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A Proposed Methodology for Assigning Sequestered CO2 from "Climate-Friendly" Forest Management to Timber used in Long-Lived Building Products

A white paper intended for discussion around the use of Life Cycle Assessment approaches for building products and buildings to advance sustainability in the design and construction industry

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Abstract

Wood is increasingly used in construction, especially as mass timber in large commercial, institutional, and multifamily buildings, and has gained a reputation as a low-carbon alternative to steel and concrete framing. Current building industry environmental life cycle assessment practices assume that forest operations are carbon-neutral at the landscape scale and ignore the role that timber construction has to play in providing an incentive for increased carbon sequestration in forests through forest management practices that exceed business as usual. The amount of carbon sequestered per board foot of lumber purchased can vary widely because of forest management practices. Specification and procurement choices that take into account the carbon impact of forest management practices can have significant effects on the carbon footprint of wood products.

This paper proposes a methodology to quantify the impact of selecting "climate-friendly" wood, or wood from forests managed to higher sustainability standards than regulatory requirements. Recent research shows that, on average, forests managed to higher sustainability standards (in this case, those certified by the Forest Stewardship Council, FSC) sequester more carbon per board foot than forests managed in a business-as-usual (BAU) scenario. We propose that when building projects specify and procure wood construction products from FSC-certified forests, the project can take credit for the additional carbon sequestered in the forestlands that the wood came from – i.e. projects can include the difference in carbon sequestered between FSC and BAU forests. This paper describes a series of conversions from finished board feet of wood products to nominal board feet of lumber, to board feet of timber, to sequestered CO2e.

A Proposed Methodology for Assigning Sequestered CO2 from "Climate-Friendly" Forest Management to Timber used in Long-Lived Building Products

Introduction

Wood (along with other bio-based materials) is unique among building products in that the land use impacts of its production involve a natural carbon cycle of a scale often larger than the other impacts of its production. Life cycle assessment (LCA) has traditionally avoided addressing land use impacts because many cannot be quantified into established impact categories, such as habitat degradation, loss of biodiversity, or impacts on water quality. The global warming potential of land-use impacts associated with wood production, however is more quantifiable.

The ISO 21930 standard allows forests that have stable or increasing carbon stocks (a condition they describe as "forest sustainability") to dispense with accounting for any change in forest carbon stock, assuming this is a conservative way to estimate the carbon footprint of the timber industry. Accordingly, current EPDs written under the standard account only for the fossil fuels used in operations such as logging, milling, and transportation. Current Environmental Product Declarations (EPDs) for wood products in North America (and globally) interpret the ISO 21930 standard's requirement for a demonstration of forest sustainability at a very large scale. For instance, the American Wood Council EPD for Glued Laminated Timber effectively argues that since the United States has no net decrease in forest area (which is assumed to be a good proxy for carbon stock), all wood from the country can be considered "sustainable" and there is no need to account for forest carbon in their EPDs for wood products.[1] Or as Bowers *et al* (2020) put it in an industry-wide EPD for glued laminated timber: "Consideration of the biogenic carbon neutrality of wood is valid for North American wood products as national level inventory reporting shows overall increasing and/or neutral forest carbon stocks in recent years."[2]

While it is clearly unreasonable to attempt to measure the sustainability of a forest at the scale of the individual tree or stand of trees (the smallest unit used for planning wood harvests), For builders interested in making impactful and targeted procurement choices, continent- and industry-wide averages are of extremely limited utility. The rate of tree growth and the carbon dynamics within forests are quite diverse between regions across the continent (e.g. Pacific Northwest, Northeast, Southeast, etc.), and even sub-regions can have very divergent patterns of carbon retention. Wood taken from a region or sub-region with declining carbon stocks (i.e. areas of significant forest loss) should not be considered carbon-neutral just because comparable areas of forest are being planted far away. Nor does this kind of broad-brush averaging account for the difference in carbon stored per acre or other values of forests in different regions and sub-regions. But more importantly for this paper, assuming carbon neutrality at the national scale ignores the opportunity for "carbon-friendly" forest management practices to positively increase the total amount of carbon sequestered in forests since it subsumes all management regimes into one undifferentiated block. Within a region where forest carbon per acre is relatively constant, however, evidence that some forests outperform the average in

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[1] American Wood Council, 2020: Environmental Product Declaration, North American Glued Laminated Timber, sec. 3.2 (p. 14): "ISO 21930 requires a demonstration of forest sustainability to characterize carbon removals the factor of -1 kg CO2e/kg CO2. ISO 21930 section 7.2.11 Note 2 states the following regarding demonstrating forest sustainability: 'Other evidences such as national reporting under the United Nations Framework Convention on Climate Change (UNFCCC) can be used to identify forests with stable or increasing forest carbon stocks.' The UNFCCC annual report of the US, as well as the report from Canada provide annual net GHG Flux Estimates for different land use categories in Table 6-1. This reporting indicates national increasing and/or neutral forest carbon stocks in recent years. Thus, North American forests meet the conditions for characterization of removals with a factor of -1 kg CO2e/kg CO2.

[2] Bowers, Tait; Tuettmann, Maureen; Ganuly, Indroneil; Eastin, Ivan, revised March 2020: "CORRIM Report: Life Cycle Assessment for the Production of Pacific Northwest Glued Laminated Timbers", p. 42. Available at https://corrim.org/wp-content/uploads/2020/06/CORRIM-AWC-PNW-Glulam-v2.pdf

carbon sequestration should be considered for addition to current accounting practices.[3] The methodology in the paper attempts to quantify the increase in sequestration due to carbon-friendlier forestry practices.

Current LCA practice

While not the primary focus of this paper, understanding how the CO2 stored in the wood mass of wood products is accounted for in LCA is important for context. Current LCA practice begins a product lifecycle with the raw material extraction stage, conventionally designated A1. For wood products, this generally includes the impacts associated with forest operations: fuel and material consumed in chainsaws and other pieces of equipment used to fell and strip trees from the forest. Stage A2 includes the impacts of moving felled trees to the sawmill, and A3 includes milling.

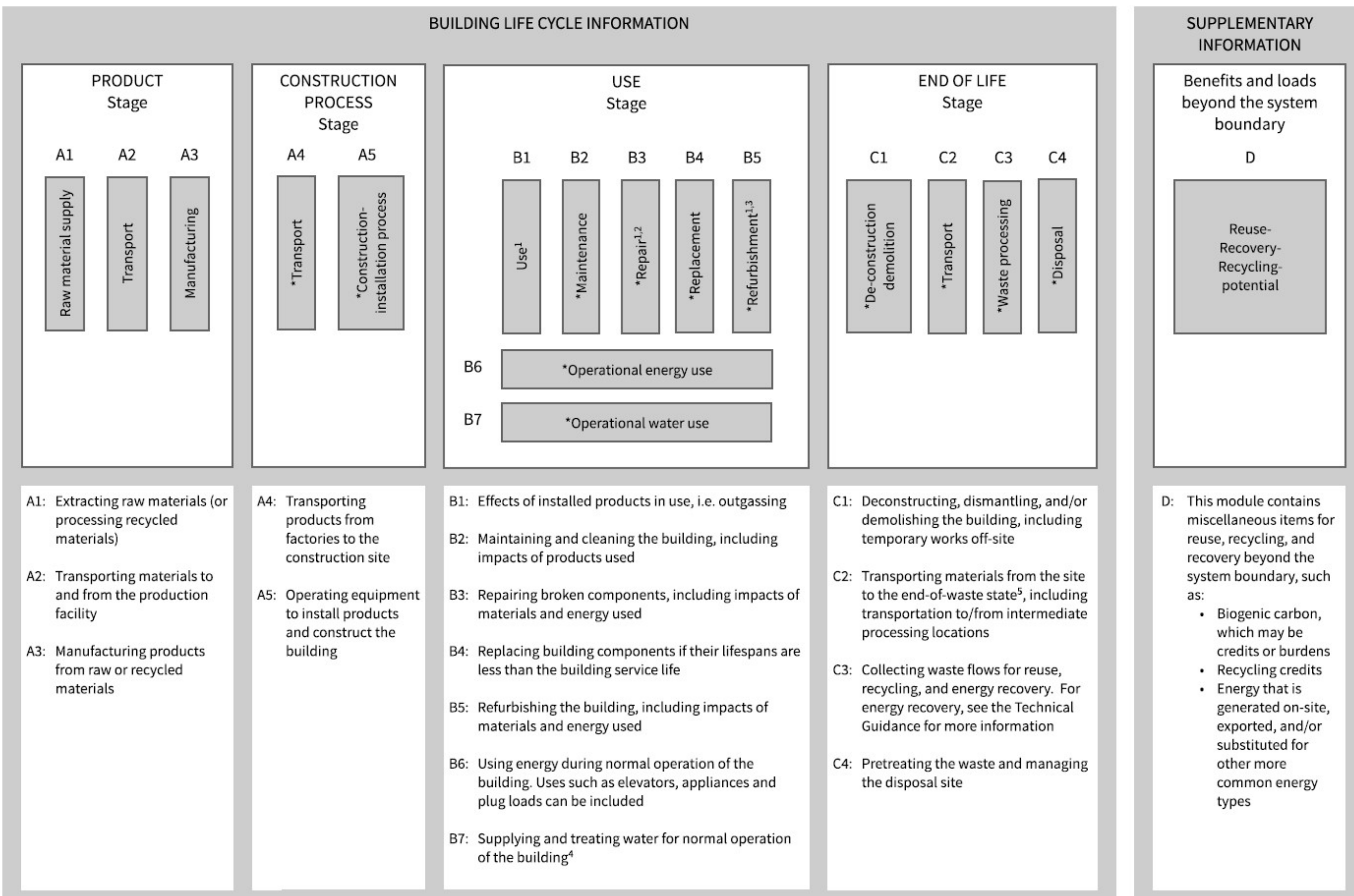

Figure 1- Standard life cycle stages and modules

from Carbon Leadership Forum's "Life Cycle Assessment of Buildings: A Practice Guide" (in turn adopted from EN 15978), available at: https://carbonleadershipforum.org/lca-practice-guide/

[3] Conversely, wood from demonstrably unsustainable practices (e.g. forestland conversion to non-forest habitat) should be penalized compared to a conventional scenario that maintains a carbon balance on the landscape scale; however, such a proposal is outside the scope of this paper.

For instance, EN 15804, section 6.2.2 defines stage A1 as "Raw material extraction and processing, processing of secondary material input (e.g. recycling processes)".[4] The AWC EPD for Glulam mentioned above states "Upstream resource extraction includes removal of raw materials and processing …A1 also includes reforestation processes that include nursery operations…, site preparation, as well as planting, fertilization, thinning and other management operations."[5]

The cumulative impacts of management choices on forest ecosystem carbon stocks are entirely missing. As noted above, they are assumed to be carbon-neutral as long as the total forest area, even at a national scale, is stable or increasing, so excluding them is seen as a conservative accounting approach. We propose that the differential carbon impacts of carbon-friendlier forestry practices versus BAU can be included without violating or disputing this conservative assumption.

Current EPDs do estimate the "biogenic" carbon of wood products, representing the amount of atmospheric CO2 that was converted to the cellulose and lignin molecules that make up wood; these are based directly on the mass of wood in the functional unit of the EPD. Wishnie refers to this biogenic carbon as carbon "storage," as opposed to carbon "sequestration" in living forests,[6] a convention that this paper follows. ISO 29130 states that "for wood entering the product system, biogenic carbon may only use the negative characterization factor [i.e. show any value for biogenic carbon stored in wood products] when the wood originates from sustainably managed forests," which in North America are taken to include forests certified by FSC and/or the Sustainable Forestry Initiative (SFI).[7] Some users argue that biogenic carbon should not be included in carbon accounting for a building project because at the end of life most wood products decompose or are burned, releasing the CO2 back to the atmosphere. However, most end-of-life information indicates that within a typical building lifetime most biogenic carbon will not have been released to the atmosphere, resulting in some long-term storage. In addition, not all wood within a landfill decomposes within the timeframe of an LCA study; much carbon is almost permanently sequestered.[8] Whether or not biogenic carbon is included in this determination depends on the expected life of the building project, the time scale of the EPD, and expect mix of end-of-life scenarios (some wood can also be recycled into new wood products). Within whole building LCA tools such as Tally, biogenic carbon is usually presented to users as an optional value to add or not at one's choice. Biogenic carbon stored in wood products is not the same as the subject of this paper, which is additional carbon sequestered in forests as a result of carbon-friendlier forest management practices.

Accounting for sustainable forestry practices

In the pivotal 2018 Ecotrust paper "Tradeoffs in Timber, Carbon, and Cash Flow under Alternative Management Systems for Douglas-Fir in the Pacific Northwest"[9] Diaz *et al* compared the impact of forest management scenarios for business-as-usual and carbon-friendly managed forests on the amount of carbon sequestered in forest stands over time. The business as usual case was defined as compliance with Oregon and Washington Forest Practice Act minimums

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[4] UL Standard 10010 - Product Category Rules for Building-Related Products and Services in North America, Part A: Life Cycle Assessment Calculation Rules and Report Requirements (version 3.2)

[5] American Wood Council, 2020: Environmental Product Declaration, North American Glued Laminated Timber, section 2.3 (p.9) available at https://www.awc.org/pdf/greenbuilding/epd/AWC-EPD-Glulam-1307.pdf

[6] Mark Wishnie, quoted in FDN Staff, 2020: "How does mass timber help capture carbon?" https://www.forestdatanetwork.com/news/how-does-mass-timber-help-capturing-carbon

[7] ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017, 2019, sec. 8.1.1 (p. 32)

[8] Tall Wood Design Institute: Carbon Impacts of CLT. Kwok, Alison; Isabel Rivera, Hannah Zalusky, Hannah McKay, 2019, "Info Sheet #14: End-of-Life CLT Carbon Impacts," available at http://tallwoodinstitute.org/sites/twi/files/Info%20Sheets_Final_200616.pdf citing US EPA WARM model, 2016, p. 116

[9] Diaz *et al*, 2018: "Tradeoffs in Timber, Carbon, and Cash Flow under Alternative Management Systems for Douglas-Fir in the Pacific Northwest", Forests 2018, 9, 447; doi:10.3390/f9080447

("FPA" scenarios) while the carbon-friendly managed cases were taken to follow FSC rules requiring 1) larger areas of uncut forest as buffers around streams ("Riparian Management Zones") and 2) greater retention of standing trees per acre harvested overall ("~FSC" scenarios, as FSC's many other rules were not applied). For both management practices, Diaz *et al* modelled a short-rotation (38-44 years) and long-rotation (75 year) version. Diaz *et al* found that "higher average carbon storage per cumulative timber output among FSC scenarios relative to business-as-usual, indicating FSC-certified wood carries an embedded carbon benefit."[10]

The source of this higher impact is due to the retention of trees on the landscape and the growth of larger trees: older trees add more carbon per year of growth than young trees, because annual growth consists of adding a new roughly cylindrical layer to the outside of a tree (the growing layer lies just under the bark), and older trees have a larger diameter and greater height than young trees. In the Pacific Northwest region in particular, the dominant Douglas-fir trees harvested for architectural and structural use can continue to have annual increases in annual carbon storage up to age 100 or more. (The degree to which this is true among the dominant species of other regions is not clear to the authors at this time, and is important to investigate; however, variation would change the quantities of the impacts outlined here but not the methodology.) As a result, allowing trees to get older – i.e. have a longer rotation time between harvests on the same stand – will result in both greater yields of timber (as measured in board feet) per year, and greater carbon sequestered in forest land.[11] Per Diaz *et al*'s findings, the greater buffer and retention requirements in FSC management practices result in enough additional older trees to substantially increase the carbon sequestered in forests.

While the numbers used here are based on research specific to the North American Pacific Northwest (PNW) region, the same methodology could be used in other areas where equivalent data exist comparing the carbon sequestered on sustainably-managed versus business-as-usual forests. In addition, while the data presented here from Diaz *et al* is based on forest growth simulations, the same methodology can be used with other data sources such as forthcoming remote-sensing and timber harvest data.[12]

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[10] Ibid, p. 1

[11] The fact that long-rotation harvesting is not common practice is due to the relatively high discount rates applied by most commercial timber operators – the future larger number of board feet has a lower net present value than the smaller quantity harvested today – and the loss of sawmills prepared to cut large logs. This calculation also notably excludes many other values achievable with long-rotation forestry as well such as watershed protection, maintenance of biodiversity, and recreational and cultural value.

[12] Specifically, Diaz *et al* "present a hybrid indicator for the "embodied carbon" of wood products generated in each management scenario, calculated as the average carbon sequestered in the forest and wood products divided by the cumulative amount of timber produced over the modeling timeframe (100 years)" (p.12). We have summarized the key figures in the following table (p. 17):

tCO2e sequestration per thousand board feet (tCO2e/MBFlog-Scribner)	**BAU (FPA-short)**	**~FPA-long**	**~FSC-short**	**~FSC-long**
Oregon median	2.4	3.1	4.2	3.9
Washington median	2.9	3.7	4.1	3.9

The larger carbon storage in the ~FSC-short scenario vs. the ~FSC-long scenario is only an artifact of the 100-year study period. The ~40 year short rotation is at a point in its cycle where it has produced more wood than the ~75 year long rotation, which has not returned close to its mature state at the cutoff period.

The ~FPA long scenario is not used in this paper, but could be used by others where data is available to support identification of wood products from forests using that style of management.

While the numbers used here are based on research specific to the North American Pacific Northwest (PNW) region, the same methodology could be used in other areas where equivalent data exist comparing the carbon sequestered on sustainably-managed versus business-as-usual forests. In addition, while the data presented here from Diaz *et al* is based on forest growth simulations, a similar methodology can be used with other data sources such as forthcoming remote-sensing and timber harvest data. Diaz *et al* expect to publish this data in the future, personal communication. For now, see their presentation from the 2019 Washington Environmental Council "Missing the Forest: How Forest Practices

Accounting for sustainability improvement

The proposed approach accounts for the increase in carbon sequestration attributable to carbon-friendly forestry practices. While Table 1 gives values for the total amount of wood sequestered in the forest associated with each MBF of logs produced, we are only interested in the difference between BAU (FPA short) and FSC scenarios. When a wood purchaser chooses certified sustainably harvested wood there is a clear additionality to their decision, as non-certified wood is always available, with the same performance characteristics, and at a lower price. One is paying extra in order to provide a premium back to the forest industry (ideally, though not always, to the forest landowner) in exchange for the benefits that sustainable forest management provides above and beyond business as usual. Sustainability certification systems, most notably FSC, exist in order to give purchasers this choice. While the additional carbon stored in certified forests has not been recognized or allocated in most regulatory or voluntary carbon emissions markets, in the absence of regulation it would make sense that it would belong to the purchaser of certified wood products (or, in cases of tradable FSC certificates, to the certificate holder) so that the landowner would receive a financial benefit in exchange for the carbon stored.[13] In contrast, the base level of carbon sequestered in BAU working forests would generally be considered to be the baseline condition for any carbon accounting system for forests, which matches the assumption of carbon-neutrality for steady-state forest stocks in ISO 21930.

Purchasers of certified sustainably harvested wood could choose to report the additional carbon sequestered due to their use of FSC-certified wood when preparing a voluntary Whole Building LCA report. There is not an accepted practice of where to place this within an LCA. It could be considered part of module A1, but is not a good fit as A1 rules generally exclude impacts from land management that do not rise to the level of land use change. It could be included in module D, which is for items outside the system boundary. Biogenic carbon is generally reported in module D, which is a relevant precedent. One could also consider creating a module "A0" to include impacts to products from before the extraction stage.

Of greater interest than where to place the carbon sequestered in sustainably managed forests is determining the value at stake. The difference between BAU and FSC scenarios is given in Table 1, showing comparison of the various FSC scenarios to the in-state BAU case, and the average of the two values. The average was used for further calculations given the lack of published information about typical FSC management practices. Anecdotal evidence from FSC group managers and FSC-certified landowners suggests that many FSC forests have a longer rotation period or otherwise do not cut the maximum allowed under FSC rules; typical procurement of FSC wood does not allow for a determination of whether the wood comes from a forest with a short or long rotation management regime.

CO2e sequestration difference between FSC and BAU practices (tCO2e/MBF-log-Scribner)	**low**	**high**	**average**
Oregon	1.5	1.8	1.65
Washington	1	2.1	1.55

Table 1 – CO2e sequestration increase from ~FSC practices

From trees to wood products

The unit "tCO2e/MBF log-Scribner" in Table 1 and Table 2 needs some unpacking.[14] "MBF-log-Scribner" is a unit that is specific to the North American timber industry. A Board Foot, "BF," is a unit of wood nominally 12 inches

Impact the Carbon Embodied in Mass Timber Projects," available at: https://wecprotects.org/wp-content/uploads/2019/11/Embodied-Carbon-of-Forest-Products_Slides.pdf

[13] If future carbon trading schemes do allow for the creation of offsets based on improved forest management practices then market regulations will define whether the offsets stay with forest land owners or go with the sale of lumber along the value chain.

[14] The unit tCO2e is the metric tons Carbon Dioxide equivalent, which is a standard unit in LCA used to measure global warming impact.

square by 1 inch high (i.e. one square foot of a board one inch thick), and “MBF” is one thousand board feet. However, the timber industry confusingly uses the term “board foot” to refer to a number of distinct volumetric units that reflect different stages of timber processing.[15] To be clear, this paper references the following units:

1. BF-log-Scribner: the nominal volume of a log of timber (unsawn tree trunk)
2. BF-lumber-nominal: the *nominal* volume of finished lumber (sawn wood boards)
3. BF-lumber-actual: the *actual* volume of finished lumber (finished wood boards)

Accordingly, to assign a value of CO2e attributable to the use of a known volume of certified sustainably harvested wood using Diaz *et al*’s values, one must convert the wood volume (often in cubic feet) first to *actual* board feet, then to *nominal* board feet, and finally to BF-log-Scribner. These conversions are linear and use the following conversion factors:

- BF-log-Scribner : BF-lumber-nominal varies depending on sawmill efficiency, and is generally held as proprietary information by sawmill owners. For the purposes of argument, one can use 1 BF-log-Scriber = 1.75 BF-lumber-nominal for 2x8 lumber produced in the PNW.16
- BF-lumber-nominal : BF-lumber-actual varies depending on the size of the piece of lumber in question. For example, a 2x8 has a nominal cross-sectional area of 16”2 (2” x 8”) but an actual cross-sectional area of 10.875”2 (1.5” x 7.25”). For a 2x8, 1.47 BF-lumber-nominal = 1 BF-lumber-actual.

To determine how many tons of CO2e are sequestered by an actual piece of wood using average Oregon values, one would calculate:

$$\frac{1.65\ \text{tCO2e}}{\text{MBF-log-Scribner}} \times \frac{1\ \text{MBF-log-Scribner}}{1.75\ \text{MBF-lumber-nominal}} \times \frac{1.47\ \text{MBF-lumber-nominal}}{1\ \text{MBF-lumber-actual}} = \frac{1.39\ \text{tCO2e}}{\text{MBF-lumber actual}}$$

Application to Buildings with Wood Products

To see how this factor for climate-friendly forestry sequestered carbon compares to the LCA impact and biogenic carbon of wood products, consider a hypothetical building that uses 10,000 board feet (actual dimensions) of glulam – enough to frame the roof for a small commercial building. Per Athena Impact Estimator[17], the per cubic foot impact of glulam is 0.72 kgCO2e/ft^3, while accounting for stored biogenic carbon changes this factor to -8.47 kgCO2e/ft^3. For comparison, the American Wood Council’s industry-wide EPM for glulam[18] gives an impact value of 5.28 kgCO2e/ft^3

[15] The *log to board* (or *timber to lumber*) conversion comes about because foresters refer to the volume of a raw log in terms of the volume of sawn board feet that can be expected from it using the “Scribner” scale that was fixed many years ago. As sawmill technology has improved mill efficiency, it is now common to produce more than one nominal board foot of sawn lumber from one “board foot” of a log of timber. The difference between *nominal* and *actual* dimensions of sawn lumber is due to rough lumber sawing variations, shrinkage of wood as it dries after it is cut, and allowances for planning a rough board to its finished dimensions. Typical industry practices use nominal dimensions, while LCA calculations demand actual dimensions, leading to these conversions.
Alternately, one could cite CORRIM’s industry-wide EPD for glulam that says it took 1.93 m^3 of roundwood to produce 1 m^3 of glulam (Bowers *et al*, p. 55)

[16] Personal communications from forest industry members.

[17] Athena Impact Estimator is a building LCA software tool that contains a library of impact factors. Calculations were run using Athena data available in September 2020. https://calculatelca.com/software/impact-estimator/

[18] AWC, op. cit., p. 11 & 15. Values have been converted from m^3 to ft^3.

and a stored biogenic carbon value (at the factory gate) of -25.5 kg/ft^3. When using actual dimensions, 12 board feet = 1 ft^3 so 10,000 board feet = 833 ft^3. For 10,000 board feet, we would see the following impacts:

	Using Athena values		**Using AWC values**	
Typical A1-A3 phase impact of fossil fuel use in extraction, transport, and harvesting	3,530	kgCO2e	4,400	kgCO2e
Biogenic stored carbon	-10,590	kgCO2e	-21,250	kgCO2e
Typical A1-A3 plus Biogenic stored carbon	-7,060	kgCO2e	-16,850	kgCO2e
	Per Diaz *et al*, using method above			
Additional carbon sequestered in forest land if ~FSC-average wood sources are used compared to BAU sources	-13,900 kgCO2e			

Table 2- CO2 impacts of 10,000 board feet of glulam per typical LCA factors, biogenic factors, and carbon-friendly forestry sequestration factors

Even allowing for the limited nature of the one study that forms the basis of this factor, the amount of carbon that can be sequestered in forests with carbon-friendly management practices is much larger than the typically reported LCA impacts for wood products and on the same order of magnitude as the amount of biogenic carbon stored in wood products themselves.

Proposal Limitations and Needs for Further Research

This paper makes its proposal as a way to advance the discussion on the how to account for the stored carbon in forests and in durable wood products between the forest industry and the building industry. While the general approach is hopefully valuable, the numerical results are illustrative rather than definitive. Specifically, the numerical solutions provided here should not be relied upon as accurate calculations of wood carbon footprint related to building projects. The specific values presented here are drawn from one simulation-based study in one region of the country; a robust industry approach using this methodology would need to have multiple studies across multiple regions. More regionally specific studies across the continent would help to redress the dominance of PNW forest data in the discussion of forest management practices, which obscures the great importance of the forests of the Northeast, the upper Midwest, and the South. Regional data could eventually allow North American forest product EPDs to adopt a regional basis, which would give forest landowners a more relevant baseline from which to measure their own operations than national averages.

In addition, this paper draws on Diaz e*t al*'s study that used a forest growth simulation model to compare different management scenarios. While simulation models are a standard part of forest carbon impact assessment, empirical measurements or estimates of observed carbon stock changes would be a far more precise, reproducible, and transparent way to attribute carbon stock change to forest areas, operations, or management practices. Encouragingly, Diaz and Ecotrust are developing an approach integrating long-term satellite data, nationwide forest inventory systems, and county- and state-level timber product output reports to characterize the "upstream" embodied carbon for forest products generated by distinct landowner types and regions across the contiguous USA.[19] This approach also promises to get around the challenge of using certification schemes like FSC or SFI as a stand-in for actual forest management practices. While laudable (especially FSC's inclusion of community and ecosystem benefits as part of their standard), certification schemes do not enable wood purchasers to identify the actual management practices adopted by the source forests; they indicate the lower bounds of acceptable practices (e.g., harvest opening size, replanting requirements, etc.)

[19] Diaz, David, personal communication.

that landowners may well have exceeded. Use of FSC certification in lieu of measured forest data might understate the benefits of “better than FSC” forest management practices; alternately, the lack of FSC certification also does not mean that forests are not increasing their carbon stocks. Measuring actual forest carbon stocks would be a big step forward in allowing wood producers and wood consumers to accurately value and reward climate-friendly practices.

Conclusion

As the building industry moves towards greater use of wood (and especially mass timber), there will be increasing pressure on the forest products sector to increase production. However, increasing the pace of forest harvesting (i.e. shorter rotation lengths between timber harvests) is a short-term strategy that reduces long-term carbon sequestration and timber yields. Diaz *et al* demonstrated that forest yields and carbon sequestration can be increased together through adoption of "carbon-friendly" forest management practices and, in particular, longer rotations that allow for the growth of larger trees in the greater buffer and retention areas in FSC management scenarios. If the increase in timber buildings is to lead to a positive shift in forest management practices, the additional carbon sequestered through carbon-friendlier management practices must be valued so that forest owners and wood product producers can be rewarded for adopting this shift. The first step in recognizing this value is accounting for it. Building projects can do this accounting by converting volumes of wood product used, typically available in actual geometrical units, to nominal forest industry units (e.g. board-foot-log-Scribner) that are used in the carbon sequestration calculations performed by Diaz *et al*. The resulting carbon sequestration values can be added to the module D of a WBLCA calculation or, perhaps more controversially, proposed as a module “A0” to recognize the linkage of wood buildings to the landscape impacts of the forest industry.[20]

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[20] Whether this is a tradeable commodity is outside the scope of discussion; not only is most forestry currently outside the scope of tradeable carbon credits, but building projects do not use whole building LCA to account for tradeable carbon credits either. I.e. if this approach is used to determine how many credits to claim in an offset transaction the credits should not be double-counted elsewhere.

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