



# The role of wood products in forest carbon accounting

By Suzanne Hearn, Forest2Market

**T**HE ONGOING CONTROVERSY over forest carbon accounting reminds me of the H.L. Mencken quote, “For every complex problem there is an answer that is clear, simple and wrong.” The clear and simple answers for complex questions, such as when to start the carbon accounting clock, for example, are oftentimes fraught with error.

How should we go about accounting for the many ways a tree continues to sequester carbon after a harvest? We know forest carbon accounting systems must account for:

- Forest inputs such as fertilizer and herbicides
- Moisture and material loss
- Electricity used to transform raw wood material to wood pellets
- Fuel (diesel) used to harvest trees and transport materials from the forest to the boiler

Methods to interpret other variables that considerably affect forest carbon—forest composition, geography and past land use, for instance—are less clear. Environmental

**Table 1**

-----25-Year Rotation: Lumber Sequestered v. Pellets Released-----							
Year	2014	2015	2019	2024	2029	2034	2039
Sequestered Carbon in Softwood Lumber	1	0.973	0.875	0.777	0.698	0.633	0.579
Tonnes CO <sub>2</sub> Remaining "In Service"	59,190,390	57,592,249	51,791,591	45,990,933	41,314,892	37,467,517	34,271,236
		59,190,390	53,152,970	47,056,360	42,143,557	38,177,801	37,467,517
			54,573,539	48,121,787	43,090,604	38,947,276	38,177,801
			56,053,299	49,305,595	43,978,460	39,716,751	38,947,276
			57,592,249	50,548,593	44,984,696	40,486,226	39,716,751
			59,190,390	51,791,591	45,990,933	41,314,892	37,467,517
				53,152,970	47,056,360	42,143,557	41,314,892
				54,573,539	48,121,787	43,090,604	42,143,557
				56,053,299	49,305,595	43,978,460	43,090,604
				57,592,249	50,548,593	44,984,696	43,978,460
				59,190,390	51,791,591	45,990,933	41,314,892
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					57,592,249	50,548,593	44,984,696
					59,190,390	51,791,591	45,990,933
						53,152,970	47,056,360
						54,573,539	48,121,787
						56,053,299	49,305,595
						57,592,249	50,548,593
						59,190,390	51,791,591
							53,152,970
							54,573,539
							56,053,299
							57,592,249
							59,190,390
<b>Total Lumber Sequestered</b>	59,190,390	116,782,639	332,354,038	573,377,306	788,889,515	983,685,086	1,068,623,298
<b>Pellets Estimated Tonnes Produced</b>	6,000,000	8,000,000	16,000,000	26,000,000	30,000,000	30,000,000	30,000,000
<b>Tonnes CO<sub>2</sub> Emissions</b>	9,122,571	12,163,429	24,326,857	39,531,143	45,612,857	45,612,857	45,612,857
<b>Sequestered v. Released</b>	50,067,819	104,619,211	308,027,181	533,846,164	743,276,658	938,072,229	1,023,010,441

— Smith, James E.; Heath, Linda S.; Skog, Kenneth E., & Birdsey, Richard A. (2006).  
Methods for Calculating Forest Ecosystem and Harvested Carbon with Standard Estimates for Forest Types of the United States.

stressors such as hurricanes or pest outbreaks and economic pressures like conversion to crop land and urbanization contribute to imbalanced carbon accounting ledgers. Add to this the difficulties of applying the same set of measurement criteria to different wood markets, and we have a complex problem indeed.

## Carbon Sequestration in Long-Lived Wood Products

One particular question that deserves an answer is how forest carbon accounting schemes account for the carbon sequestered in end-use

products. Changes in forest carbon stocks occur whenever forests are harvested, yet these changes do not mean all of the carbon sequestered by the harvested trees is immediately released into the atmosphere. In fact, it is quite the opposite.

Hundreds of products made from trees—lumber, OSB, plywood, paper, packaging and furniture, to name a few—continue to sequester carbon for decades. Table 1 (*on previous page*) displays the percentage of primary wood products that remain in an end use product after a specified number of years following harvest and production.

For example, column two indicates 57.9% of softwood lumber remains in an end-use product like lumber or furniture 25 years after the initial harvest. This means that as of today 57.9% of the softwood lumber manufactured 25 years ago remains “in service,” sequestering carbon in the studs, joists and floors of our homes. After 100 years, nearly a quarter (23.4%) of softwood lumber harvested a century earlier remains in products that sequester carbon.

When considered in terms of a typical 25-year sawtimber rotation, the ongoing sequestration benefits of a harvest are staggering. Forests in the U.S. South produced 47 million tons of southern yellow pine lumber in 2012. Converting this to tonnes and taking moisture content and carbon percentage into account translates into carbon sequestration, expressed as its CO<sub>2</sub> equivalent, of 59,190,390 tonnes.

By 2038, when 57.9% of lumber from the original harvest remains in service in products, 34,271,236 tonnes remain sequestered (*Table 2*).

Now let us consider the CO<sub>2</sub> emissions from wood pellets produced from the same harvest (*Table 3*). If we estimate 6,000,000 tonnes of pellets

Table 2

Southern Yellow Pine, Carbon Sequestered Expressed as CO <sub>2</sub> Equivalent	
47,000,000 green short tons x 0.907185 =	42,637,695 green tonnes
42,637,695 / 1.15 moisture content =	37,076,257 bone dry tonnes
37,076,257 x 0.435 tonnes carbon =	16,128,172 tonnes C per tonne lumber
16,128,172 x 3.67 tonnes CO <sub>2</sub> =	59,190,390 tonnes CO <sub>2</sub> e per tonne lumber

Table 3

Pellets, Carbon Emitted Expressed as CO <sub>2</sub> Equivalent	
6,000,000 tonnes produced	
6,000,000 / 1.05 moisture content =	5,714,286 bone dry tonnes
5,714,286 x 0.435 tonnes carbon =	2,485,714 tonnes C per tonne pellets
2,485,714 x 3.67 tonnes CO <sub>2</sub> =	9,122,571 tonnes CO <sub>2</sub> e per tonne pellets

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were produced from sawtimber harvest byproducts, we find 9,122,571 tonnes of CO<sub>2</sub> are released to the

atmosphere from those pellets.

When we subtract the 9,122,571 tonnes of CO<sub>2</sub> emitted from those pel-

lets from the 59,190,390 tonnes of CO<sub>2</sub> sequestered in the lumber, we have a net gain of 50,067,819 tonnes

Table 4

-----Fraction of Carbon in Primary Wood Products Remaining in End Uses-----							
Year After Production	Softwood Lumber	Hardwood Lumber	Softwood Plywood	OSB	Non-structural Panels	Misc. Products	Paper
0	1	1	1	1	1	1	1
1	0.973	0.938	0.976	0.983	0.969	0.944	0.845
2	0.947	0.882	0.952	0.967	0.939	0.891	0.713
3	0.922	0.831	0.930	0.952	0.911	0.841	0.603
4	0.898	0.784	0.909	0.937	0.883	0.794	0.509
5	0.875	0.741	0.888	0.922	0.857	0.749	0.430
6	0.854	0.701	0.869	0.908	0.832	0.707	0.360
7	0.833	0.665	0.850	0.895	0.808	0.667	0.299
8	0.813	0.631	0.832	0.881	0.785	0.630	0.243
9	0.795	0.600	0.815	0.869	0.763	0.595	0.192
10	0.777	0.571	0.798	0.856	0.741	0.561	0.149
11	0.760	0.545	0.782	0.844	0.721	0.530	0.115
12	0.743	0.520	0.767	0.832	0.701	0.500	0.088
13	0.728	0.497	0.752	0.821	0.683	0.472	0.068
14	0.712	0.476	0.738	0.810	0.665	0.445	0.052
15	0.698	0.456	0.724	0.799	0.647	0.420	0.040
16	0.684	0.438	0.711	0.789	0.630	0.397	0.030
17	0.671	0.421	0.698	0.778	0.614	0.375	0.023
18	0.658	0.405	0.685	0.768	0.599	0.354	0.018
19	0.654	0.389	0.673	0.759	0.584	0.334	0.013
20	0.633	0.375	0.662	0.749	0.569	0.315	0.009
21	0.622	0.362	0.650	0.740	0.555	0.297	0.006
22	0.611	0.349	0.639	0.731	0.542	0.281	0.005
23	0.600	0.337	0.629	0.722	0.529	0.265	0.004
24	0.589	0.326	0.619	0.713	0.571	0.250	0.003
25	0.579	0.316	0.609	0.705	0.505	0.236	0.002

— Assumes 47,000,000 green short tons of southern yellow pine harvest goes toward lumber production.

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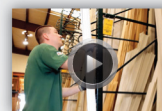
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CO<sub>2</sub> sequestered (column 2, Table 1).

To consider these benefits across time, the amount of lumber taken in an initial harvest is multiplied by the percentage of lumber that remains in an end-use product in the years following that harvest. Immediately after a harvest, 100% of the lumber produced sequesters carbon. Within one year, 3% of that lumber is no longer in use. As a result, only 97% of the lumber produced in the initial harvest remains in use to sequester carbon in year two.

Table 4 (previous page) shows these cumulative affects at the time of harvest and one, five, 10, 15, 20 and 25 years into the future. Keep in mind, this sequestration benefit is from the softwood lumber produced from just one harvest. These numbers do not account for the carbon that remains sequestered in other wood

products, such as OSB or paper.

## Carbon Accounting for Wood Pellets

Just as it is illogical to believe 100% of the carbon sequestered by a harvested tree is immediately released to the atmosphere, it is irrational to include the carbon from a whole tree when accounting for carbon in the wood pellets used to generate electricity. Pellets are produced from harvest byproducts such as the unmerchantable tops and limbs of whole trees. A good portion of the carbon stored by those trees remains sequestered in lumber and other forest products.

Likewise, carbon accounting for wood pellets sourced from whole pulpwood trees (the come-along products of a sawtimber harvest) must count only the carbon sequestered by

those small trees that go into the pellet, not the large sawtimber-sized trees used for lumber and other long-lived products.

An accurate forest carbon accounting system must consider both forest carbon and carbon that remains in harvested wood products (Table 5). A failure to account for carbon stores in long-lived wood products considerably inflates emissions estimates in the harvest year. We simply cannot declare wood-to-energy is a problem until we account for and explore the many challenges inherent in complex systems of carbon accounting.

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Calculations in this piece are based on logic presented in *Dovetail Partners Carbon in Wood Products – The Basics*.

Table 5

-----CO <sub>2</sub> Remaining "In Service"-----		
Year	2014	2015
Sequestered Carbon in Softwood Lumber	1	0.973
CO <sub>2</sub> Remaining "In Service"	59,190,390 in 2014 harvest	59,190,390 in 2015 harvest
		59,190,390 * 0.973 = 57,579,249 from 2014 harvest
Total Lumber Sequestered	59,190,390	116,782,639



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