



PV Climate Tool

PT#HWP

Estimation of baseline and project
emissions and removals from harvested
woody products

Version 1.0

27 May 2026

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Contents

1.	Summary.....	3
2.	Sources.....	3
3.	Definitions.....	4
4.	Applicability Conditions.....	5
5.	Procedures.....	7
5.1.	Baseline removals.....	8
5.2.	Baseline Emissions.....	9
5.3.	Project Removals.....	9
5.4.	Project Emissions.....	10
5.5.	Leakage.....	11
6.	Parameters.....	11
7.	References.....	18

1. Summary

This tool provides approaches for estimating carbon stored in woody products harvested from PV Climate project areas under baseline and project scenarios. The tool is applicable to any project areas where there is harvesting of timber or other woody resources such as bamboo for usage in long lived (i.e. >50 years) woody products. The procedures are based on a combination of the conceptual framework detailed in Winjum et al 1998¹ and regional or local data sources to provide greater accuracy specific to the project area.

The tool may be used to generate values for the following parameters that are used to estimate climate benefits following **PM001**:

$BR_{WP,a,y}$ Net GHG removals in woody products under the baseline scenario for project area a up to year y (t CO₂e)

$PR_{WP,a,y}$ Net GHG removals in woody products under the project scenario for project area a up to year y (t CO₂e)

$BE_{WP,a,y}$ Net GHG emissions from woody products under the baseline scenario for project area a up to year y (t CO₂e)

$PE_{WP,a,y}$ Net GHG emissions from woody products under the project scenario for project area a up to year y (t CO₂e)

2. Sources

This tool can be used in conjunction with the following Plan Vivo methodologies and modules:

PM001 Agriculture and Forestry Carbon Benefit Assessment Methodology, Version 1.0

PU001 Estimation of baseline and project GHG removals by carbon pools in Plan Vivo projects, Version 1.1

¹ Winjum, J.K., Brown, S. and Schlamadinger, B., 1998. Forest harvests and wood products: sources and sinks of atmospheric carbon dioxide. Forest Science, 44(2), pp.272-284.

<https://doi.org/10.1093/forestscience/44.2.272>

PU002 Estimation of baseline and project GHG emissions from carbon pools in Plan Vivo projects, Version 1.0

This tool directly refers to the following Plan Vivo module:

PU004 Estimation of GHG emissions from leakage in Plan Vivo projects, Version 1.0

Development of this tool was informed by the following source:

Winjum, J.K., Brown, S. and Schlamadinger, B., 1998. Forest harvests and wood products: sources and sinks of atmospheric carbon dioxide. *Forest Science*, 44(2), pp.272-284. <https://doi.org/10.1093/forestscience/44.2.272>

3. Definitions

The tool follows the definitions provided in the PV Climate Glossary and PM001, except where additional definitions are provided below for the purposes of this tool.

Biomass Expansion Factor (BEF)

A conversion factor used to estimate a tree's total aboveground biomass from its merchantable stem biomass or volume by accounting for branches, bark, and other non-merchantable components.

Industrial Roundwood

Logs and other harvested wood intended for processing into manufactured products such as lumber, plywood, veneer, pulp, and engineered wood products, excluding fuelwood.

Long-Lived Woody Products

Woody products with relatively long service lives, such as structural lumber, mass timber, and furniture, that continue to store carbon for decades after harvest. Under the Plan Vivo framework, long-lived means any woody product with an expected service life of 5 years or more.

Mill / Manufacturing Efficiency

The proportion of harvested woody fiber that is converted into finished products during industrial processing, with the remainder becoming residues, by-products, or waste.

Paper

A thin sheet material manufactured primarily from wood pulp or other plant fibers for writing, printing, packaging, or sanitary applications.

Paperboard

A thick, stiff paper-based material, typically heavier than paper, used primarily for packaging, cartons, and other structural applications.

Wood

The material produced in the stems and branches of trees and other woody plants, composed primarily of cellulose (40-50%), hemicellulose (20-35%), and lignin (20-35%).

Wood-Based Panels

Engineered sheet products manufactured by bonding wood fibers, particles, strands, or veneers with adhesives or other binders, including plywood, oriented strand board (OSB), particleboard, and medium-density fiberboard (MDF).

Wood Product Class

A category of woody products grouped according to their physical characteristics, manufacturing process, intended use, or expected service life for purposes such as carbon accounting, market analysis, or lifecycle assessment.

Woody products

Also known as Harvested Woody Products (HWPs), these are products made wholly or partly from woody vegetation and store or utilize carbon.

Woody Vegetation

Vascular plants like trees and bamboo that develop stiff, bark-covered, or hard-stemmed structures from secondary xylem, lending themselves for use in long-lived products following harvest and processing.

Wood Waste

Wood material generated during processing, construction, demolition, or product use that is not incorporated into the primary intended product and may be reused, recycled, used for energy, or disposed of.

4. Applicability Conditions

The tool provides procedures for the estimation of expected and actual emissions or removals in harvested woody products under baselines and/or project scenarios where harvesting occurs. Example intervention types include but are not limited to:

- Forest protection – Forest protection, e.g. Logged to Protected Forests (LtPF) and Reducing Emissions from Deforestation and Forest Degradation (REDD), implies a change from a forest being subjected to extractive and potentially degradative activities to one where those activities will be prohibited, preventing further degradation or deforestation. In this activity, baseline HWP's would be accounted for both emissions and removals.
- Forest conservation – Forest conservation, e.g. Improved Forest Management (IFM) and Reducing Emissions from Deforestation and Forest Degradation (REDD), implies a change from a forest being subjected to extractive and potentially degradative activities to one where those activities will be allowed but with certain restrictions, thereby mitigating further degradation or deforestation. In this activity, baseline and project HWP's would be accounted for both emissions and removals.
- Afforestation, Reforestation, and Revegetation (ARR) – ARR projects establish or increase forest cover (i.e. Afforestation and Reforestation) and/or woody biomass (i.e. Revegetation) as compared to the baseline. In this activity, HWP's would be considered *de minimus* in the baseline. HWP's in the project are only accounted for if the project activity includes harvesting.
- Forest restoration activities may also apply the proposed HWP tool if harvesting occurs in either the baseline or the project or both. 'Restoration' implies that the current forest ecosystem is in a degraded state (e.g. reduced species richness, biodiversity, habitat, ecosystem services, etc.), and the goal of the activity is to restore the forest to a healthy state. This may involve removal of "undesirable" species (e.g. invasives, exotics, species representative of an undesirable successional stage) or age classes and human assistance to recovery / restoration to the desired state.

The following table (Table 1) illustrates applicability of various carbon pools and emission sources for the proposed tool.

Variable	Baseline	Project
Harvested aboveground biomass	Required if baseline activity includes harvesting	Required if project activity includes harvesting
Belowground biomass of harvested vegetation		

Harvested Wood Products (HWPs)		
Residual lying dead wood	Optional; conservative to exclude	Conditional, may be excluded if residual in-situ biomass is not burned following harvest
Residual litter	Excluded	Excluded

The tool is applicable globally to estimate baseline and project biomass emissions or removals from any eligible project areas where woody material (e.g. timber) is harvested for use in long-lived woody products under the baseline and/or project scenario, thereby enabling users of the tool to generate fPVCs, rPVCs and vPVCs. As such, if the project complies with the applicability requirements of PM001, PU001 and PU002, then there are no foreseen circumstances where use of the tool would not be permitted or should not be applied.

5. Procedures

This tool's procedures follow the conceptual framework outlined in the Winjum et al 1998 paper. While the Winjum paper provides for a globally applicable method to estimate carbon stored in harvested wood products, parameters such as mill efficiencies and annual oxidation factors have been provided with greater specificity in the IPCC 2006 Guidelines and wide-spanning databases. As such, each individual equation's variables will follow a data preference order, which is provided below.

In IPCC terminology, Tiers 1, 2, and 3 represent increasing levels of complexity, data specificity, and accuracy for estimating greenhouse gas (GHG) emissions. Tier 1 uses default global data for simple calculations, Tier 2 employs country-specific data for improved accuracy, and Tier 3 utilizes local data and tailored modeling for highest precision. Good practice suggests that usage of local data and tailored modeling (Tier 3) takes precedent in all cases, but this is subject both to availability and practical application, otherwise national data from FAO or other authoritative sources (Tier 2) or defaults from Winjum (Tier 1) are acceptable, in that order of preference. Lower Tier data sources may be allowed if the project provides ample justification that it is more conservative to do so than using Tier 1 or 2.

Step 1: Identify the likely wood product class(es) p for the harvested wood for year y from the below list, derived from the IPCC 2013 Revised Supplementary Methods:

- Sawnwood
 - Coniferous sawnwood
 - Non-coniferous sawnwood
- Wood-based panels
 - Hardboard (HDF)
 - Insulating board (Other board, LDF)
 - Fibreboard compressed
 - Medium-density fibreboard (MDF)
 - Particle board
 - Plywood
 - Veneer Sheets
- Paper and paperboard
- Other industrial roundwood
- Other classes of wood products

5.1. Baseline removals

Equation 1 - Calculate the biomass carbon of the volume harvested for each wood product class p for each species j from within the project boundary in year y

$$BR_{HWP,j,a,y} = \sum_j \sum_p [BR_{HWB,j,a,y} * (1 - \frac{1}{BEF_j}) * WW_{p,y} * LTU_p * FYU_p]$$

Where:

$BR_{HWP,j,a,y}$ Net GHG removals in harvested woody products for species j under the baseline scenario for project area a in year y (t CO₂e)

$BR_{HWB,j,a,y}$ Net GHG removals in harvested aboveground woody biomass for species j under the baseline scenario for project area a in year y (tCO₂e)

BEF_j 'Biomass Expansion Factor' (BEF) for species j , accounts for non-merchantable parts of harvested woody biomass, dimensionless

$WW_{p,y}$ 'Wood waste'; Portion of wood harvested for wood product class p not lost as wood waste due the production year y 's mill inefficiency, dimensionless

LTU_p Portion of wood harvested for wood product class p that enters long-term use (5 years or more), dimensionless

FYU_p 'Fifty-Year Use'; Portion of wood harvested for wood product class p that is estimated to remain sequestered (removed) for fifty or more years, dimensionless

5.2. Baseline Emissions

Equation 2 -

$$BE_{HWP,j,a,y} = \sum_j \sum_p [(BR_{HWP,j,a,y} - (BR_{HWP,j,a,y} * (1 - \frac{1}{BEF_j}) * WW_{p,y} * LTU_p * FYU_p)) + BE_{BG,j,a,y}]$$

Where:

$BE_{HWP,j,a,y}$ Net GHG emissions from harvested woody products for species j under the baseline scenario for project area a in year y (t CO₂e)

$BR_{HWP,j,a,y}$ Net GHG removals in harvested aboveground woody biomass for species j under the baseline scenario for project area a in year y (tCO₂e)

BEF_j 'Biomass expansion factor' (BEF) for species j , accounts for non-merchantable parts of harvested woody biomass, dimensionless

$BE_{BG,j,a,y}$ Net GHG emissions in belowground biomass from harvested woody vegetation of species j under the baseline scenario for project area a in year y

$WW_{p,y}$ 'Wood waste'; Portion of wood harvested for wood product class p not lost as wood waste due the production year y 's mill inefficiency, dimensionless

LTU_p Portion of wood harvested for wood product class p that enters long-term use (5 years or more), dimensionless

FYU_p 'Fifty-Year Use'; Portion of wood harvested for wood product class p that is estimated to remain sequestered (removed) for fifty or more years, dimensionless

5.3. Project Removals

Equation 3 - Calculate the biomass carbon of the volume harvested for each wood product class p for each j from within the project boundary in year y of the project scenario

$$PR_{HWP,j,a,y} = \sum_j \sum_p [PR_{HWP,j,a,y} * (1 - \frac{1}{BEF_j}) * WW_{p,y} * LTU_p * FYU_p]$$

Where:

$PR_{HWP,j,a,y}$ Net GHG removals in woody products for species j under the project scenario for project area a in year y (t CO₂e)

$PR_{HWP,j,a,y}$ Net GHG removals in aboveground woody biomass for species j under the project scenario for project area a in year y (tCO₂e)

BEF_j 'Biomass expansion factor' (BEF) for species j accounts for non-merchantable parts of harvested woody biomass, dimensionless

$WW_{p,y}$ 'Wood waste'; Portion of wood harvested for wood product class p not lost as wood waste due to mill inefficiency in year y , dimensionless

LTU_p Portion of wood harvested for wood product class p that enters long-term use (5 years or more), dimensionless

FYU_p 'Fifty-Year Use'; Portion of wood harvested for wood product class p that is estimated to remain sequestered (removed) for fifty or more years, dimensionless

5.4. Project Emissions

Equation 4 -

$$PE_{HWP,j,a,y} = \sum_j \sum_p [(PR_{HWP,j,a,y} - (PR_{HWP,j,a,y} * (1 - \frac{1}{BEF_j}) * WW_{p,y} * LTU_p * FYU_p)) + PE_{BG,j,a,y}]$$

Where:

$PE_{HWP,j,a,y}$ Net GHG emissions from harvested woody products for species j under the project scenario for project area in year y (t CO₂e)

$PR_{HWP,j,a,y}$ Net GHG removals in harvested aboveground woody biomass for species j under the project scenario for project area a in year y (tCO₂e)

BEF_j 'Biomass expansion factor' (BEF) for species j , accounts for non-merchantable parts of harvested woody biomass, dimensionless

$PE_{BG,j,a,y}$ Net GHG removals in belowground biomass from harvested vegetation of species j under the project scenario for project area a in year y

$WW_{p,y}$ 'Wood waste'; Portion of wood harvested for wood product class p not lost as wood waste due to mill inefficiency in year y , dimensionless

LTU_p Portion of wood harvested for wood product class p that enters long-term use (5 years or more), dimensionless

FYU_p 'Fifty-Year Use'; Portion of wood harvested for wood product class p that is estimated to remain sequestered (removed) for fifty or more years, dimensionless

5.5. Leakage

Procedures for accounting for leakage follow **PU004**. PU004 assigns its applicability to all PV project interventions that have a risk of activity shifting or market leakage. Given that both harvest frequency and intensity may differ between the baseline and project scenarios, there is a risk that leakage may occur (e.g. if harvesting is allowed in the baseline but prohibited in the project, the harvesting may occur elsewhere). **PU004** includes variables related to wood harvesting in equations 4 and 5. It is therefore necessary that any project using the HWP tool also use **PU004**.

6. Parameters

Data/Parameter	$BR_{HWP,j,a,y}$
Units	tCO ₂ e
Description	Net GHG removals in harvested woody products for species j under the baseline scenario for project area a up to year y
Equations	1
Source	Module PU001
Value	N/A
Justification of choice of data or description of	See module PU001

measurement methods and procedures applied	
Purpose of Data	Calculation of baseline removals by HWPs
Comments	May also be measured throughout the quantification period

Data/Parameter	$BR_{HWP,j,a,y}$
Units	tCO ₂ e
Description	Net GHG removals in harvested aboveground woody biomass for species j under the baseline scenario for project area a in year y
Equations	1, 2
Source	Module PU001
Value	N/A
Justification of choice of data or description of measurement methods and procedures applied	See module PU001
Purpose of Data	Calculation of baseline removals by HWPs
Comments	May also be measured throughout the quantification period

Data/Parameter	BEF_j
Units	tCO ₂ e
Description	Biomass Expansion Factor (BEF) accounts for non-merchantable parts of harvested woody biomass for species j , dimensionless
Equations	1, 2, 3, 4
Source	CDM AR-Tool-14 v4.2 (or most recent version), as per PU001. Note that AR-Tool-14 v4.2 relies on IPCC 2006 Guidelines Table 4.5.
Value	Dimensionless
Justification of choice of data or description of	See module PU001. Non-merchantable parts of harvested woody biomass are assumed to be emitted instantaneously.

measurement methods and procedures applied	In the case of pulp and paper products, all aboveground biomass is assumed to be utilized.
Purpose of Data	Calculation of removals by HWPs
Comments	May also be measured throughout the quantification period

Data/Parameter	$BE_{HWP,j,a,y}$
Units	tCO ₂ e
Description	Net GHG emissions from harvested woody products for species j under the baseline scenario for project area a up to year y
Equations	2
Source	Module PU002
Value	NA
Justification of choice of data or description of measurement methods and procedures applied	See module PU002
Purpose of Data	Calculation of baseline emissions from HWPs
Comments	May also be measured throughout the quantification period.

Data/Parameter	$BE_{BG,j,a,y}$
Units	tCO ₂ e
Description	Net GHG removals in belowground biomass from harvested vegetation of species j under the baseline scenario for project area a in year y
Equations	2
Source	Module PU002
Value	NA
Justification of choice of data or description of measurement methods and procedures applied	See module PU002
Purpose of Data	Calculation of baseline emissions from HWPs

Comments	May also be measured throughout the quantification period.
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Data/Parameter	$PR_{HWP,j,a,y}$
Units	tCO ₂ e
Description	Net GHG removals in harvested woody products for species j under the project scenario for project area a up to year y
Equations	3
Source	Module PU001
Value	NA
Justification of choice of data or description of measurement methods and procedures applied	See module PU001
Purpose of Data	Calculation of project removals by HWPs
Comments	Estimated prior to validation and measured throughout the quantification period.

Data/Parameter	$PR_{HWB,j,a,y}$
Units	tCO ₂ e
Description	Net GHG removals in harvested aboveground woody biomass for species j under the project scenario for project area a in year y
Equations	3, 4
Source	Module PU001
Value	N/A
Justification of choice of data or description of measurement methods and procedures applied	See module PU001
Purpose of Data	Calculation of project removals by HWPs
Comments	May also be measured throughout the quantification period

Data/Parameter	$PE_{HWP,j,a,y}$
Units	tCO ₂ e
Description	Net GHG emissions from harvested woody products for species j under the project scenario for project area a up to year y
Equations	4
Source	Module PU002
Value	NA
Justification of choice of data or description of measurement methods and procedures applied	See module PU002
Purpose of Data	Calculation of project emissions from HWPs
Comments	Estimated prior to validation and measured throughout the quantification period.

Data/Parameter	$PE_{BG,j,a,y}$
Units	tCO ₂ e
Description	Net GHG removals in belowground biomass from harvested vegetation of species j under the project scenario for project area a in year y
Equations	4
Source	Module PU002
Value	NA
Justification of choice of data or description of measurement methods and procedures applied	See module PU002
Purpose of Data	Calculation of project emissions from HWPs
Comments	May also be measured throughout the quantification period.

Data/Parameter	FYU_p
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Units	Dimensionless
Description	‘Fifty-Year Use’; Portion of wood harvested for woody product class p that is estimated to remain sequestered (removed) for fifty or more years, dimensionless
Equations	1, 2, 3, 4
Source	Tier 2: Project Country’s UNFCCC National Inventory Document (NID) – accessible here: https://unfccc.int/reports Tier 1: Winjum et al 1998
Value	N/A
Justification of choice of data or description of measurement methods and procedures applied	See module PU002
Purpose of Data	Calculation of baseline and project emissions and removals from HWP
Comments	Estimated prior to validation and measured throughout the quantification period.

Data/Parameter	$WW_{p,y}$
Units	Dimensionless
Description	Wood waste; accounts for volume lost due to mill and manufacturing inefficiency for HWP class p for year y
Equations	1, 2, 3, 4
Source	Tier 3: Project-specific mill/manufacturing efficiency factors; Tier 2: Either FAOSTAT, or Country-specific FAO Forest Resource Assessment report; Tier 1: Winjum et al 1998 (default)
Value	N/A
Justification of choice of data or description of measurement methods and procedures applied	Tier 3: Verifiable evidence from mill and manufacturing plants that process harvested wood from the project area a for HWP class p

	Tier 2: EITHER (a) Latest country-specific FAO Forest Resource Assessment (FRA) report: While the FRA focuses on forest area, it includes data on industrial roundwood removals. By comparing the volume of industrial roundwood removals (raw material) to the reported production of sawnwood (finished product) in these reports, you can calculate or infer conversion efficiency. OR (b) FAOSTAT Forest Product Statistics: This database provides comprehensive annual production and trade statistics for forest products from 1961 onwards, including annual data on (a) Industrial roundwood production and (b) sawnwood production. The conversion efficiency is typically analyzed by examining the ratio between raw timber input (roundwood) and processed output (sawnwood) listed in these tables. Tier 1: Winjum et al 1998 estimates that developing nations lose approximately 24% of biomass when producing wood products, whereas developed nations lose 19% for the same. In other words, the proportion of wood not lost in production of HWPs is .76 for developing nations, and .81 for developed nations. Projects may use the International Monetary Fund's (IMF) classifications of "Advanced Economies" and "Emerging Market and Developing Economies" (EMDEs) for determining whether the project is in a "developed" or "developing" nation.
Purpose of Data	Calculation of wood volume (carbon) lost due to mill/manufacturing inefficiency in the production of the HWP class

Comments	Estimated prior to validation and measured throughout the quantification period.
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Data/Parameter	LTU_p	
Units	Dimensionless	
Description	Portion of wood harvested for wood product class p that enters long-term use (5 years or more), dimensionless	
Equations	1, 2, 3, 4	
Source	Winjum et al 1998	
Value	N/A	
Justification of choice of data or description of measurement methods and procedures applied	Winjum et al 1998 provides the following long-term use factors for the following generic wood product classes:	
	Wood Product Class	LTU_{WP}
	Sawnwood	0.8
	Wood-based panels	0.9
	Paper and paperboard	0.6
	Other industrial roundwood	0.7
	Other classes of wood products	0.0
Purpose of Data	Calculation of wood volume by wood product that enters in to long-term use.	
Comments	Estimated prior to validation and measured throughout the quantification period.	

7. References

CDM AR-Tool-14 Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities. Available from:
https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-14-v4.2.pdf/history_view

IPCC 2006 Guidelines Table 4.5 Default biomass conversion and expansion factors (bcef), tonnes biomass (m3 of wood volume)-1. Available from: <https://www.ipcc-nggip.iges.or.jp/public/2006gl/>

IPCC 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol. Available from: <https://www.ipcc.ch/>

FAO Forest Resource Assessment (FRA) reports. Available from: <https://www.fao.org/forest-resources-assessment/>

Food and Agriculture Organization's FAOSTAT. Available from: <https://www.fao.org/faostat/en/#home>

PM001 Plan Vivo Agriculture and Forestry Project Carbon Benefit Assessment Methodology, Version 1.0. PV Climate Methodology. Available from: <https://www.planvivo.org/projects/certify-a-project/pvclimate/methodologies/approved-methodologies>

PU001 Estimation of Baseline and Project GHG Removals by Carbon Pools in Plan Vivo Projects, Version 1.1. PV Climate Module. Available from: <https://www.planvivo.org/projects/certify-a-project/pvclimate/methodologies/approved-modules>

PU002 Estimation of Baseline and Project GHG Emissions from Carbon Pools in Plan Vivo Projects, Version 1.0. PV Climate Module Available from: <https://www.planvivo.org/projects/certify-a-project/pvclimate/methodologies/approved-modules>

PU004 Estimation of GHG Emissions from Leakage in Plan Vivo Projects, Version 1.0. PV Climate Module. Available from: <https://www.planvivo.org/projects/certify-a-project/pvclimate/methodologies/approved-modules>

UNFCCC National Inventory Document (NID) for Project Countries. Available from: <https://unfccc.int/ghg-inventories-annex-i-parties/2025>

Winjum, J.K., Brown, S. and Schlamadinger, B., 1998. Forest harvests and wood products: sources and sinks of atmospheric carbon dioxide. Forest Science, 44(2), pp.272-284. <https://doi.org/10.1093/forestscience/44.2.272>