Harvested Wood Products (HWP)

Summary →

- Harvested Wood Products (HWP) need to be accounted for in forest carbon projects because they represent a significant pool of stored carbon that is created when a harvest occurs.
- Typical approaches to HWP accounting – where carbon in product and forest pools are tracked through time – are not compatible with short-term deferral projects.
- Using the principle of economic discounting to quantify the expected damages caused by carbon emissions allows us to identify the number of tons of carbon that need to be held out of the atmosphere for a year to have the same value as holding a ton out of the atmosphere forever.
- This same principle must therefore be applied to the delay in when carbon is transferred from living trees to HWP in this harvest deferral methodology.
- The total number of credits generated by this methodology is very sensitive to the choice of growth model and the discount rate used, and is less sensitive to HWP product mixtures.
- Using a national average HWP decay curve and a 3% growth rate, 100 tonnes of deferred carbon would result in 2.16 credits (2.16 units each of which represents the cumulative avoided emissions and/or removals from the project that mitigate the economic damages of one metric tonne of carbon dioxide (mtCO2E) emitted today).

Why we account for harvested wood products

When a timber harvest takes place, the carbon stored in trees becomes available for emission to the atmosphere. Some of that carbon is rapidly emitted due to short-term decomposition of harvest residue (slash) and mill processing residue. Other carbon is stored in harvested wood products (HWP) and emitted later, as those products are further processed and eventually decompose over years and decades.

Improved forest management (IFM) projects produce carbon credits from both removals of carbon from the atmosphere as trees grow, and avoided emissions from harvesting. Because emissions from HWP as they decay over time are a part of harvest emissions, they need to be accounted for, just as immediate emissions are.

Typical approaches to HWP

Existing IFM methodologies account for HWP by first estimating what proportion of a harvested tree gets utilized. Then they construct a HWP decay curve for the species of trees and specific product mix common in the region where a project takes place. When credits are issued, the number of credits generated reflects the difference in forest carbon stocks and HWP carbon between the baseline and project scenarios over the crediting time frame. This approach is commonly implemented in multi-decade improved forest management methodologies[1] resulting in most of the carbon initially stored in HWP being credited over the lifetime of the project. However, in short-term harvest deferral projects, the climate benefit comes from the shift by one year, or longer, of harvests and therefore the transfer of carbon from living trees to HWP. Therefore, if applied to a short-term harvest deferral methodology, a traditional HWP method will underestimate the climate impact of a deferral credit since it wouldn't take into account the emissions from HWP decay occurring after the project period.

Accounting for HWP in short-term deferral

A more comprehensive method of accounting for the movement of carbon between pools due to a one-year harvest deferral is to estimate the full expected emissions of the baseline and project scenarios out to 100 years or longer and calculate the difference between scenarios. Since some of that difference occurs over many decades, it needs to be discounted to reflect the time value of short-term carbon storage[2]. The result is an estimate of the discounted total emissions flow based on the difference between project and baseline scenarios.

A clear advantage of this approach is that it does not rely on the prediction of unknowable harvests decades in the future - it simply calculates the difference in total emissions for a one-year offset in harvesting timing between a baseline (*status quo*) scenario and a project scenario. Even though it is important to accurately project HWP decay over time, the final accounting is not particularly sensitive to the shape of the decay curve -the difference in discounted emission flows calculated using 50% or 0.50% decay rates is less than 2%. This is because the same rate of decay is expected in the baseline and project scenarios, just offset by one year. What matters is not the absolute HWP carbon decay, but the one-year shift in when it occurs.

However, the final accounting is very sensitive to the choice of growth model and discount rate. Where growth rates exceed the discount rate, such as in major timber-producing areas like the US South and Pacific Northwest, more credits per tonne of deferred carbon are generated than where growth rates are less than the discount rate. For example, assuming 20% leakage and 10% uncertainty deductions, the following numbers of credits would be produced per 100 tonnes of deferred carbon:

1 For example, CAR Forest Protocol v5.0, ACR Methodology for small non-industrial forest lands, ACR Methodology for industrial lands in Canada.

2 Zack Parisa, Eric Marland, Brent Sohngen, Gregg Marland, and Jennifer Jenkins. "The Time Value of Carbon Storage." *Forest Policy and Economics* (2022).

Product mix	Forest type	Growth rate	HWP multiplier	Raw credits / 100 tonnes - no leakage, uncertainty)	Credits / 100 tonnes - including leakage, estimated uncertainty deduction	Percent credits from growth
U.S. Average	U.S. Average	3%	1	3	2.16	37%
Maine	spruce-fir	2%	0.91	2.75	1.98	20%
Georgia	loblolly	4.1%	1.13	3.42	2.46	45%
WA/OR	doug fir	3.7%	1.08	3.27	2.35	42%

Constructing Utilization and Decay Curves

Constructing HWP decay curves is a common practice for understanding the rate of decomposition of forest products, typically carried out using datasets aggregated by the US Forest Service and other forest ecological researchers. The steps taken are:

01 Estimate the proportion of total harvested carbon that becomes HWP. Based on USFS research, the total proportion of carbon left as slash is roughly 25% for most forests[3].

02 Estimate the rate of decay of slash. Estimates vary widely and by region. In areas where burning of logging slash is common the emission is near-instantaneous; rates of 5% per year are estimated in the arid intermountain West[4], and rates of 5-15% per year have been estimated in other regions[5, 6] and subsequently used in carbon methodologies[7].

03 Estimate carbon lost as milling residue. The Climate Action Reserve has aggregated mill efficiencies by region[8]. A rough average is 60% mill efficiency, meaning that 40% of material received by the mill is lost and can be considered immediate carbon emissions.

04 Estimate the product mixture for forests harvested under the baseline scenario. CAR has published assessment area data that estimate what proportion of HWP becomes softwood lumber, hardwood lumber, plywood, oriented strand board, non-structural panels, miscellaneous, paper, and exported sawlogs for every region of the U.S.

3 Oswalt, Sonja N.; Smith, W. Brad; Miles, Patrick D.; Pugh, Scott A., coords. 2019. Forest Resources of the United States, 2017: a technical document supporting the Forest Service 2020 RPA Assessment. Gen. Tech. Rep. WO-97. Washington, DC: U.S. Department of Agriculture, Forest Service, Washington Office. 223 p. https://doi.org/10.2737/WO-GTR-97

4 Wright, Clinton S., Alexander M. Evans, and Joseph C. Restaino. "Decomposition rates for hand-piled fuels." Res. Note. PNW-RN-574. Portland, OR: US Department of Agriculture, Forest Service, Pacific Northwest Research Station. 18 p. 574 (2017).

5 Russell, Matthew B., Christopher W. Woodall, Shawn Fraver, Anthony W. D'Amato, Grant M. Domke, and Kenneth E. Skog. "Residence times and decay rates of downed woody debris biomass/carbon in eastern US forests." Ecosystems 17, no. 5 (2014): 765-777.

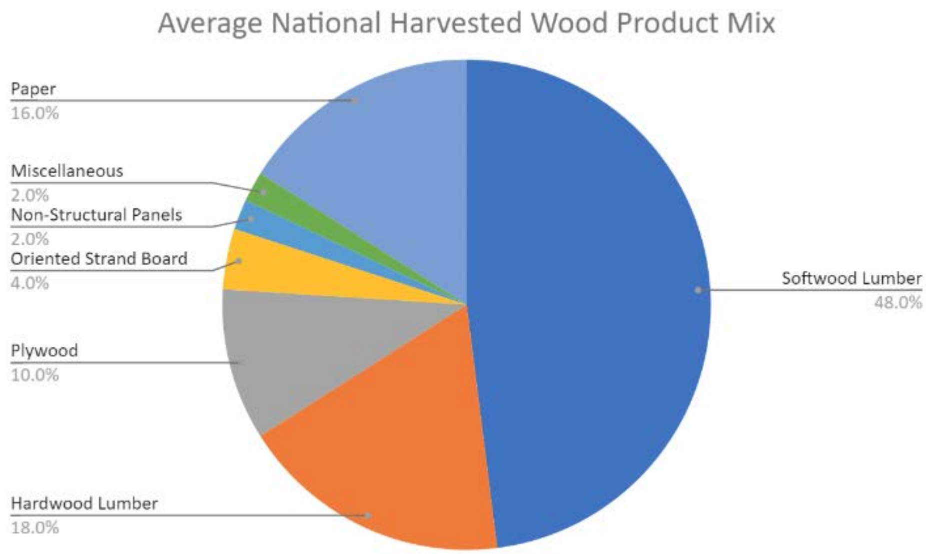
6 Yin, Xiwei. "The decay of forest woody debris: numerical modeling and implications based on some 300 data cases from North America." Oecologia 121, no. 1 (1999): 81-98.

7 https://verra.org/wp-content/uploads/2018/03/VM0035-RIL-C-Methodology-v1.0.pdf

8 https://www.climateactionreserve.org/how/protocols/forest/assessment-area-data/

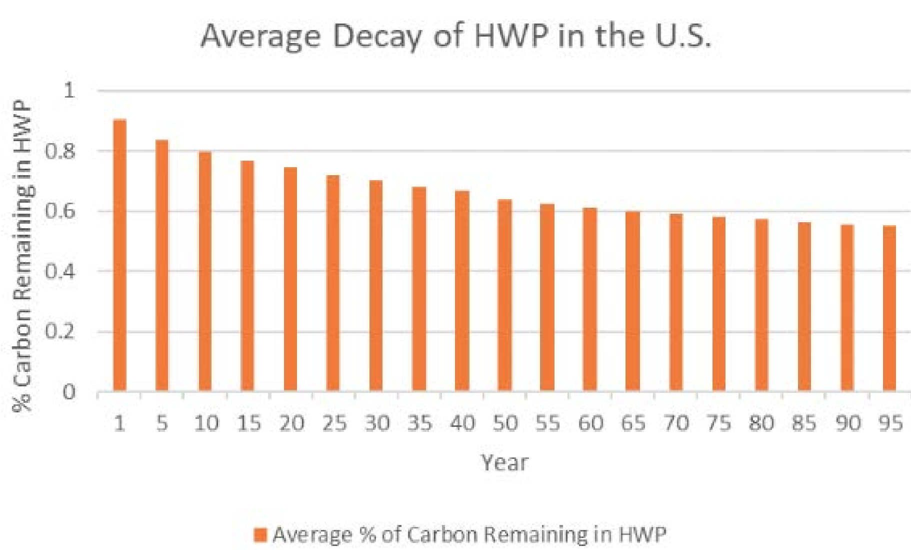
05 Estimate the specific decay of each product. USFS published datasets provide landfill and decomposition rates for harvested wood products[9]

Figure 1. Average U.S. HWP Mix. Climate Action Reserve Assessment Area Data 2.2, 2019



We used these datasets to build decay curves for each forest type and product mix across the U.S, as well as assembled them to create US national average values. The average product mix across the country is then multiplied by the specific product decay curve to obtain a national average decay curve for all products manufactured and used within the US. This average is about a 0.5% linear decay per year, meaning that 55% of the carbon that is in harvested wood products remains in HWP or landfills after 100 years.

Figure 2. Average Decay of HWP in the U.S. NCX Analysis.



9 Smith, James E., Linda S. Heath., Kenneth E. Skog., Richard A. Birdsley. "Methods for Calculating Forest Ecosystem and Harvested Carbon with Standard Estimates for forest Types of the United States." General Technical Report NE-343: 35-38.

Application of this Method

Total deferred carbon or the climate impact of a project follows this simplified equation where HWP decay over 100 years is considered an emission in both the project and baseline scenarios in the same way processing loss and slash decomposition are considered emissions.

We are calculating the discounted impact of emissions associated with HWP decay under the project and baseline scenarios, in order to fully quantify the total net benefit of delaying harvest for one year. This approach is parallel to the approach we use to calculate the cumulative overall economic impact of a one-year delay in a planned harvest[10].

Total impact (mtCO2E) = (discounted impact of emissions in the baseline scenario) - (discounted impact of emissions in the project scenario)

For an example, consider a baseline scenario where 100 tonnes of carbon are harvested in year zero of the baseline.

- 25 tons are logging slash (25%)
- 30 tons are residues from milling and processing (40% processing loss rate)
- 45 tons then move into HWP, where they decay in use at an estimated rate of 0.5% per year

Under the project scenario, with a timber growth rate of 2%, that 100 tonnes is 102 tonnes when harvested the next year.

- 25.75 tons are logging slash (25%)
- 30.9 tons are residues from milling and processing (40% processing loss rate)
- 46.35 tons then move into HWP, and decay at an estimated rate of 0.5% per year
- Applying a discount rate of 3% to account for the value of future economic damages associated with the emissions from HWP, a project deferring 100 tonnes of harvest for one year produces 2.75 credits before deducting for leakage and uncertainty.

Ongoing Work

Our current methodology uses national-level averages for some of the aggregate curves constructed as detailed in this memo. Increased localization of this approach is warranted. This may include the development and application of regional scalars, millshed-specific product utilization and decomposition curves, and the propagation of uncertainty from the cited publications into the project accounting.

10 Parisa et al. 2022.