppliers
- Lifecycle databases

Toe 6 - Calculating Greenhouse gas emissions associated with purchased and sold electricity, steam, heat and hot and cold water.

Introduction

Toe 6 includes CO_2 emissions associated with purchased or sold electricity, steam ,heat and heated/chilled water used at facilities that manufacture forest products, including chip mills, pulp mills, paper and paperboard mills and final manufacturing facilities (e.g. box plants).

Toe 6 does NOT include;

- CO_2 from burning biomass (included as additional information and may be useful in characaterizing carbon sequestration along the value chain as discussed in Appendix F.)
- Emissions from forest product manufacturing facilities, including those associated with electricity and steam generation at the mill (included in Toe 3).
- Emissions from facilities manufacturing raw materials or fuels (included in Toes 4 and 5)
- Emissions associated with purchases of electricity, steam or heat by facilities manufacturing raw materials (included in Toes 4 and 5)
- Emissions associated with growing and harvesting wood and with processing recovered paper (included in Toe 4).
- Emissions associated transporting wood or recovered fibre or other raw materials to a manufacturing facility (included in Toe 7)

The emissions in Toe 6 will normally be outside of the control of the manufacturer of the product described in the footprint. Toe 6 emissions can usually be included in balances sheets unless the balance sheet includes only emissions within the company's control.

Calculation steps

1. Use cut-off criteria and knowledge from other studies to decide which purchases of electricity, steam or heat to include.
2. Determine sources and quantities of purchased electricity, steam and heat. Adjust them to account for any allocations that were made to these as products or co-products in Toe 3. See the discussion below for more information on options for adjusting the footprint to address sales of electricity, steam or heat.
3. Estimate emissions associated with the selected purchases.
4. If needed to satisfy the objectives of the footprint, divide the emissions into categories reflecting control.
5. Record the greenhouse gas emissions attributable to the functional unit of the product being studied in the appropriate reporting form.

Special: Adjusting for sales of electricity, steam or heat There are three methods for adjusting carbon footprints to account for sales of electricity, steam or heat. – The first approach is to identify electricity, steam or heat sales as products or co-products and allocate emissions to them under Toe 3. When handled this way, it is important not to deduct these sales from purchased electricity or steam in Toe 6 and not to claim avoided emissions in Toe 10. This may be more involved than is necessary if the amounts sold are small. – In some cases, it may be appropriate to deduct electricity sales from purchases in Toe 6 and estimate emissions for net purchases instead of total purchases. In this case there are no allocations under Toe 3 and no avoided emissions under Toe 10. – In other circumstances it may be appropriate to estimate the avoided emissions associated with sales of electricity under Toe 10. In this case, no allocation is made under Toe 3 and Toe 6 is based on total purchases. – For footprints that are made available to the public, the company should be ready and willing to explain the basis for adjusting the footprint to account for sales of electricity, steam or heat.
Sources of data and emission factors – Information from the company from whom the electricity, steam or heat is purchased. – Information from electrical power producers – Guidelines issued under the EU Emissions Trading Scheme – Guidelines issued by other government agencies – Lifecycle databases

Toe 7 – Calculating transport-related greenhouse gas emissions

Introduction

Toe 7 includes greenhouse gas emissions associated transporting raw materials,products and wastes along the value chain. It includes emissions from transporting wood, recovered fibre, other raw materials, intermediate products, final products and used products as well as manufacturing residuals.

Toe 7 does NOT include;

- CO_2 emissions from burning biomass (included as additional information and may be used to characterize sequestration along the value chain as discussed in Appendix F.)
- Emissions associated with growing and harvesting wood and with processing mixed waste to produce recovered paper (included in Toe 4).

Many of the emissions in Toe 7, especially those related to transport of finished products, will be outside of the control of the manufacturer of the product described in the footprint.

Toe 7 emissions can usually be included in balances sheets unless the balance sheet includes only emissions within the company's control.

Calculation steps

1. Use system boundaries, cut-off criteria and knowledge from other studies to decide which types of transport to include in the analysis.
2. Estimate emissions associated with the selected aspects of transport.
3. If transport is used for multiple products, use appropriate allocation methods to identify that emissions associated with the product of interest.
4. If needed to satisfy the objectives of the footprint, divide the emissions into categories reflecting control.
5. Record the greenhouse gas emissions attributable to the functional unit of the product being studied in the appropriate reporting form.

Special

Sources of data and emission factors

- Information from the company providing transport services
- Company transport experts
- Lifecycle databases

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Toe 8 – Calculating emissions associated with product use

Introduction

Toe 8 includes emissions that occur when a product is used. These are very unusual for forest products.

Toe 8 does NOT include;

- Emissions of biomass-derived CO_2 (included as additional information and may be used to characterize biomass carbon sequestration along the value chain as discussed in Appendix F.)
- Emissions associated products made of wood or paper where the functional unit is different that the wood or paper product itself. For instance, houses can be made from wood and emissions occur during the use of a house, but the functional unit is not the wood, but the house. In other words, the wood does not emit greenhouse gases during use but the house does (or more precisely, the appliances in the house do).
- Transport-related emissions (included in Toe 7)
- Carbon storage while products are in use (included in Toe 2)

Toe 8 emissions can usually be included in balances, even though they are usually “zero” for forest products.

Calculation steps

1. Decide whether the forest product (and functional unit) described by the footprint releases greenhouse gases or causes greenhouse gases to be released during use.
2. Determine whether the product use phase is within the system boundaries. If system boundaries do not include products in use, these should be outside of system boundaries for calculations in all Toes of the footprint.
3. Determine products and co-products.
4. Estimate emissions during use.
   - These will depend on the functional unit and use of the product.
5. If needed to satisfy the objectives of the footprint, divide the emissions in to two categories; one consisting of emissions that the company controls and the second consisting of emissions that the company does not control.
6. Allocate greenhouse gas emissions to products and co-products as determined in step Allocation should be made according to ISO 14044:2006.
7. Record the greenhouse gas emissions attributable to the functional unit of the product being studied in the appropriate reporting form.

Special

Sources of data and emission factors

Dependent on the specific product

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Toe 9 – Calculating emissions associated with the end-of-life of forest products

Introduction

Toe 9 includes emissions that occur after a product is used. They consist primarily of CH_4 resulting from the anerobic decomposition of forest products in landfills, although burning used forest products for energy may result in the release of small amounts of CH_4 and N_2O.

Toe 9 does NOT include;

- Biomass-derived CO_2 emissions (include as additional information and may be used to characterize biomass carbon sequestration along the value chain as discussed in Appendix F.)
- Emissions associated with transporting used products or recovered fibre (included in Toe 7)
- Emissions associated with producing recovered fibre (included in Toe 4)
- Carbon storage associated with the end-of-use, landfills in particular (included in Toe 2).
- Avoided emissions associated with using discarded forest products, or substances derived from discarded forest products, as biomass fuels (included in Toe 10).

Toe 9 emissions are almost always outside of the control of the company that manufactured the product described in the footprint. Toe 9 emissions can be included in greenhouse gas balance sheets, although the estimates are usually subject to considerable uncertainty.

Calculation steps

1. Determine whether end-of-life emissions are within the system boundaries for the footprint.
   - Because these are almost always well outside of the company's control and because the estimates are so uncertain, it may be appropriate to place end-of-life emissions outside of the system boundaries. This will be determined, however, by the intended use of the footprint.
2. Determine the fate(s) of the product after use.
3. Select an approach for estimating emissions.
   - There are a variety of approaches for estimating end-of-life emissions, especially CH_4 emissions from landfills. Sources of information and important considerations in selecting an approach are discussed below.
4. Estimate emissions
   - For landfilling, the only emission of significance is CH_4. If used products are burned for energy, small amounts of CH_4 and N_2O may be formed.
5. If needed to satisfy the objectives of the footprint, divide the emissions into categories reflecting control.
6. Record the greenhouse gas emissions attributable to the functional unit of the product being studied in the appropriate reporting form.

Special: Calculating CH_4 attributed to forest products in landfills. The emissions of CH_4 from decomposing forest products in landfills depend on the amounts of material placed in the landfill, the type of material, the degradation rate and whether the landfill is designed to capture and burn CH_4. The method used to develop estimates of CH_4 from products in landfills should be consistent with the method used to characterize carbon stored in landfills. The methods are described in Toe 2 above. Calculation methods developed for national-level greenhouse gas accounting are not well suited to corporate- or product-level footprints. The parameter values used in the calculations should be appropriate for the region where the product is disposed.
Sources of data and emission factors – IPCC's 2006 Revised Guidelines for National Greenhouse Gas Inventories – The Calculation Tools for Pulp/Paper Mills and Wood Products Facilities issued under the WRI/WBCSD GHG Protocol – Guidelines issued under the EU Emissions Trading Scheme – Guidelines issued by other government agencies – Trade associations – Lifecycle databases

Toe 10 – Calculating avoided emissions

Introduction

Toe 10 includes emissions that do not occur (i.e. are avoided) because of an attribute of the product or an activity of the company making the product.

The credibility of avoided emissions is directly dependent on the scenario used to describe what would have happened in the absence of the product attribute or company activity. There are an almost infinite number of possible avoided emissions so it is not possible to offer specific guidance.

While avoided emissions can be very useful in illustrating important connections to the climate change issue, their use in balance sheets can be controversial. The decision on whether to allow avoided emissions to be netted against other emissions in a balance sheet is primarily a policy issue that will be decided differently in different situations.

Calculation steps

Although there are a large number of avoided emissions of potential interest to the forest products industry, several are mentioned here because they represent especially important connections between the forest products value chain and the global carbon cycle. The specific calculations, and whether the information is used in a balance sheet, need to be determined on a case-by-case basis. The attribution of avoided emissions to specific products is an additional problem that will need to be addressed if these are used in a footprint.

- When a mill exports electricity to the grid, it may displace electricity from the grid that would have been produced by more greenhouse gas-intensive methods. Thus, these emissions are avoided by the mill's activities. In producing this electricity, the mill's emissions may have increased even though, by displacing electricity on the grid, the mill may have caused lower emissions overall. Allowing avoided emissions to be netted against the mill's emissions may be the only way for the company to get "carbon footprint credit" for its generation of "cleaner" electricity. Calculation methods are generally related to those for estimating emissions associated with purchases of electricity.
- Several national authorities have developed information to assist in calculating the greenhouse gas emissions avoided by recycling paper. The avoided emissions are extremely dependent on local conditions and are especially significant in situations where the paper would have been landfilled if it was not recycled. Several tools for these calculations are identified in the table in Appendix H.
- Wood-based building products reduce lifecycle greenhouse gas emissions compared to most other building materials when the comparisons involve structures with comparable heating and cooling requirements. Therefore, the use of wood for construction can be said to avoid greenhouse gas emissions compared to a scenario whether more greenhouse gas-intensive materials are used. A large number of studies have examined the avoided emissions associated with substitution effects accomplished when you substitute wood-based building materials for more greenhouse-gas intensive ones.

- One of the most important contributions of the forest products industry, but one of the most difficult to quantify, is the role of the industry in providing economic incentives for keeping land in forest. Conversion of forest to other uses almost always results in large losses of carbon. Avoided emissions are sometimes estimated for avoided deforestation in the tropics, but seldom for land in the developed world, even though it is threatened by development, agriculture and other uses. Methods that have been used to examine avoided deforestation in the tropics may be useful in situations where companies want to examine the importance of the company's demand for wood on keeping land in forest, although these methods can be very complex. A simple approach may be to calculate the amount of carbon that must be maintained in sustainably managed forests to produce the functional unit of product on a sustainable basis.

Special

In some cases, it is possible to address avoided emissions via expanding system boundaries. ISO14040 may be relevant here. The methodology used here depends on the purpose; if used for external declarations, it is proposed to not in the first place include system expansions. If used for decision making, system expansion is recommended.

Sources of data and emission factors

Protocols developed for project-level carbon accounting may be useful in calculating avoided emissions. The protocols for projects under the Clean Development Mechanism, for instance may provide insights on possible approaches. Also, the WRI/WBCSD GHG Protocol for Project Accounting may be useful.

Appendix J: Contacts and sources of additional information

- Still to be finalised -

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Appendix K: Guidance on organizing emissions and sequestration information according to ownership and control.

In some footprints, the primary objective is to identfy opportunities for a company to make improvements. In these cases, it is important to understand the amount of control that the company has over the emissions and sequestration in the different toes of the footprint. Two useful sources of information on dividing emissions and sequestration according to ownership and control are the WRI/WBCSD GHG Protocol Corporate Accounting Standard and ISO 14064-1:2006.

The GHG Protocol Corporate Accounting Standard divides emissions into three categories, called Scopes. Scope 1 is for emissions from sources owned or controlled by the company preparing the inventory. Scope 2 is for emissions associated with electricity, steam or heat that is used by the company but where the emission sources are not owned or controlled by the company. Scope 3 is for other emissions that were caused by the activities of the company but were emitted from sources not owned or controlled by the company. Several approaches are described for determining corporate ownership or control, including an “equity share” approach and a “control” approach. Under the equity share approach, a company accounts for GHG emissions from operations according to its share of equity in the operation. Under the control approach, “a company accounts for 100 percent of the GHG emissions from operations over which it has control. It does not account for GHG emissions from operations in which it owns an interest but has no control. Control can be defined in either financial or operational terms. When using the control approach to consolidate GHG emissions, companies shall choose between either the operational control or financial control criteria.” More details on how to apply these tests of ownership and control are in the GHG Protocol. (WRI/WBCSD GHG Protocol Revised Corporate Accounting Standard).

ISO’s framework is similar, but instead of dividing the emissions into Scope 1, 2, and 3, the three categories are, respectively, (a) direct greenhouse gas emissions, (b) energy indirect greenhouse gas emissions, and (c) other indirect greenhouse gas emissions. ISO also uses the equity share and control approaches to establish ownership and control of emission sources. (ISO 14064-1:2006).

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Appendix L. Example approaches for reporting the results of a carbon footprint

Example 1. Stock change accounting of biomass carbon and emissions not divided according to control

The Ten Toes of the Carbon Footprint of Forest Products *		Emissions or sequestration (negative emissions) in CO_2 eq.
1. Change in forest carbon stocks (increase in stocks is a negative emission) ***		
2. Product carbon stocks or stock changes	2a. Carbon in product as it enters commerce	
	2b. Long-term carbon storage in product in use (increase in stocks is a negative emission) (Optional)	
	2c. Long-term carbon storage in product in landfills (increase in stocks is a negative emission) (Optional)	
Net sequestration of biomass carbon		Negative of (1 + 2b + 2c)
3. Greenhouse gas emissions from forest products manufacturing facilities **		
4. Greenhouse gas emissions associated with producing virgin or recovered fibre **		
5. Greenhouse gas emissions associated with producing other raw materials **		
6. Greenhouse gas emissions associated with purchased or sold electricity, steam or heat, or hot water **		
7. Transport-related greenhouse gas emissions ** (Optional for transport activities after final product is manufacturered)		
8. Greenhouse gas emissions attributable to product use (Optional)		
9. Greenhouse gas emissions attributable to end-of-life management of products** (Optional)		
Total emissions		∑ 3 through 9
10. Avoided emissions (Optional)		

* Include only those aspects that are within the system boundaries established for the carbon footprint. Not all of these estimates will necessarily be suitable for use in a greenhouse gas balance sheet.

** Additional information: Biomass-derived CO_2 from burning biomass fuels =

*** At a minimum, explain how forest management practices are ensuring that long term forest carbon stocks are not declining. If all wood in the product comes from areas where such a statement can be supported, the company has the option of entering "zero" to indicate that the product is not causing significant increases or decreases in forest carbon stocks, or if carbon stocks are increasing or decreasing, the appropriate value can be entered here.

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Example 2. Atmospheric flow accounting of biomass carbon and emissions divided according to control using WRI/WBCSD GHG Protocol approach

The Ten Toes of the Carbon Footprint of Forest Products *		**Emissions or sequestration (negative emissions) in CO_2 eq.**			
		Scope 1	**Scope 2**	**Scope 3**	**Total**
1. Net uptake of CO_2 in the forest ***					
2. Biomass carbon emissions	2a. Carbon in product as it enters commerce				
	2b. Release of biomass CO_2 from biomass fuels (Optional)				
	2c. Release of biomass carbon (as CO_2) from elsewhere in the value chain (Optional)				
Net sequestration of biomass carbon (1 + 2b + 2c)					
3. Greenhouse gas emissions from forest products manufacturing facilities **					
4. Greenhouse gas emissions associated with producing virgin or recovered fibre **					
5. Greenhouse gas emissions associated with producing other raw materials **					
6. Greenhouse gas emissions associated with purchased or sold electricity, steam or heat, or hot water **					
7. Transport-related greenhouse gas emissions ** (Optional for transport activities after final product is manufacturered)					
8. Greenhouse gas emissions attributable to product use (Optional)					
9. Greenhouse gas emissions attributable to end-of-life management of products** (Optional)					
Total emissions (∑ 3 through 9)					
10. Avoided emissions (Optional)					

* Include only those aspects that are within the system boundaries established for the carbon footprint. Not all of these estimates will necessarily be suitable for use in a greenhouse gas balance sheet.

** Additional information: Biomass-derived CO_2 from burning biomass fuels =

*** At a minimum, explain how forest management practices are ensuring that long term forest carbon stocks are not declining. If all wood in the product comes from areas where such a statement can be supported, the company has the option of entering "zero" to indicate that the product is not causing significant increases or decreases in forest carbon stocks, or if carbon stocks are increasing or decreasing, the appropriate value can be entered here.

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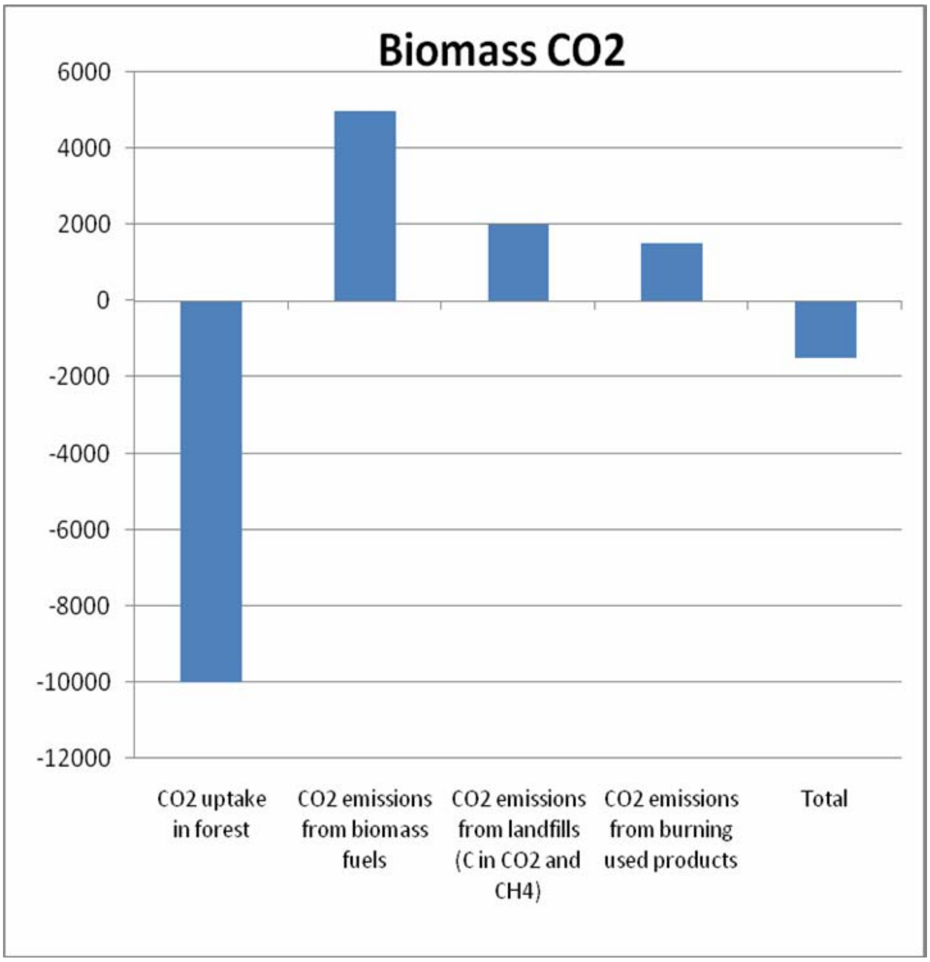
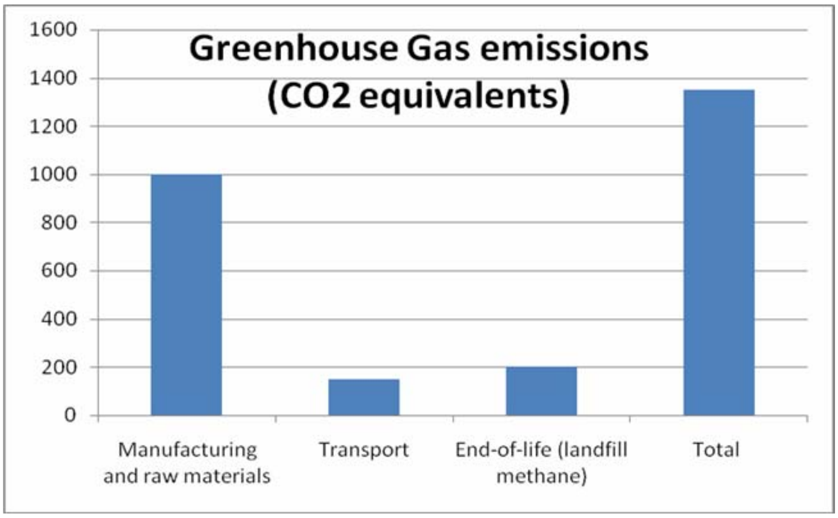
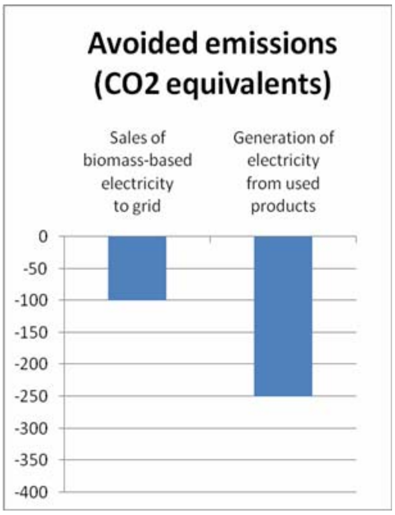
Using graphs to present the results of a carbon footprint of forest products

Example 3. Hypothetical forest product value chain – Flow accounting used for biomass carbon (highlights role of forests in removing CO_2 from the atmosphere)







Example 4. Hypothetical forest product value chain – Stock change accounting used for biomass carbon (same net sequestration as in Example 3 but stock accounting clarifies role of carbon storage in forests and products)