In September, 2009, Dovetail Partners distributed a critique of *Wood Products Carbon: Can Increased Production Help Solve the Climate Crisis*?, a report released by The Wilderness Society. At the generous invitation of Dovetail staff, I submitted a general response [link] for inclusion in the October newsletter. This more detailed document responds to specific page-by-page comments in the review.

Key weaknesses listed in the Dovetail review, with my brief response, are:

- *Disregard of the existence of complete life cycle analyses (LCA) of wood products manufacturing and carbon storage;*

  Rather than disregard these analyses, I drew upon them extensively in our report. Please see second p. 3 comment below. These analyses typically exclude forest impacts which, for reasons explained in my general response, I believe should be included. Available LCAs also tend to focus on construction lumber rather than the entire suite of wood products. One analysis of the forest products sector as a whole, cited in the report on p. 22, concluded that the sector releases twice the GHGs that it stores long-term, even without considering forest impacts.

- *Simplification of the importance of wood-based products and fuels as substitutes for fossil fuel-based products (avoided emissions issue);*

  Substitution benefits were discussed in several parts of our report (please see p. 4 comment below). If anything, I probably complicated rather than simplified this issue by introducing several alternative ways to interpret these potential (but not certain) benefits. See further discussion of LCAs and substitution in my general response.

- *Faulty assumptions regarding end-of-life disposal of wood products;*

  The fossil emissions portion of the report assumed 30% recovery of materials. This is a valid point for the carbon losses portion of the report, but has little effect on overall conclusions. Please see response to p. 16 comment below.

- *Establishment of a false dichotomy between healthy carbon-storing forests and efficiently manufactured carbon-storing wood products;*

  The Broader System Effects section on pp. 16-19 of our report describes several ways that harvesting material may either detract from *or enhance* long-term forest carbon storage. In special situations, such as unnaturally dense fire-prone forests, removing material can help protect long-term carbon stores. But in general there is limited potential to *increase* timber harvest without *decreasing* forest carbon stores. One person's false dichotomy may be another's caution against heedless expansion. That said, a moderate level of timber harvest (which transfers some carbon to products) can clearly coexist with modest stores of forest carbon. See also first p. 30 comment below.

- *A tendency to single out wood production as a culprit in our nation's use of energy and materials.*

  Our report was generated partly in response to a lack of attention to wood product impacts in recent publications. I did not set out to compare various materials, as abundant information is available on that topic. As mentioned in response to the second point above, I did acknowledge that impacts of other materials might be greater.

The following pages discuss criticisms of specific report passages. Rather than repeat the material in the Dovetail review I have simply identified the comments by report page number.

<u>First p. 3 comment and p. 5 comment.</u> The critique suggests that eliminating logging losses in Table 2 of our report would show that 22% to 59% of the wood leaving harvest sites would remain stored after 100

years. The recalculated medium estimate would actually be 2% (59 tons lost for every 60 tons removed from the site). I recommend not computing a total estimate for the low and high ranges (those totals are blank in Table 2) because the same wood is unlikely to experience either the lowest or the highest losses at every processing stage. More likely, a product that experiences high losses in primary processing will experience lower losses at the secondary processing or construction stages, and vice versa. Adding up all the high-range losses would result in losses greater than 100%, clearly an impossible result. For the sake of computing a lower bound of possible losses, adding up all the low-range losses would result in 62% of wood leaving the site remaining stored at 100 years (30 tons lost for every 78 tons leaving the site).

I couldn't agree more with the remainder of the first p. 3 comment, which describes the information needed to assess the full life-cycle impacts of a change in wood product production.

Second p. 3 comment. CORRIM researchers and several other authors reviewed in Sathre and O'Connor 2008 (cited in Dovetail critique) have given us a good start on LCAs for selected wood products. CORRIM's most complete analysis covers only two regions (west-side PNW and forests centered on North Carolina in the southeast), limited product types (softwood dimension lumber, softwood plywood, and a selection of wood composites - oriented strandboard, glu-lam timbers, I-joists , and laminated veneer lumber), and two construction designs in two geographic regions (Atlanta and Minneapolis). Most LCAs focus on construction lumber, and few include forest impacts. As stated on p. 22 of our report: "Only life-cycle analysis of specific products and regions can determine whether a particular wood product stream has GHG benefits."

p. 4 comment. This sentence is part of a longer statement by another author about the importance of accurate LCAs, which was the major point of this selection. However, I believe that this statement remains true. Several studies (including the one by Perez-Garcia cited by Dovetail) have demonstrated that selected wood products have a *lower GHG footprint than selected alternatives* if there are no impacts on carbon in the source forest and if landfill methane emissions from discarded wood are not included. This is not the same thing as demonstrating *positive net C storage*, which requires that the wood product itself store more than its production generates. The rest of this comment focuses on substitution benefits, which is another matter from net C storage (see our general response for a discussion of substitution). The report did not ignore the possibility of avoided emissions from uses of wood. I treated this topic in the Broader System Effects section on pp. 18-19, in the Leakage portion of the Policy Implications section on pp. 28-29, and for biomass energy on p. 19. The policy section on p. 22 also clearly acknowledges the importance of avoided emissions: "The *clearest climate benefits of wood use, for either products or fuel, come from substitution effects*—that is, consequent reduced use of alternative fossil-fuel-intensive materials. This is obvious in the case of biomass fuel, but it is true of wood products as well. In the case of wood products, the opportunities for substitution may be limited, but *when substitution does occur it reduces fossil fuel emissions 'forever'*."

p. 6 comment and Figure 2. I acknowledge that combining data from multiple sources can be a problem. I also agree that it would be best to separate hardwood from softwood, but I could not find sufficient distinct data for hardwood. The ranges were reported for that reason, to indicate the variability across the forest and manufacturing sectors, which was the major point that I hoped to convey. Figure 2 does in fact illustrate the medium-range estimates from Table 2. The Table reports amounts lost, while the Figure shows amounts remaining, which might account for the impression that the Figure uses the high-end estimates.

p. 9 two comments. I did not capture the extent to which wastes from one stage of manufacturing enter other long-lived products. Most of this material would be used for fuel or paper (as explained in the report, I assumed that these emit their carbon too rapidly to contribute to climate mitigation, which is the emphasis of this report). I assumed that all wood processing waste goes to landfills (illustrated as the checkerboard pattern in Figure 2) which probably overstates landfill storage and understates products in use. I would welcome better information on the extent to which wood waste recovery occurs and the types of products that result. Offset policies that track specific wood streams would ideally reflect re-use of byproducts to provide incentives for greater recovery of wood waste, an outcome supported later in our report. The portion of wood waste captured for biomass energy is not relevant to the wood products portion of the report, because the carbon is released, not stored. This topic *is* treated in the separate biomass section, where substitution benefits are acknowledged. It is appropriate to track carbon releases separately when they are used for energy capture, and then to assess how much of the energy use actually substitutes for fossil fuels.

p. 14 comment. As I understand it, this comment objects to the inclusion of emissions associated with transport of wood products to the final consumer in a wood products LCA because similar emissions would apply to other materials. A "cradle-to-grave" LCA includes all impacts, and would be compared to a similar LCA for other materials. Any differences in final transport distances or other processes would be reflected in the comparison. Our report did not make any statements about emissions from other products, but did address possible substitution benefits (see p. 4 comment above and more general response for more on substitution).

p. 15 comment. Even though an entire house (including perhaps a concrete foundation, asphalt or metal roof, vinyl siding, etc.) must be built in order to store its wood components long-term, we did not include the emissions associated with these other materials in our quantitative summary. The topic is mentioned here merely as an indicator that storing wood carbon in homes does have other GHG repercussions. I do not imply that the full amount of those emissions is a "debit" in the life-cycle impact. The paragraph concludes: "The entire home must be built in order to store the wood long-term, *but it is not clear what portion of total emissions should be considered a direct cost* of wood carbon storage."

p. 16 comment. This processing emissions section uses the data and assumptions from the CORRIM study, which are that 30% of house demolition materials are recycled (with associated emissions assigned to the new re-use rather than to demolition). However, the previous section on carbon losses did make the simplifying assumption that materials are landfilled at the end of house life. The analysis would be greatly improved by adding data about actual wood waste recovery, including the nature of the recycled products. Because landfilling is apparently (and unfortunately from my perspective!) a fairly effective sequestration strategy, this assumption has little effect on total carbon remaining at year 100, but it does affect the allocation between products and landfills. Increased wood recovery is indeed good news for the climate, and was emphasized as a positive approach through the example on p. 22.

p. 18 comment. This comment again relates to substitution benefits and objects to my statement that opportunities to substitute wood for other materials are limited in the U.S. because wood is already the most common building material for homes and it is difficult to use wood in other applications. The examples of wooden multi-story buildings indicate that substitution opportunities are not fixed and may well expand in the future. I agree that I could have better emphasized evolving technical opportunities. Wood in newly emerging applications can make a much stronger claim to substitution benefits than the bulk of wood in "business as usual" applications. Comprehensive cap-and-trade legislation will favor development of such technologies as it increases costs for fossil-fuel-intensive materials.

p. 19 comment. The point is well taken that when new biomass capacity is located at an existing wood processing facility, raw material transport emissions will be minimal. Many wood product mills already generate energy on-site. The LCA for *expanded* wood energy capacity is what is at stake when we consider forward-looking GHG policies, and the studies I reviewed that assess the life-cycle for wood biomass energy did assume that new plants would be free-standing. If biomass subsidies reflect full life-cycle emissions, co-located facilities will be favored.

p. 27 comment. Our report did not suggest eliminating wood products from offset projects, as the Dovetail critique seems to imply, both here and in the summary paragraph. Rather I suggest that both baseline and measures of additional carbon storage be project-specific and not derived from broad regional averages (because of the differences in wood processing flows highlighted earlier in the report). Wood products baselines are in fact more difficult to establish than on-site forest baselines since the wood is not under the control of the project developer but is scattered all over the countryside (and even the world). Forest carbon can be measured on-site and modeled and re-measured over time with some degree of accuracy, but few forestland owners track the fate of their wood products in an equally reliable way. I do question the crediting of product substitution for offset projects, for reasons outlined above. Despite the fear that offsets lacking substitution benefits would discourage use of wood materials, a comprehensive cap-and-trade program would already favor low-emissions wood materials.

p. 29 comment. I agree that trees do not store carbon permanently, but the expected life-time exceeds wood product life-time for many species. Longevity of carbon in a forest ecosystem also exceeds that of individual trees, unless the forest is subject to massive disturbances. "If old-growth forests reach high above-ground biomass and lose individuals owing to competition or small-scale disturbances, there is generally *new recruitment or an abundant second canopy layer waiting in the shade of the upper canopy to take over and maintain productivity*" (Luyssaert et al. 2008). Forests with frequent and severe natural disturbances will lose carbon periodically, and unfortunately those events may become more frequent and less "natural" as the climate changes. But forests can replace their lost carbon stores over time without any associated fossil fuel emissions, while replenishing harvested wood carbon stores using current technology requires fossil fuel use.

First p. 30 comment**.** Weighing the advantages of these two options (storing more carbon in forests or in products) does not imply that we need to choose one or the other, merely that there are some basic trade-offs. The two can be compatible in some situations, for instance in fire-prone forests where careful thinning can reduce fire severity. But we can only push the system so far, and at some point the two goals will come into conflict. This report does not call for limiting offsets to on-site forest carbon, but for careful accounting that accurately assesses net GHG reductions from each particular project. Far from oversimplifying, the analysis on p. 17-18 of our report summarizes some of the complexities by referring to studies that have analyzed total GHG impacts (including harvested wood products storage) of alternative silvicultural approaches for different forest types.

Second p. 30 comment. I believe we are in agreement that reduced consumption *and* use of less carbon-intensive alternatives are both important climate change mitigation strategies. We might disagree over my perceived need for a reality check lest our enthusiasm over one particular GHG strategy – expanded use of wood products and fuels – distract us from the more fundamental economic changes that are needed.

I'd like the thank Dovetail Partners for the opportunity to respond to their comments, and would welcome further conversations.

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Citation: Luyssaert, Sebastiaan, E. -Detlef Schulze, Annett Borner, Alexander Knohl, Dominik Hessenmoller, Beverly E. Law, Philippe Ciais & John Grace. 2008. Old-growth forests as global carbon sinks. Nature 455: 213-215)