Dept of Environmental Science, Policy, and Management
130 Mulford Hall #3114
Berkeley, CA 94720-3114
billstewart@berkeley.edu
(510) 643-3130 May 1, 2012

The global carbon storage benefits of leaving forest management residues are ephemeral, extremely difficult to calculate, and may be negative if leaving the residues in the forest would reduce the future productivity of forests managed to produce solid wood for building products

Bill Stewart, Forestry Specialist, University of California, Berkeley
billstewart@berkeley.edu May 1, 2012

Since California built a series of wood waste fired combined heat and power facilities in the 1980s, we have a long track record that can be used to evaluate the concept of whether the best estimate for the wood for energy is 'carbon neutral' with a large range around the 0 value. As many authors have done, it is simple to construct any number of hypothetical scenarios that 'prove' that there are large climate benefits or large climate non-benefits. In California, the data shows that harvesting forests simply to sell for energy chips is not the correct 'story' as it is neither cost-effective or logical. A more realistic scenario based on actual land use practices is that the forest residues that were collected for energy would have been managed to decompose even faster to reduce fire risks and improve regeneration than the decomposition rates estimated by (Harmon 2001; Harmon et al. 2001).

Five major sources of woody residues used for energy in California

1. Post consumer wood debris, urban tree waste, hazard trees, etc
2. Sawmill waste
3. Orchard waste (annual trimmings and orchard tree replacement
4. Forest treatments to reduce fire risk or improve stand value by thinning
5. Collection of logging residues

In all of these cases, the residues could have been left in place where they would have 1) slowly decomposed without any additional management or 2) been treated in some other way that would have sped up the decomposition process and led to a shorter period of temporary carbon storage. The rate of woody residue decomposition is strongly dependent on the scale of warm and wet conditions. Global estimates for the rate of decomposition of different types of forests will be highly variable with (Harmon 2001; Harmon et al. 2001) providing averages (but no standard deviations or methods to adjust to site conditions related to temperature and moisture) of what are presumably unmanaged rates of mortality and decomposition.

	tropical forest	conifer	deciduous (# studies)
mortality rate yr -1	0.0167 (40)	0.010 (44)	0.012 (22) -
decomp rate yr -1	0.176 (16)	0.032 (33)	0.80 (23) -

This means that the global averages are that conifer forests lose about 1% of living biomass dies annually and then decomposes at a rate of 3.2% per year. Deciduous forests lose about 1.2% of living biomass annually and then decompose at a rate of 8.0% per year.

If the mortality (natural or from a logging operation) is left unmanaged, the global Harmon et al. (2001) estimates would imply that the 100 year storage for conifer trees would be equal to 30 percent of the initial loading and would be 12 years for conifer trees. Since logging residues would be a mix of the species, the average estimate would be somewhere in between <u>if nothing additional</u> would be done to the wood residues in the forest as part of fire risk reduction, stand preparation for new plantings, or collection for energy. Most long term research on the carbon storage levels in the forest floor and forest soils (the largest repository of forest carbon storage) show no long term relationship between harvest practices and carbon storage. A recent study from the Northeast US (Hoover 2011) confirms what other reviews (Malmsheimer et al. 2011; Stewart et al. 2011) have concluded – the carbon storage benefits of keeping dead trees on site is ephemeral. There can be many other ecological benefits but they are forest specific and not directly related to climate benefits.

Since modern wood fired energy plants are far more efficient in terms of energy production and control of particulates, the logical extension of the story that wood should always be left in the forest is that the US EPA would also need to regulate the collection of firewood for home heating. Since tree mortality is scattered, it is rarely collected by timber managing companies. However collecting firewood, typically from mortality, is the #1 activity practiced by family forest owners (Butler 2008) with 20% of owners cover 28% of family forest area planning on doing it in the next five years. Firewood collection requires government issued permits and is also a popular activity on National Forest lands.

For commercial logging operations that do not let locals come and collect some of the debris for firewood, forest owners typically do other activities that reduce the temporary carbon storage estimates that can be derived from the Harmon et al. (2001) estimates. This is what forest residues look like in California. The pile could be utilized but the scattered residues will be left.

Large slash pile on the Tahoe National Forest

Uncollected residues that will decompose in situ

Three in-forest management approaches to speed up decomposition

1. Pile and burn – When trees are brought to a landing to be have the branches cut off and then be loaded onto log trucks, large piles of residue are created. To reduce fire risks and create open space for new trees to grow, it is common to pile and burn residues as long as local air quality (particulate) standards are met.
2. Masticate or 'lop and scatter' –To reduce fire risk or give the preferred species preferential access to water, sunlight, and nutrients, it is common the US Forest Service and other public entities to do man. This will accelerate the decomposition of biomass and shorten the temporary carbon storage.
3. In California, it is also common for forest managers to create considerable biomass with fuels reduction projects and treatments to accelerate the growth of the larger trees. Maintaining high levels of woody debris on site may increase temporary carbon storage but it can interfere with the rate of carbon accumulation in the long lived trees as opposed to pioneer trees and shrubs that are not long term carbon stores as plants or products.

More recent analyses have highlighted the fact that earlier estimates of dead tree carbon storage where based on equations rather than measurements (Domke, Woodall, and Smith 2011), and that the size and the vector of dead tree carbon storage are a 'work in progress'. While the accuracy of the estimates of carbon in growing trees is heavily influenced by the model choice (Melson et al. 2011), there is little logic to support the case for promoting more hard to measure short term carbon storage benefits at the expense of the long term benefits of more productive forests.

Attempting to estimate the foregone short term change in-situ carbon storage to scale a 'penalty' that will be applied to only one feedstock/use combination (logging residues to wood fired energy plants) would be problematic for a number of reasons. A whole set of related actions (what is the replacement fuel, how will the managed forests regenerate, will the risk of fire change) would need to be accurately estimated. Adding a new permitting cost of wood collection (potentially for both highly efficient wood energy plants, home heating stoves, and fireplaces) would lead to many logging residues simply being left uncollected to avoid the need for a US EPA permit. The net revenue to the forest land owner will decline even if they

make no net profit from selling the residues as they will have to do other things to get rid of the residues if they interfere with the future forest growth. Since the management of forest residues is typically done to increase the growth of the regenerated forest, the net effect will most probably be a decline in the overall climate benefits provided by US forests. In conclusion, he global carbon storage benefits of leaving forest management residues in the inland forests of the West are ephemeral, extremely difficult to calculate, and may be negative if leaving the residues in the forest would reduce the future productivity of forests managed to produce solid wood for building products.

References

Butler, Brett J. . 2008. Family Forest Owners of the United States, 2006 GTR NRS 27. edited by U. F. S. Northern Research Station.

Domke, Grant, Christopher Woodall, and James Smith. 2011. Accounting for density reduction and structural loss in standing dead trees: Implications for forest biomass and carbon stock estimates in the United States. *Carbon Balance and Management* 6 (1):1-11.

Harmon, M. E., O. N. Krankina, M. Yatskov, and E. Matthews. 2001. Predicting broad-scale carbon stores of woody detritus from plot level data. In *Assessment methods for soil carbon*, edited by R. Lal, J. M. Follett and B. A. Stewart. Boca Raton, FL: Lewis Publishers.

Harmon, Mark E. 2001. Moving Towards a New Paradigm for Woody Detritus Management. *Ecological Bulletins* (49):269-278.

Hoover, Coeli. 2011. Management Impacts on Forest Floor and Soil Organic Carbon in Northern Temperate Forests of the US. *Carbon Balance and Management* 6 (1):1-8.

Malmsheimer, Robert W., James L. Bowyer, Jeremy S. Fried, Edmund Gee, Robert L. Izlar, Reid A. Miner, Ian A. Munn, Elaine Oneil, and William C. Stewart. 2011. Managing Forests because Carbon Matters: Integrating Energy, Products, and Land Management Policy. *Journal of Forestry* 109 (Supplement 1):S7-S51.

Melson, S. L., M. E. Harmon, J. S. Fried, and J. B. Domingo. 2011. Estimates of live-tree carbon stores in the Pacific Northwest are sensitive to model selection. *Carbon Balance and Management* 6 (2):(10 April 2011).

Stewart, William, Robert F Powers, Kathryn McGown, Lindsay Chiono, and Teresa Chuang. 2011. Potential Positive and Negative Environmental Impacts of Increased Woody Biomass Use for California - PIER Final Project Report. CEC-500-2011-036. edited by C. E. C. PIER: Public Interest Energy Research. Sacramento, CA.

Sincerely,

William Stewart
Forestry Specialist
Co-Director Center for Forestry http://forestry.berkeley.edu/
Co-Director Center for Fire Research and Outreach http://firecenter.berkeley.edu/