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To: Internal Revenue Service, U.S. Department of Treasury

From: Woodwell Climate Research Center

Date: August 2, 2024

Re: IRS REG-119283-23| Section 45Y Clean Electricity Production Credit and Section 48E Clean Electricity Investment Credit

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Thank you for the opportunity to comment on the proposed guidance by the Internal Revenue Service on Section 45Y Clean Energy Production Credit and Section 48E Clean Energy Investment Credit and for raising these important issues.

Woodwell Climate Research Center (Woodwell) is a scientific research organization that works with a worldwide network of partners to understand and combat climate change. We bring together hands-on research experience, and 38 years of policy impact to find societal-scale solutions that can be put into immediate action by policymakers and decision makers. Scientists from Woodwell work in more than 20 countries on six continents, collaborating with a wide range of partners, including national subnational and local governments, nonprofit organizations, universities, and private sector companies. Throughout Woodwell's history, our scientists have been among the world's leaders in studying natural climate solutions and the role of forests in maintaining a stable climate.

Executive Summary

Scientists from Woodwell and collaborators respectfully submit the following comments that are tied to specific sections of the proposed guidance. As a general observation, we note that the content of the proposed guidance is ambiguous or even conflicting about some parts of the rule regarding sources of forest bioenergy. Parts of the guidance should be made much clearer and more definitive to ensure that there are no unintended consequences. Guardrails could be put in place to avoid the many ways that increasing use of wood for bioenergy would increase emissions rather than having the desired effect of decreasing emissions. It is also important to consider the many values of forests beyond climate mitigation, such as timber, biodiversity, water, and recreation.

In our comments we highlight several issues with the proposed guidance that paint a misleading picture of the likely reductions in emissions if forest bioenergy is used in place of fossil fuels. We argue that it is necessary to account for indirect emissions but not induced land-use change; that assuming "carbon neutrality" or zero emissions from using forest bioenergy has been discredited as being a false assumption; and that most sources of woody bioenergy should not be considered "waste wood" because of the many other potential values and uses of this material. We also highlight in some detail specific

"counterfactuals" associated with the different sources of forest bioenergy, and argue that spatial scale should be small while temporal scale should be long. Finally, we note that the potential for using forest bioenergy is quite small compared with other possible sources of bioenergy, especially considering that forest bioenergy typically results in increasing net emissions rather than decreasing net emissions.

Comments on Proposed Guidance

- **Accounting issues** (p. 47802-47803) – *It is important to account for "indirect emissions", i.e., emissions from forest management practices such as thinning, harvesting live trees, using logging residues, transportation and converting the biomass to fuel. But, is it necessary to account for market interactions and induced land-use changes?*

With respect to using woody biomass from forests, accounting for the "indirect emissions" is an important part of assessing the impacts of burning forest biomass for energy or heating. Indirect emissions are substantial and tend to persist for decades. Therefore, ignoring these emission sources can lead to underestimation of the climate impacts. The main sources of woody biomass are intact forests harvested specifically to provide bioenergy; logging debris from timber harvests that are conducted to provide other wood products besides bioenergy; and forest thinnings that are either commercial (i.e. designed to provide timber products and improve the value of future harvests) or intended to improve forest health or resistance to wildfire.

A landmark study from Canada[1] clearly illustrates that the GHG impacts from increasing the use of harvest residues for bioenergy are of similar magnitude to the displaced emissions from fuel substitution, and that the estimates are highly variable depending on many different factors (Figure 1). Thus, we recommend including accounting for indirect emissions (except for market and induced land-use change) in the accounting for woody bioenergy.

Although market interactions and induced land-use changes may have significant effects on net emissions, the ability to produce credible estimates of these effects is limited. Empirical studies are lacking, and modeling studies lack convincing estimates because the effects of marginal increases in demand are poorly reflected in the model results, since effects of small changes in demand or timber price cannot be separated from other factors. Economic models[2] that assess impacts of timber demand on land use have been developed over many years, yet still rely on assumptions that may capture impacts of very significant shifts in demand, but lack ability to discern impacts of very small shifts such as the marginal increase in demand for pellets relative to the overall demand for all timber products. Thus, it is hard to imagine that a marginal increase in a low-value product like residues and thinnings is likely to sway landowners to invest in pine plantations or more intensive management as concluded from this study. The authors acknowledge that the forest area projections used in this study are based on the assumption that wood pellet demand can influence timber rents, and subsequently landowner's

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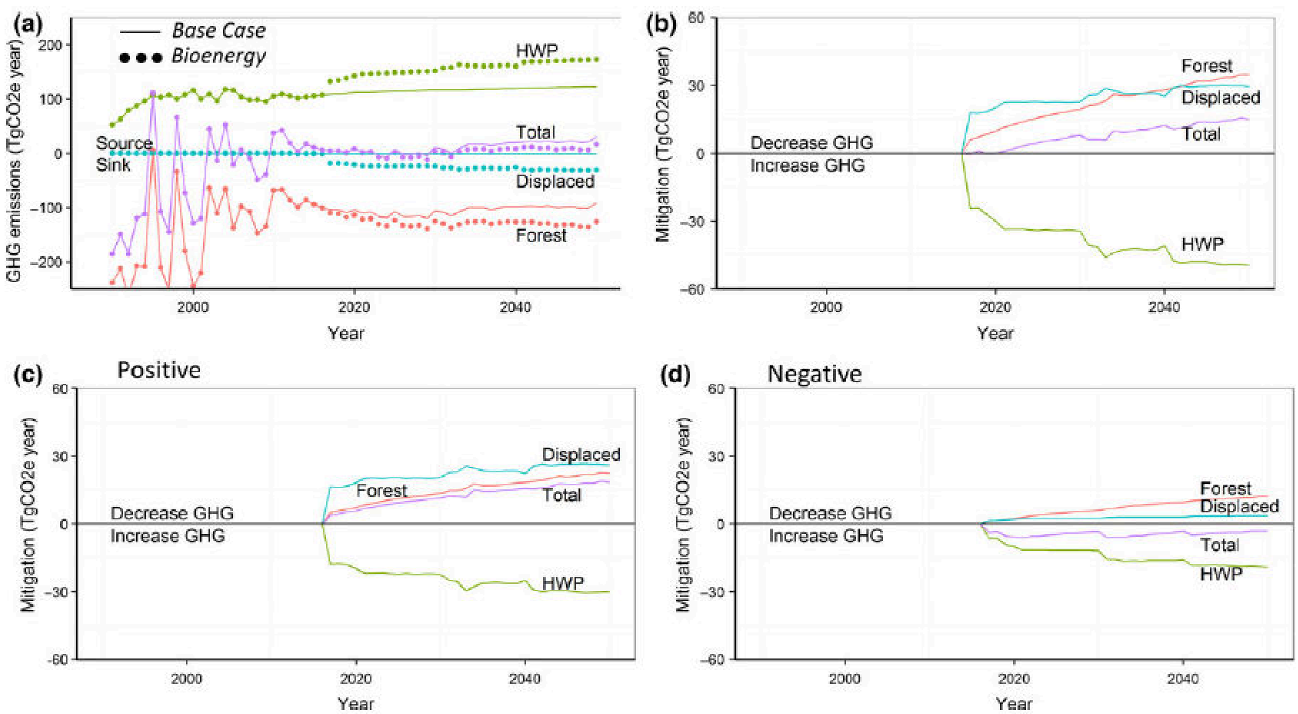
[1] Smyth, C.E., W.A. Kurz, G. Rampley, T.C. Lemprière & O. Schwab. (2016). Climate change mitigation potential of local use of harvest residues for bioenergy in Canada. *Global Change Biology Bioenergy*, *9*(4), 817–32. https://doi.org/10.1111/gcbb.12387.

[2] Duden, A.S., P.A. Verwij, A.P.C. Faaji, R.C. Abt, M. Junginger & F. van der Hilst. (2023). Spatially-explicit assessment of carbon stocks in the landscape in the southern US under different scenarios of industrial wood pellet demand. *Journal of Environmental Management, 342.* https://doi.org/10.1016/j.jenvman.2023.118148; Favero, A., A. Daigneault & B. Sohngen. (2020). Forests: Carbon sequestration, biomass energy, or both? *Science Advances, 6*(13). DOI: 10.1126/sciadv.aay6792; Hardie, I., P. Parks, P. Gottlieb & D. Wear. (2000). Responsiveness of rural and urban land uses to land rent determinants in the U.S. South. *Land Economics*, *76*(4), 659–673. https://doi.org/10.2307/3146958.

decisions and resulting forest area. And economic modeling may not include all factors involved in landowner decision making. Furthermore, there is no empirical evidence that private landowners actually respond to small increases in timber demand. One of the main conclusions of previous modeling of induced land-use change is that policies affecting land use have different results in different localities, suggesting that many other factors affect land-use decisions besides price of timber. Claims that expanding the industrial use of wood will result in greater removal of CO_2 from the atmosphere in the future is based on a premise that cannot be assumed to be true. Since land-use changes are central to determining the results, such statements do not give much confidence that the results bear resemblance to what might actually happen on the landscape over 20 years or longer as a result of small changes in timber demand.

Because of the uncertain state of knowledge regarding market and land-use impacts associated with increasing use of forest bioenergy, we do not recommend including these potential reductions in emissions in the accounting for indirect emissions.



Time series of (a) net GHG emissions/removals from the forest ecosystem, HWP emissions including bioenergy, displaced emissions and the total emissions for the *Base Case* and *Bioenergy Scenarios*, and (b) total climate change mitigation potential for all FMUs and the contribution from each component. Time series of the total and components for (c) FMUs with positive mitigation in 2050, and (d) FMUs with negative mitigation in 2050.

Figure 1. Time series of increasing and decreasing emissions from forest mitigation projects (from Smyth et al. 2016).

- **Estimation issues** (p. 47803) – *It is extremely misleading to assume "carbon neutrality" when accounting for "indirect emissions". And, we lack the tools for assessing market interactions and induced land-use changes.*

IPCC AR5 WG 3 11.13.4 states the following: "The combustion of biomass generates gross GHG emissions roughly equivalent to the combustion of fossil fuels. If bioenergy production is to generate a net reduction in emissions, it must do so by offsetting those emissions through increased net carbon uptake of biota and soils."

" …bioenergy systems have often been assessed (e.g., in LCA studies, integrated models, policy directives, etc.) under the assumption that the CO2 emitted from biomass combustion is climate neutral because the carbon that was previously sequestered from the atmosphere will be re-sequestered if the bioenergy system is managed sustainably.[3] The shortcomings of this assumption have been extensively discussed in environmental impact studies and emission accounting mechanisms."

A study led by Chatham House in England and the Woodwell Climate Research Center examined the full impacts of harvesting, manufacturing, transporting, and consuming pellets sourced from Southern U.S. forests in energy generation facilities in England.[4] Results of the study clearly showed that using a default "carbon neutral" estimate of emissions from burning pellets for energy ignored significant emission sources, and that there was no net reduction in carbon dioxide emissions from substituting wood for coal in England (Figure 2). According to that study, 69% of emissions were direct from combustion, and 31% from indirect sources. Other studies have reached similar conclusions[5] regarding the fallacy of assuming carbon neutrality.

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[3] Cherubini, F., G.P. Peters, T. Berntsen, A.H. Strømman & E. Hertwich. (2011). CO_2 emissions from biomass combustion for bioenergy: atmospheric decay and contribution to global warming. *Global Change Biology Bioenergy*, *3*(5), 413- 426. https://doi.org/10.1111/j.1757-1707.2011.01102.x; Chum H, Faaij A, Moreira J et al. (2011) Bioenergy. In IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation [O. Edenhofer, R. Pichs-Madruga, Y. Sokona, K. Seyboth, P. Matschoss, S. Kadner, T. Zwickel, P. Eickemeier, G. Hansen, S. Schlömer, C. von Stechow (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. In: Creutzig, F. et al. (2015). Bioenergy and climate change mitigation: an assessment. *Global Change Biology Bioenergy*,*7*(5), 916–44. https://doi.org/10.1111/gcbb.12205; Creutzig, F., et al. (2015), Bioenergy and climate change mitigation: an assessment. *Global Change Biology Bioenergy*,*7*(5), 916-944. https://doi.org/10.1111/gcbb.12205

[4] Brack, D., R. Birdsey, and W. Walker. (2021) *Greenhouse gas emissions from burning US-sourced woody biomass in the EU and UK*. Chatham House. ISBN: 978 1 78413 493 8.

[5] Birdsey, R., P. Duffy, C. Smyth, W.A. Kurz, A.J. Dugan & R. Houghton. (2018). Climate, Economic, and Environmental Impacts of Producing Wood for Bioenergy. *Environmental Research Letters* 13, 050201. https://doi.org/10.1088/1748-9326/aab9d5; Searchinger, T. D., S.P. Hamburg, J. Melillo, W. Chameides, P. Havlik, D.M. Kammen, G.E. Likens, R.N. Lubowski, M. Obersteiner, M. Oppenheimer, G.P. Robertson, W.H. Schlesinger & G.D. Tilman. (2009). Fixing a critical climate accounting error. *Science*, *326*(5952), 527–528. https://doi.org/10.1126/science.1178797; Booth, Mary. (2018) Not carbon neutral: assessing the net emissions impact of residues burned for bioenergy *Environmental Research Letters, 13* 035001. https://doi.org/10.1088/1748-9326/aaac88; Funk, J.M., N. Forsell, J.S. Gunn & D.N. Burns. (2022). Assessing the potential for unaccounted emissions from bioenergy and the implications for forests: The United States and global. *Global Change Biology Bioenergy*, *14*(3), 322-345. https://doi.org/10.1111/gcbb.12912; Cowie, A.L., G. Berndes, N.S. Bentsen, et al. (2021). Applying a science-based systems perspective to dispel misconceptions about climate effects of forest bioenergy. *Global Change Biology Bioenergy*, *13*(8), 1210-1231. https://doi.org/10.1111/gcbb.12844.

Unfortunately, there is a lack of credible tools for estimating emissions from market interactions and induced land-use changes, though it is expected that small increases in wood demand for bioenergy would have a negligible effect on emissions compared with the much larger demand for more traditional wood products.

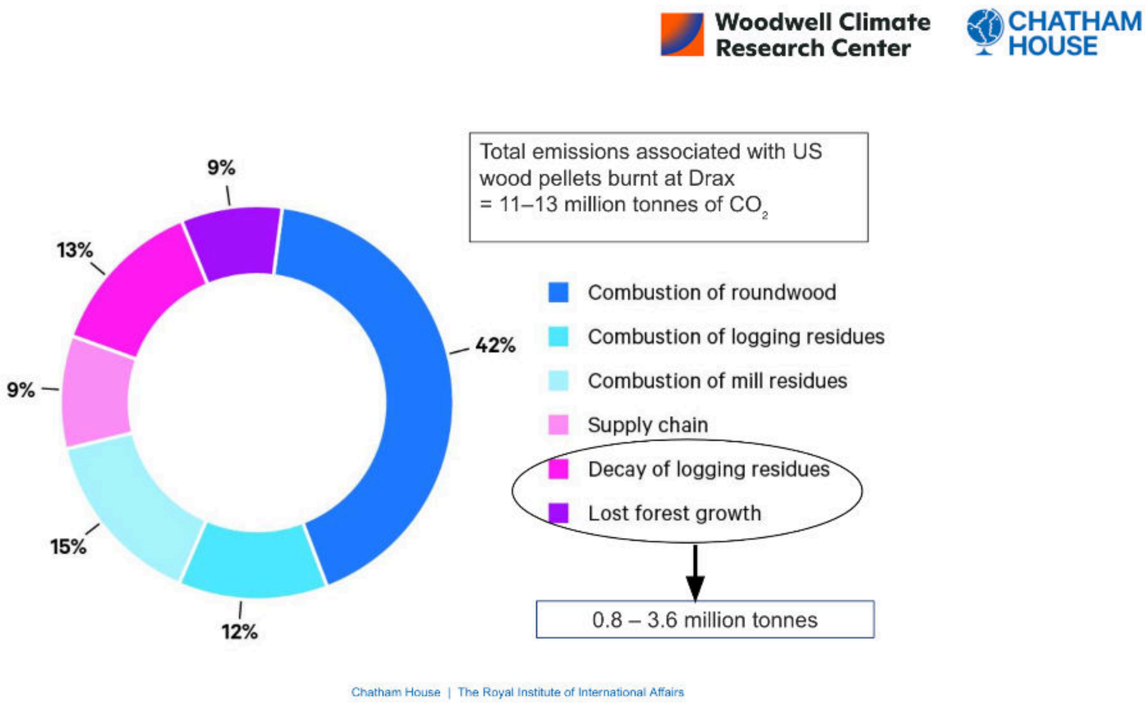

Figure 2. CO_2 emissions associated with U.S.-sourced wood pellets burnt at Drax in England (from Brack et al. 2022).

- **Anticipated baseline** (p. 47803) – *What is the appropriate counterfactual baseline for using logging debris, thinnings, or intact forests as sources of woody bioenergy?*

Each source of woody biomass has a different baseline against which emissions from burning for energy or heat should be compared to determine the net change in emissions. Logging debris is typically piled and either left to decompose over time, or burned – either way, the stored carbon is returned to the atmosphere. This case represents one of the few ways that using wood for bioenergy rather than fossil fuels may reduce emissions.[6] Yet other factors such as transportation to facilities may diminish the potential reductions in emissions, and the counterfactual alternative uses such as composite timber products will affect the calculations of additional emission reductions.

Thinning, or the intentional removal of live trees to restructure forests for promoting growth of remaining trees, or more recently, to reduce risk of wildfire, is another potential source of bioenergy. Wood from thinning is suitable for pellet production and frequently used, though the "thinnings" are not always sourced from true thinning operations but rather result from a harvest cut.[7] Thinning is often broadly defined by the bioenergy industry to include harvesting from intact forests. According to

[6] Birdsey et al. 2018 (ibid); Smyth et al. 2016 (ibid).
[7] Brack et al. 2021 (ibid); Williams, Christopher. (2021). Forest Clearing Rates in the Sourcing Region for Enviva Pellet Mills in Virginia and North Carolina, U.S.A., https://selc.link/3Bm7bKf.

bioenergy industry documents identifying source material, roughly 55-67% of the total biomass used to manufacture pellets for export to the EU and UK is from “roundwood” which is claimed by producers to be mostly from commercial thinning[8]. Because of poor data and reporting, it is highly likely that a significant portion of biomass defined as “thinning” by manufacturers is actually from clearcut harvests[9].

Yet like logging debris, use of thinning for any purpose will be diminished if the source is located very far from roads or facilities. Using forest thinnings for bioenergy is only practical when thinnings are near roads because of high transportation costs, typical in much of the West because of roadless areas. The counterfactual may vary -- unless thinnings are removed from the forest and used for some purpose (primarily pulpwood), the cut trees are left on the ground to decay.

Each case must be carefully evaluated to determine if there is a net reduction in emitted greenhouse gasses. The key is knowing the counterfactual – what would have happened if the wood were not used for bioenergy. In the case of logging debris, composite wood products could be made, or the material may be piled and burned or left to decompose over time. In the case of thinning or any use of live trees for bioenergy, the wood could be used for various types of products; there is a stock of carbon in the trees that is not released to the atmosphere; there is ongoing growth that sequesters carbon, and there are many other values attributed to intact forests.

Both thinnings and any other harvest of live trees represent a reduction of carbon stock and loss of the ability of the trees to remove carbon dioxide from the atmosphere. Use of live trees for bioenergy almost always results in a “carbon debt” and loss of sequestration and accumulation capacity, which are not recovered for decades or longer.[10] Thus, there are few cases where use of thinnings would result in a net reduction in emissions.

- **Direct emissions** (p. 47804) – *What should be included? As stated on p. 47804: under consideration are emissions from feedstock and fuel harvesting and extraction and direct land use change and management, including emissions from fertilizers, and changes in carbon stocks.*

As stated previously, indirect emissions are significant and measurable, as well as highly variable depending on source material, location, harvest intensity, and other variables. Omitting indirect emissions carries a strong risk of over-estimating emissions from using the fuel as a substitute. Therefore, we strongly recommend classifying direct emissions to include emissions from feedstock, fuel harvesting, and extraction; land management activities including thinning and emissions from fertilizers; and changes in carbon stocks. We do not recommend including market effects and induced land-use changes, which are difficult to quantify and likely to be negligible. See previous comments for recommended references.

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[8] Brack et al. 2021 (ibid); Buchholz, T., J.S. Gunn & B. Sharma. (2021). When biomass electricity demand prompts thinnings in southern US pine plantations: A Forest Sector Greenhouse Gas Emissions Case Study. *Frontiers in Forests and Global Change*, *4*, 1–14. https://doi.org/10.3389/ffgc.2021.642569.

[9] Williams 2021 (ibid).

[10] Birdsey et al. 2018 (ibid); Funk et al. 2022 (ibid); Ter-Mikaelian, M. T., S.J. Colombo & J. Chen. (2015). The burning question: Does forest bioenergy reduce carbon emissions? A review of common misconceptions about forest carbon accounting. *Journal of Forestry*, *113*(1), 57–68. https://doi.org/10.5849/jof.14-016.

- **Excluded emissions** (p. 47804) – *Can any be ignored? For example, claiming "carbon neutrality" for biomass feedstock. Need to consider alternative fates (counterfactuals).*

We recommend including all emission categories except for market effects and induced land-use change. As stated previously, the existence of induced land-use changes is highly speculative, based on economic models that are only able to detect and attribute the impact of much larger increases in demand for woody bioenergy[11]. This could change in the future if demand for bioenergy were to increase dramatically, thus having a real and detectable effect on timber prices and landowner income.

Given the marginal availability of woody bioenergy (not including that from intact forests), it is not likely that demand will be significant enough to induce changes in land use. There is simply not enough biomass from logging debris and forest thinning to satisfy the current and projected demand for bioenergy, especially considering the cost of transport from forest operation locations to combustion facilities and pellet mills in areas with sparse road networks. It is notable that logging debris, thinning, and harvest of other live trees represent only a small proportion of the different sources of available bioenergy. According to the Department of Energy's Billion-Ton Report and a National Academy of Sciences Report (2018)[12], the technical potential of using whole-trees in the U.S. for bioenergy feedstock is currently 186 $MtCO_2$/yr, compared with the potential from all sources of 1,248 $MtCO_2$/yr. The economic feasibility, accounting for transportation and other costs, is significantly less: 80 $MtCO_2$/yr for whole-trees and 508 $MtCO_2$/yr for all sources combined.

- **Spatial and temporal scales** (p. 47806) – *It is very important to give a full accounting of the effects of activities, by including the effects of small-scale projects over long timeframes.*

The effects on emissions of sourcing bioenergy from forests or forest operations take place at small scales and over long time periods.[13] Fortunately, analytical tools are available to quantify effects at these scales,[14] and estimated emissions are likely to be significant and necessary to give a full accounting of net emission changes as shown in figures 1 and 3.[15] However, because of the many variables affecting emissions, each activity should be assessed individually to determine their full impacts on emissions, and the rule should not allow use of a default assumption of carbon neutrality. Figure 3 shows how the impacts on emissions accumulate over time, and also highlight that using logging residues has a very small effect compared with other mitigation options because of the limited supply.

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[11] Duden et al, 2023 (ibid); Favero et al. 2020 (ibid); Hardie et al. 2000 (ibid).

[12] U.S. Department of Energy. (2016). 2016 Billion-Ton Report: Advancing Domestic Resources for a Thriving Bioeconomy, Volume 1: Economic Availability of Feedstocks. M. H. Langholtz, B. J. Stokes, and L. M. Eaton (Leads), ORNL/TM-2016/160. Oak Ridge National Laboratory, Oak Ridge, TN. 448p;
National Academies of Sciences, Engineering, and Medicine. 2018. *Negative Emissions Technologies and Reliable Sequestration: A Research Agenda*. Washington, DC: The National Academies Press. [Chapter 5]. https://doi.org/10.17226/25259.

[13] Ter-Mikaelian et al. 2015 (ibid).

[14] For example, see Murray, L.T., C. Woodall, A. Lister, K. Stockmann, H. Gu, S. Urbanski, K. Riley, E. Greenfield, et al. 2024. Chapter 5: Quantifying greenhouse gas sources and sinks in managed forest systems. In Hanson, W.L., C.Itle, K. Edquist. (eds.). *Quantifying greenhouse gas fluxes in agriculture and forestry: Methods for entity-scale inventory*. Technical Bulletin Number 1939, 2nd edition. Washington, DC: U.S.Department of Agriculture, Office of the Chief Economist.

[15] Dugan, A.J., R. Birdsey, V.S. Mascorro, M. Magnan, C.E. Smyth, W.A. Kurz & M. Olguin. (2018). A Systems Approach to Assess Climate Change Mitigation Options in Landscapes of the United States Forest Sector. *Carbon Balance and Management*, *13*(13). https://doi.org/10.1186/s13021-018-0100-x; Smyth et al. 2020 (ibid).

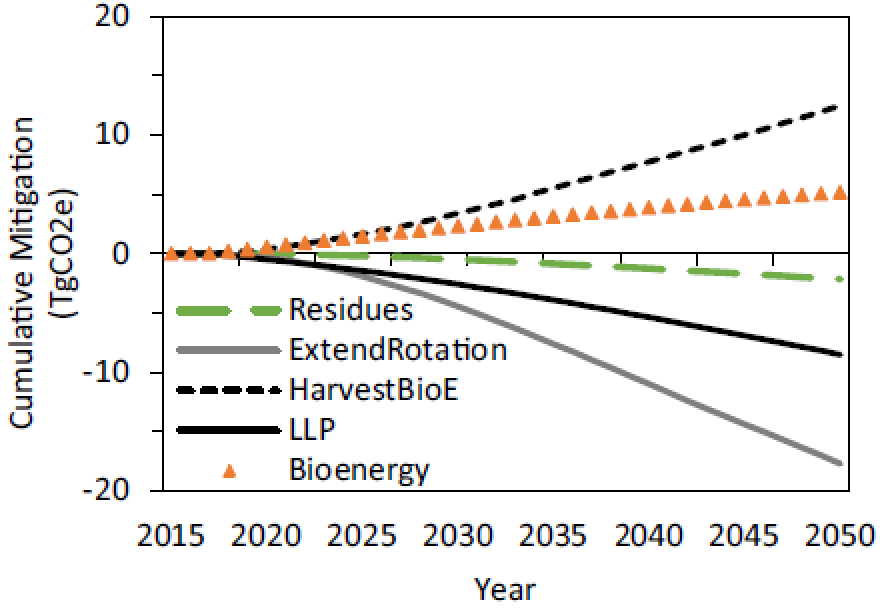

Figure 3. Time series of cumulative mitigation potential relative to the baseline for several scenarios in Northern Wisconsin. Increasing the use of logging residues is depicted by the dashed green line. Negative values denote a reduction in GHG emissions.

- **Waste products** (p. 47806-47807) – *Specifically, how to define these for forests? Are logging debris, thinnings, and undesirable tree species to be considered waste products and therefore treated as zero emissions in the LCA?*

It is very clear that logging debris, thinnings, and undesirable tree species should not be considered "waste products" because of their many uses, their carbon stocks, and the growth potential and CO_2 removal by live trees. These categories of biomass are considered waste by the forest products industry, which is only concerned about timber volume and not other values and benefits of trees and forests. It is imperative that these sources not be ignored or treated as zero emission sources because of their many values besides sources of bioenergy. In fact, it seems incongruous to consider logging debris to be both a valuable (though small) source of bioenergy with the potential to reduce net emissions if circumstances are favorable, and at the same time, a waste product that is exempt from emissions.

As stated before, it is always necessary to assess each situation to determine if there is a net reduction in emissions, considering the multiple variables that affect emissions.[16] It is clearly established in the literature and earlier in this comment that important factors include but are not limited to transport distance, the proportion of harvest residues that can be extracted for bioenergy, and the counterfactual baseline that defines what the bioenergy would have been used for, if it would have been burned, or if it would have been left to decompose over time.

Thank you for your consideration of these comments. Please contact Laura Uttley, Director of Government Relations, at luttley@woodwellclimate.org, if Woodwell can provide additional information or resources.

[16] Ter-Mikaelian et al. 2015 (ibid); Smyth et al. 2016 (ibid); Birdsey et al. 2018 (ibid).