PD ISO/TR 25080:2025

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Wood and wood-based products — Background and examples of calculating contributions to carbon stored in harvested wood products (HWP)

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The UK participation in its preparation was entrusted to Technical Committee SES/1/12.

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Published by BSI Standards Limited 2025

ISBN 978 0 539 33121 9

ICS 79.040; 79.060.01

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This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 May 2025.

Amendments/corrigenda issued since publication

Date	Text affected

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Technical Report

ISO/TR 25080

First edition
2025-05

Wood and wood-based products — Background and examples of calculating contributions to carbon stored in harvested wood products (HWP)

Bois et produits à base de bois — Contexte et exemples de calcul des contributions au carbone stocké dans les produits ligneux récoltés (PLR)

Reference number
ISO/TR 25080:2025(en)

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Contents

Page

Foreword ... **iv**
Introduction ... **v**
1 Scope ... **1**
2 Normative references ... **1**
3 Terms and definitions ... **1**
4 The harvested wood product coefficient (HWP coefficient) concept ... **1**
5 Background and options provided by IPCC Guidelines and their applicability for reporting at an organizational level ... **2**
5.1 General ... 2
5.2 HWP approaches to estimate greenhouse gas dynamics ... 2
5.2.1 Approaches ... 2
5.2.2 Estimating greenhouse gas dynamics based on carbon stock changes ... 3
5.2.3 Estimating greenhouse gas dynamics based on greenhouse gas fluxes to the atmosphere ... 4
5.3 HWP methods to estimate greenhouse gas dynamics ... 5
5.4 IPCC tiers 2 and 3 calculations ... 7
6 Tier 1 calculations ... **7**
6.1 General ... 7
6.2 First order decay in IPCC tier 1 ... 7
6.3 Data requirements to calculate HWP coefficients in ISO 13391-1 ... 8
6.4 Using HWP coefficients in the first order decay model in ISO 13391-1 ... 9
6.5 Tier 1 HWP coefficients ... 11
7 Calculation of HWP contribution under tiers 2 and 3 ... **12**
7.1 General ... 12
7.2 Recycling rates and market growth ... 12
7.3 HWP coefficient for roundwood ... 14
7.4 Product residence time ... 15
7.4.1 IPCC country-specific half-lives ... 15
7.4.2 Refining the IPCC country-specific half-life at an organizational level ... 15
7.4.3 Altering the function used to model residence time ... 16
7.4.4 Tier 3 calculation of HWP contribution ... 16
7.4.5 Considerations based on IPCC guidelines ... 16
8 Data availability/Literature review ... **17**
9 Examples of methods for calculating HWP coefficients ... **18**
9.1 Assumptions ... 18
9.2 Example 1: Using national inventory reports and country-level statistics on wood-based products ... 19
9.3 Example 2: Using market development data ... 21
9.4 Using organization-specific data ... 23
9.5 Note on sensitivity related to assumptions and limitations in the examples ... 23
10 HWPs in landfill and other methods of woody carbon storage ... **24**
10.1 General ... 24
10.2 Tier 1 approach for landfill carbon storage ... 24
10.3 Considering non-standard landfills ... 25
10.4 Tier 2 methods for material entering landfill using half-life ... 25
10.4.1 General ... 25
10.4.2 Recycling ... 26
10.4.3 Burning for energy ... 26
10.4.4 Landfilling ... 27
Bibliography ... **30**

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Full document details: PD ISO/TR 25080:2025

Foreword

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This document was prepared by Technical Committee ISO/TC 287, *Sustainable processes for wood and wood-based products.*

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Introduction

ISO 13391-1 defines a framework for calculating greenhouse gas dynamics of wood and wood-based products. The framework identifies a component for wood-based carbon (i.e. biogenic carbon stored in wood-based products), representing the contributions to the harvested wood products (HWP) pool and wood-based carbon storage in landfills or through biogenic carbon capture and storage (bio-CCS), see Figure 1. ISO 13391-1 further elaborates on the calculation of these contributions based on the delivery of a set of wood and wood-based products in a specified time period at an organizational or aggregate level. This document provides additional background and examples to users of ISO 13391-1.

ISO 13391-1 introduces the concept of a HWP coefficient to estimate the long-term contribution of a set of wood and wood-based products to the HWP pool. It is defined as a factor for calculating the net contribution to the HWP pool per delivered volume of a wood-based product. Subclause 5.4 of that document elaborates on the calculation of HWP coefficients.

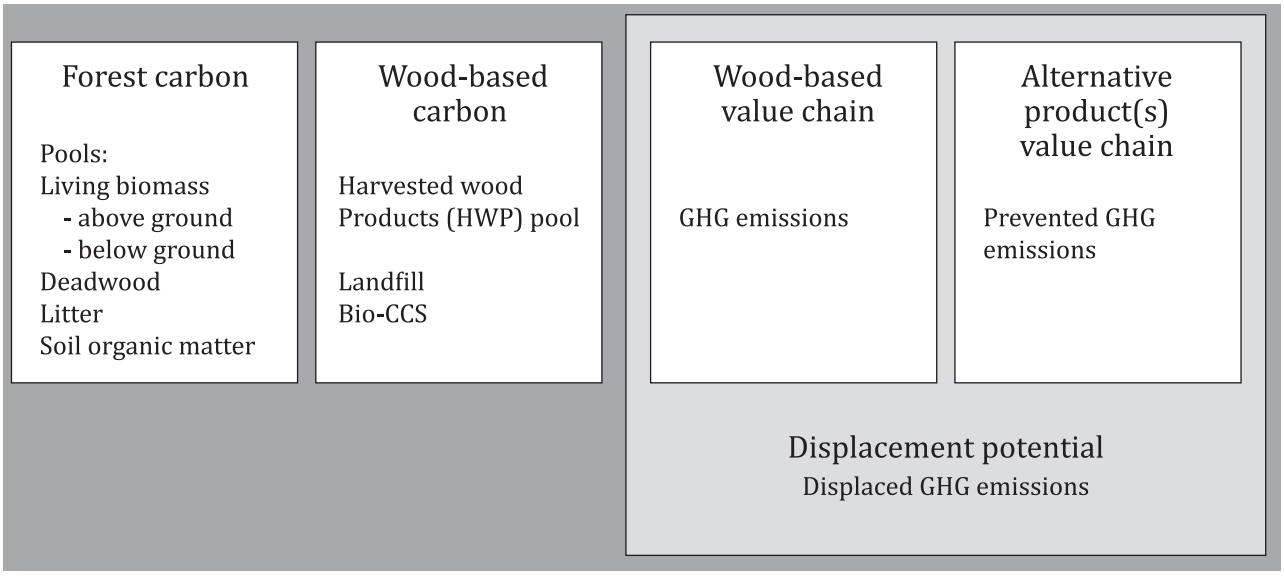

Figure 1 — Illustration of the components of the greenhouse gas dynamics of wood and wood-based products

This document provides background and examples. Clause 4 introduces the concept of an HWP coefficient, as used in ISO 13391-1. Clause 5 considers the background to quantification of HWP storage, with particular relevance to the IPCC methodologies used for national reporting.

Clause 6 considers the data requirements for calculating HWP coefficients and provides examples of HWP coefficients, according to the tier 1 methodology of ISO 13391-1. These include factors for recycling.

This is followed by Clause 7, in which the details of calculating HWP coefficients are considered, when working from market data and models. The concept of handling recycling within HWP coefficient calculations is introduced. It also considers the other methodologies for HWP calculations, as discussed in the IPCC guidelines, often termed tier 2 and tier 3 methods, and their counterparts within ISO 13391-1. This provides context for ongoing research activity and thought leadership in the field, which is evolving.

Clause 8 provides a literature review showing how research has progressed on this topic.

Clause 9 gives examples of methods for calculating an HWP coefficient using national inventory reports, market development data or organization-specific data. It also details some sensitivities related to these examples.

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Clause 10 discusses the long-term storage of carbon in wood and wood-based products which are disposed into landfill, or into other long term storage options including bio-CCS, biochar etc.

NOTE The methods described in this report are largely based on IPCC guidelines; however, approaches for organizational or national reporting can vary depending on local conditions or legislations.

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Wood and wood-based products — Background and examples of calculating contributions to carbon stored in harvested wood products (HWP)

1 Scope

This document provides background information, methods and examples of calculating contributions to carbon stored in wood-based products (harvested wood products, HWP), including storage resulting from HWPs in landfill and bio-CCS, as defined in ISO 13391-1:2025. It includes background to the tier 1 HWP coefficients for various wood-based product categories defined in ISO 13391-1:2025.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 13391-1:2025, *Wood and wood-based products — Greenhouse gas dynamics — Part 1: Framework for value chain calculations*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13391-1 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 The harvested wood product coefficient (HWP coefficient) concept

Wood-based products in use, including the use of recycled wood-based material, extend the time of biogenic carbon storage until the material is disposed of, after which the wood-based carbon is released to the atmosphere, enters landfills, or meets a different fate. The carbon storage in wood-based products is therefore considered as a carbon pool by IPCC, as described in Clause 5.

The pool of carbon in wood-based products (or harvested wood products - HWP) has an inflow of new woody material, and an outflow of disposed woody material. The difference between the inflow and outflow in a given time period represents the net change in the HWP pool.

The HWP coefficient has been defined in ISO 13391-1 as the proportion of the inflow that represents a net change in the HWP pool. This builds on the principle that it is the net change of the HWP pool that is relevant for the greenhouse gas dynamics, just as the net change of forest carbon storage is relevant.

While the inflow of new material is straightforward to calculate based on the quantities of wood-based products put on the market by an organization, the outflow depends on the quantities and fates of corresponding products put on the market historically. Determining the outflow from the pool related to the organization's production is therefore a critical methodological aspect. As the actual outflow is difficult to measure, this can be done through modelling.

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Two main parameters for determining the outflow through modelling are:

a) The rate of decay of woody material in the HWP pool. This is usually determined by assuming an estimated life span for each product category, combined with assumptions on proportions of recycling.

b) The historical growth or decline of market quantities for each product category.

Over the long term, an increasing market quantity will increase the HWP pool and thereby result in a positive HWP coefficient, while a decreasing market will lead to a decrease of the HWP pool and a negative HWP coefficient. However, as it is not meaningful to assign a negative storage effect for an organization that delivers products, which are physically storing carbon, to the market, ISO 13391-1 states that the HWP coefficient can be assumed to be zero in this case.

One limitation of this approach is that the calculation of HWP coefficients to be applied by an organization will depend on products delivered in the past, whose fate the organization cannot influence.

Another limitation is that historical market developments can vary between regions, which can lead to different HWP coefficients for similar products.

The HWP coefficient is used to estimate the present net gain of carbon in the HWP pool, but it does not indicate a permanent net gain.

The following clauses elaborate on the use of HWP coefficients when implementing ISO 13391-1.

5 Background and options provided by IPCC Guidelines and their applicability for reporting at an organizational level

5.1 General

The methodology to estimate the carbon storage associated with a HWP carbon pool in ISO 13391-1 is based on the 2019 Refinement to the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories,[6] adjusted for use at an organizational or aggregate level.

5.2 explains the guidance provided by IPCC,[6] as background for calculating the contribution to the HWP pool according to ISO 13391-1. In order to calculate the carbon storage in the HWP pool under the IPCC Guidelines, both an approach and a method need to be defined. The approaches and methods outlined in the IPCC Guidelines are described in the following clauses.

5.2 HWP approaches to estimate greenhouse gas dynamics

5.2.1 Approaches

The IPCC Guidelines define different ‘approaches’ that can be taken to estimate greenhouse gas dynamics of a HWP pool. The approach defines the system boundary, which indicates what will be estimated and reported when calculating the greenhouse gas emissions and removals of an HWP. The approach is defined to ensure that all emissions and removals are accounted for and double-counting does not occur, by being transparent, complete, and consistent. When selecting the approach, it is important to consider the specific question being addressed or the type of estimate that is required.

The 2006 IPCC Guidelines[8] consider four approaches for calculating the greenhouse gas emissions and removals of an HWP:

— ‘stock-change’ approach which estimates changes in carbon stocks in the HWP pool within the national boundaries;

— ‘production’ approach which estimates changes in carbon stocks in the HWP pool consisting of products made from wood harvested in a country;

— ‘atmospheric-flow’ approach which estimates fluxes of greenhouse gases from and to the atmosphere from HWP, taking place within national boundaries; and

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— ‘simple-decay’ approach which estimates fluxes of greenhouse gases from and to the atmosphere from HWP, associated with woody biomass harvested from the forests and other wood-producing lands within a country.

The four IPCC approaches have similarities and differences based on what is being estimated and where the HWP is being consumed and used. As per the guidelines:

— The ‘stock-change’ and ‘production’ approaches work with carbon stock changes in HWP pools, whereas the ‘atmospheric-flow’ and ‘simple-decay’ approaches work with greenhouse gas fluxes;

— The ‘stock-change’ and ‘atmospheric-flow’ approaches cover stock changes or greenhouse gas fluxes associated within a consuming country, whereas the ‘production’ and ‘simple-decay’ approaches cover those associated with a producing country.

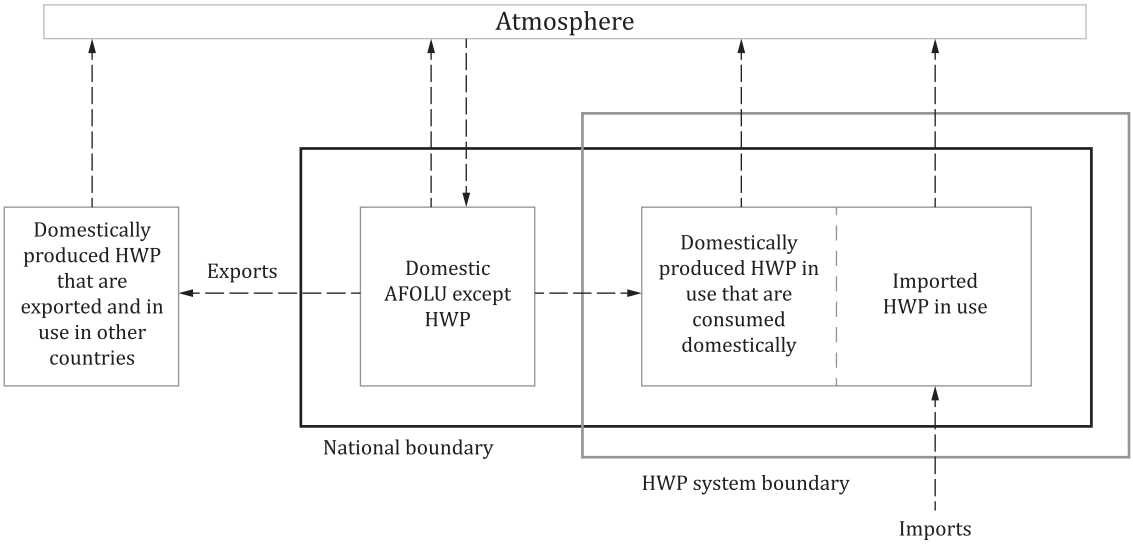
In the context of organizational greenhouse gas dynamics (considered in ISO 13391-1) the production approach is of greatest relevance. Organizations might find the principles of other approaches useful in other contexts, depending on their location within the supply chain and other factors.

The following subclauses describe in further detail the differences in the system boundaries of the various IPCC approaches in order to estimate the greenhouse gas dynamics.

5.2.2 Estimating greenhouse gas dynamics based on carbon stock changes

The two IPCC approaches to estimate the greenhouse gas emissions and removals associated with a HWP based on the carbon stock changes in the biomass pools are the ‘stock-change’ approach and ‘production’ approach.

The two pool-based approaches contain conceptual differences which impact the carbon inflow to the HWP pool. For instance, the annual carbon inflow to the HWP pool based on the ‘stock change approach’ is calculated based on the domestic consumption, while the ‘production’ approach is calculated based on the domestic production. Since the ‘stock change’ approach estimates carbon stock changes of a HWP in use within national boundaries, the calculated domestic consumption accounts for domestic production, plus imports and minus exports of HWP in use that are consumed domestically. Domestically produced HWP that are exported and in use in other countries are outside of the system boundary. Therefore, the HWP pool system boundary for the ‘stock change’ approach is within the national boundary, as shown in Figure 2.



NOTE AFOLU stands for Agriculture, Forestry and Other Land Use.

Figure 2 — System boundary of the ‘stock change’ approach[6]

On the other hand, since the ‘production’ approach estimates carbon stock changes of ‘products in use’, the annual carbon inflow to the HWP pool accounts for the domestic production of wood commodities

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manufactured from domestic harvest. Therefore, domestically produced HWPs that are exported and in use in other countries are within the system boundary. As a result, the HWP pool system boundary for the 'production' approach does not align with the national boundary, as shown in Figure 3.

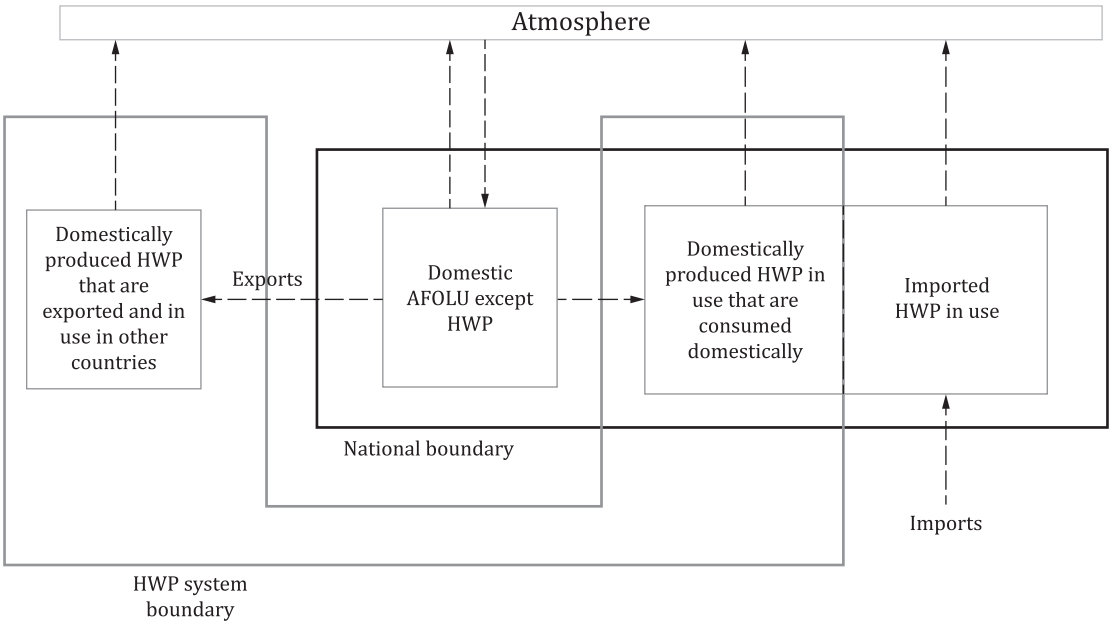

Figure 3 — System boundary of the 'production' approach[6]

5.2.3 Estimating greenhouse gas dynamics based on greenhouse gas fluxes to the atmosphere

The two approaches to estimate the greenhouse gas emissions and removals associated with a HWP based on greenhouse gas fluxes to the atmosphere are the 'atmospheric-flow' approach and 'simple-decay' approach.

The two greenhouse gas flux-based approaches consider both carbon stock changes within the HWP pool in use, as well as all cross-border greenhouse gas fluxes in wood-based products used for energy. Since the 'atmospheric-flow' approach considers greenhouse gas fluxes occurring within national boundaries, the emissions from HWP and wood-based products used for energy are reported by a consuming country. In this approach, the HWP pools are the same as the 'stock-change' approach. The HWP pool system boundary for the 'atmospheric-flow' approach is shown in Figure 4.

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