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Apparent Half-Life-Dynamics of Harvested Wood Products (HWPs) in Austria: Development and analysis of weighted time-series for 2002 to 2011

Martin Braun [a], Georg Winner [b], Peter Schwarzbauer [c], Tobias Stern [d,*]

[a] University of Natural Resources and Life Sciences, Vienna, Austria
[b] Market Analysis and Innovation Research Team, Kompetenzzentrum Holz — Wood K plus, Austria
[c] Forest Products Markets and Marketing, University of Natural Resources and Life Sciences, Vienna, Department of Economics and Social Sciences, Institute for Marketing & Innovation, Vienna, Austria
[d] University of Graz, Institute of Systems Sciences, Innovation and Sustainability Research, Austria

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ABSTRACT

Harvested Wood Products (HWPs) are considered as means of carbon sequestration in the second commitment period of the Kyoto Protocol. The Intergovernmental Panel on Climate Change (IPCC) has introduced the average (service) life multiplied by ln(2) as so-called "Half-Life" (HL) to define the period for accounting carbon sequestration in wood products.

This work investigates the dynamics of apparent HL and carbon content within three important categories of wood utilization (construction, furniture and packaging) considering sales on the wood product level in Austria for the period 2002 to 2011. Static HL for finished products derived from a literature study is used for upscaling information about carbon flows and associated HL to semi-finished HWP. From HL on the product level three category-HLs are derived. Averaged over 10 years, we find the following HLs: 33.0 years for construction, 8.5 years for furniture, and 1.4 years for packaging. For each category the shares of semi-finished HWP (sawnwood and wood-based panels) are determined. With this information, the average Kyoto-relevant HL for semi-finished HWP can be deducted. For the period 2002–2011, it is 9.5 to 16.6 years for sawnwood and 9.0 to 11.0 years for wood-based panels.

1. Introduction

HWPs in general are all wooden products including bark leaving the harvest site (IPCC, 2006). All HWPs have different service-lives and thus different half-lives (HLs). By definition the HL is the average [service-] life ∗ ln(2) (IPCC, 2006). It represents the time when half of the products produced in a certain year – e.g. semi-finished HWP (SF-HWP; which are relevant for the Tier 2 approach from IPCC, 2014) – reach the end of their service life. Since the Half-Life of SF-HWP in use is varying with time making it difficult to provide generally applicable values for product lifetimes, we use information derived from F-HWP data to estimate changes in SF-HWP HL. The service life of F-HWP is mainly defined by physical and chemical conditions, but also by socio-economic factors (Pingoud and Wagner, 2006). Depending on the type of use F-HWP can be more affected by physicochemical characteristics, e.g. for F-HWP used in civil engineering or for outdoor purposes or more by socioeconomic ones, e.g. for decorative building elements of indoor furniture.

When using F-HWP information with static HL and changing material flow for deriving SF-HWP HL the changes of HL of SF-HWP are influenced by the F-HWP distribution to the categories construction, furniture or packaging.

The reason for upscaling to SF-HWP is that it can be easily incorporated in models for the forest-based sector while the information about F-HWP products can be updated and corrected for periodically.

As an Annex I party to the KP Austria is obliged to reduce its greenhouse gas emissions. Following Article 3.4 of the KP, Austria "shall provide... data to establish its level of carbon stocks in 1990 and to enable an estimate to be made of its changes in carbon stocks in subsequent years." This data is recalculated each year in Austria's Annual National Greenhouse Gas Inventory (NGHGI; e.g. EAA, 2012) which incorporates a section on LULUCF (land use, land use change and forestry; Sector 5). For the first commitment period Article 3.3 of the KP limited "… forestry activities, … to afforestation, reforestation and deforestation since 1990, …". Hence HWPs were not included in the relevant sector 5, LULUCF. The 1996 IPCC (Intergovernmental Panel on Climate Change) Guidelines for National Greenhouse Gas Inventories (IPCC, 1997) excluded HWP as a sink of carbon, stating "… that all carbon biomass harvested is oxidised in the removal [harvest] year" (IPCC, 1997;

* Corresponding author.
E-mail addresses: peter.schwarzbauer@boku.ac.at (P. Schwarzbauer), t.stern@kplus-wood.at (T. Stern).

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p.5.17, Box 5). This is true if the pool of HWP is not changing. But what if the pool is changing? Then it represents a form of carbon removal or emission and a methodology for accounting the HWP contribution to sector 5 is necessary.

The 2006 IPCC Guidelines (currently revised) operate with default HL for two HWP categories (30 years for solid wood products and 2 years for paper products) and five annual variables to estimate the change in carbon stocks in HWP in Gg of carbon. They are the basis for calculating two further variables, leading to the total HWP contribution in Gg of CO_2 to AFOLU (Table 9 in the Guideline's Appendix).

At the UN climate change conference, 2011 in Durban, Australia, decision 2/CMP.7 was adopted concerning HWP (UNFCCC, 2012b). Each Annex I party is now obliged to account for the carbon stored in that pool leaving imported HWP aside.

Currently there are three ways for accounting HWP in accordance to Good Practice Guidance (IPCC, 2014):

- Instantaneous oxidation (Tier 1): Default method (as before) with the assumption that all harvested biomass is oxidized in the removal year.
- First order decay (Tier 2): If sufficient data is available for the three HWP categories sawnwood, wood-based panels, and paper & paperboard. Using a first-order decay approach with default IPCC factors.
- Country-specific methods (Tier 3): Adding country-specific methodologies to Tier 2. Either country-specific HL or methodologies for accounting which are at least as accurate as in Tier 2.

The scope of this work is on assessing apparent half-lives for semi-finished HWP (SF-HWP: sawnwood and wood panels) for domestic consumption and finished HWP (F-HWP; wood products derived from end product data from the Austrian Business Cycle Statistics) produced thereof. The latter are used to determine HL for the categories construction, furniture and packaging which are then used to determine the HL of the semi-finished Harvested Wood Products. Pulp and paper products are willingly excluded because of their low HL of 2 years (IPCC, 2006).

The study at hand presents a possible way for deriving weighted HL for SF-HWP values based on detailed country specific F-HWP data for Austria. Furthermore it is of particular interest to compare the results with the IPCC default values and modeled data. Finally, the work investigates how such calculated average HL values would change over time given the fact that production patterns change over time as well. This is a new issue, as the use of default HL values would consider constant values over long periods.

2. State of the art

International research focused mainly on the development and implementation of calculation procedures in order to assess the amount of carbon stored in wood products (e.g. Wimmer, 1992, Gielen, 1998, Skog and Nicholson, 1998, Lim et al., 1999, Börjesson and Gustavsson, 2000, Pingoud et al., 2001, Bjørnstad and Skonhoft, 2002, Hashimoto et al., 2002, Pingoud and Lehtilä, 2002, Marland and Marland, 2003, Petersen and Solberg, 2005, Gustavsson et al., 2006, Böttcher et al., 2008, Grabar and Gitarskii, 2008, Skog, 2008, Tonosaki, 2009, Dias et al., 2009).

Literature covering HWP on a country-specific level for Europe is for example available for Portugal (Dias et al., 2007) and Ireland (Donlan et al., 2012).

Although already mentioned in Table 12.6 in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories that "*half-life* [is] *likely to vary over time*" very few papers address the dynamic change of HL on a national level over a longer period of time so far. Skog (2008) for example uses a Tier 3 method that includes change in HL over time to estimate HWP carbon contribution.

3. Materials

Looking into the change for HL of the categories construction, furniture and packaging and the applicability of international default HL for the SF-HWP sawnwood and wood-based panels in Austria requires knowledge about the change in the amounts of the yearly production of F-HWP. This work uses data for the period of 2002 until 2011 from the Statistik Austria (2003, 2012) (Konjunkturstatistik [KJS], Business Cycle Statistics) plus the data on production from the FAO (2002, 2011); Food and Agricultural Organisation) for the SF-HWP and data on import and export from the FHP (2002–2011; Forst Holz Papier, Cooperation of Forest-, Wood- and Paper-Industries in Austria) to establish the amount of SF-HWP staying in Austria. Information on uncertainty related to the KJS and FHP data is not available (Milota, 2013) and estimates for FAO data on production and trade are ±15% (IPCC, 2003). In order to also cover the development over a longer period of time, the Industry and Craft Statistics in 1982, 1987, and 1992 (Oesterreichisches Statistisches Zentralamt 1982, 1987, 1992) and the Business Cycle Statistics from the year 1997 (Oesterreichisches Statistisches Zentralamt 1997) were used as an additional data source.

3.1. Business Cycle Statistics (Konjunkturstatistik im produzierenden Bereich, KJS), Industry and Craft Statistics (Industrie und Gewerbestatistik, IGS), and FAO and FHP data from 2002–2011

The KJS lists the financial and physical volume of goods produced in Austria. It is based on a legally confined field research and results in a complete inventory count with a cover ratio of 90% of the total turnover. It shows different numbered divisions and production types. The latter is relevant for this work. Each production type has a number of inventory items (Güterpositionen) – which represent the end uses – for the various products.

The domestic production from the year 2011 includes for example 5466 inventory items (10-digit-level, in the deepest level of classification) of which 3261 show up in the statistic. Out of these 3261 items 57.9% stay unpublished for reasons of data protection. This illustrates a problem for deriving HWP-relevant data. Some items do not show up at all years from 2002 to 2011. In the case of unavailable amounts for wood-based panels and veneer sheets, data from the FAO on production is used.

Dealing with the KJS, it is important to avoid double counting because of the classification levels. That means: either sum up the amounts of the deepest level (10-digit-level) or take the amount from the next higher level (8-digit-level).

The KJS also represents a mix of product types: F-HWP, SF-HWP and other wood products which are not (yet) HWP in the strict sense (e.g. chips, particles and wood residues). Three initial groups are:

1. Sawnwood,
2. Chips, particles and wood residues, and
3. Roundwood and veneer-sheets.

From the data reported for these initial groups some can be attributed to F-HWP while a large fraction of SF-HWP however is not represented by the subset of F-HWP, because they are not reported in the KJS (Fig. 1). Including the data on imports and exports from FHP allows determining the amount of SF-HWP staying in Austria.

As for the HL for the period from 1982 until 1997 KJS and its predecessor the Industry and Craft Statistics (IGS) are used. The IGS differs significantly from the KJS in form – it has no code-system – but it is feasible to single out the F-HWP.

3.2. Half-Life data and conversion factors

The HLs for HWP within the (aggregated) F-HWP categories construction, furniture and packaging are specific for Austria if available. Otherwise, respecting the methodology behind the Production Approach, HLs specific for Europe are used being the primary export