Comments on "Removal activities under the Article 6.4 mechanism."

May 25, 2023

Thank you for the opportunity to comment on information note "Removal activities under the Article 6.4 mechanism." The following comments are from the US-based Partnership for Policy Integrity and the John Muir Project, with contributions from unnamed others.

We understand that the current version of the note is updated. However, we believe there are some additional changes needed. The following brief comments focus mostly on the topic of forest carbon, harvested wood products, and BECCS.

We refer to paragraph numbers in the text.

17(b)(i). We concur that durable storage be defined as 200 – 300 years. We emphasize that restored forest ecosystems do not just store carbon, but continue to accumulate it, over such time-frames. We are concerned by certain sections of the note that seem unaware of the true longevity and stability of natural forest ecosystems, and the potential for restored forests to act as meaningful carbon sinks.

17(b)(ii). We agree that the duration of carbon storage in harvested wood products is typically not very long, as acknowledged by IPCC rate constants for loss of carbon from these pools. However, other parts of the report seem to be inconsistent with this, suggesting that wood products do provide meaningful storage. These inconsistencies should be addressed.

17(b)(iii). We agree that retaining the word "net" with removals is useful, emphasizing the need to account for carbon losses.

17(d). The question is asked if "*the emissions avoided are greater than the emissions caused by the implementation of the activity), should the emissions from the activity still be deducted from the removals achieved?*" The answer to this is yes. As a general principle, "avoided" emissions should not be credited as a reduction in emissions associated with an activity. Taking a simple example, if a coal plant was operating, but then shut down and replaced with a gas plant of the same capacity, subtracting out the "avoided" emissions of the coal plant from the gas plant would result in the conclusion that the gas plant had a negative emissions rate, clearly an absurd conclusion. This principle applies whether the replacement activity is accounted on a gross or net emissions basis.

23. We understand that the question posed here, "*If the wood that was grown in country X over the last half century is pelletized and burned in a BECCS plant in country Y today, does that achieve removals?*" is somewhat rhetorical and designed to illustrate the general theme of the need for temporal boundaries, but we want to emphasize that the answer to this question is obviously no. Taking carbon that is already sequestered in trees, then burning it and storing it belowground, does not "remove" CO_2 from the atmosphere. The "removal" occurs if/when

the forest regrows and sequesters carbon. Thus, BECCS that relies on forest biomass does not deliver "negative" emissions for the same reason that burning forest biomass without CCS is not "carbon neutral" – because there is a large time-gap between the emissions and their ultimate potential offsetting by the logged forest's recovery. We use the word "potential" because many forests that are logged never again store the carbon that they did prior to logging.

To illustrate the incredible urgency of clarifying these definitions and criteria, particularly when it comes to woody biomass, consider bioenergy giant Drax, located in the UK. Drax burned coal and now burns wood, much of it imported as pellets manufactured from North American trees. If you've not seen the BBC's expose on how Drax is logging primary temperate rainforests in British Columbia to make pellets, it's only 29 minutes long and worth the time. .[1] Drax's use of pellets manufactured from mature wetland forests in the US is also well-documented.[2] Drax refers in a recent announcement to the "global need for carbon removals," implying that its business can deliver this. But this is clearly impossible. Moving carbon from trees (where it is stored away from the atmosphere) to belowground storage does not constitute "removals."
25. Yes, clearly, the temporal scope of removals must be limited to those removals that occur after the activity is registered. And to re-emphasize the point, burning wood and storing the CO_2 belowground does not inherently deliver a "removal" of CO_2 any more than burning coal and storing its CO_2 does. It is the regrowth phase of biomass that has the potential to deliver removals, not the combustion phase.

29. No, simply burning "biogenic waste" (a term that has no real meaning) and storing that CO_2 belowground does not deliver removals, for the reasons explained above. And while it is indeed the case that determining the net carbon impact of bioenergy requires comparing the emissions trajectory of the bioenergy system with a non-bioenergy counterfactual (or business-as-usual baseline), this doesn't mean that capturing any emissions that would otherwise be emitted under the counterfactual constitutes "removals" in the sense taking CO_2 out of the atmosphere. Just as with coal+CCS (where emissions that were entering the atmosphere are prevented from doing so), biomass+CCS (BECCS) does not automatically "draw down" atmospheric CO_2 levels.

30. Are the authors of this memo unaware of the well-known fact that burning biomass for energy generally emits more CO_2 per unit energy generated than burning fossil fuels[3]? How else to explain the statement that "*If the biogenic material would have been stored durably in the baseline (e.g. buried), then the BECCS activity achieves nothing* ***except the emission savings resulting from displacement of the grid electricity*** *(if the GHG balance is favourable)*." In fact, there is no instantaneous "emissions savings" when biomass displaces fossil fuels.

[1] https://vimeo.com/795555785/c6e9420ff6
[2] E.g., https://www.nrdc.org/sites/default/files/global-markets-biomass-energy-06172019.pdf
[3] https://forestdefenders.eu/biomass-plant-co2-emissions-an-explanation/

31. The same problem occurs again here: The statement that BECCS “displaces emissions from the grid electricity” is false. This is counting avoided emissions, and crediting them to the GHG balance of the pathway that was selected. Simple math (and the point made above for 17(d)) shows this approach is not legitimate.

32. It’s alarming to see the authors say here, “Of course” about the following statement as if it is unqualifiedly true, that “*a BECCS activity driven by biomass sourced from dedicated plantations or energy crops (specifically raised for the purpose of producing fuel for the power plant) generates removals. In such a case, the raising of plantation falls within the boundary of the BECCS activity and emissions associated with the cultivation of biomass will be accounted within the activity*.” We understand the point that they are trying to make here, that trees or crops intentionally grown for power generation “pre-sequester” carbon, removing it from the atmosphere where it can then be harvested, burned, and stored belowground, thus theoretically effecting a removal of carbon from the atmosphere that occurs *before* the carbon is stored using CCS. However, it is concerning that the authors make this statement without noting that the very act of appropriating land (that was probably storing carbon already) for energy crops or tree plantations can itself result in significant direct and indirect emissions.

37(a)(i). Broad categories of storage methods examples seem to ignore the real impacts of forest harvesting on total carbon storage. The example for ecosystem carbon pools is “*Land-based ecosystem reservoirs such as above-ground biomass, belowground biomass, deadwood, litter, and soil-organic matter can store carbon over durations ranging from years to centuries. These reservoirs have the limitation of becoming saturated over time and thus cannot go on accumulating carbon indefinitely unless biomass is harvested at a sustained rate and transferred to other reservoirs such as long-lasting products or geological storage*.”

Again, we understand that the intention here is to outline the ways in which ecosystem carbon can be theoretically manifested. However, the uncritical repetition of forest industry talking points about “saturation” of carbon storage in ecosystems suggests that the authors are unaware of the following:

1. A large body of work shows the ability of forests to continue storing carbon when mature. They do not become “saturated.” See this overview by the Old-growth Forest Network in the US.[4]

2. The fact that the majority of managed forests have greatly reduced carbon stocks compared to the carbon stock *capacity* of natural forests – thus could have hundreds of years of carbon accumulation ahead of them, if left alone, or managed only lightly.

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4 https://static1.squarespace.com/static/5c087e9e4cde7a66033e482d/t/5f5908ed8ea49e78c62fcb57/1599670514807/Wild+Carbon+and+Wild+Forests.pdf

3. Logging forests causes them to leak carbon in a variety of ways. For example, removing forestry residues to serve as biomass feedstock – a forest "waste" that is generally assumed to simply decompose if not collected and burned for energy – actually depletes soil carbon stocks (Achat et al, 2015a[5]; Hamburg, 2019[6]) and nutrient stocks (Achat et al, 2015b[7]), thus putting the carbon balance further into debt and potentially interfering with forest regeneration.

   We are aware of a new paper, Roebroek et al 2023[8], that argues relatively little carbon can be stored via forest restoration. That paper has already caused consternation among the community of scientists that study carbon storage in natural forests. The paper is new and the rebuttals are being assembled, but we offer some preliminary responses here that serve to show the carbon storage potential of managing forests closer to their natural state. Erb et al. (2018)[9] conclude that the additional carbon storage potential in forests is far greater – even ten times more - than what Roebroek et al. conclude. Roebroek et al'sconclusions are skewed by the fact that they used GlobBiomass as the potential maximum biomass. A study now in review examines primary forests in Europe, finding that field measured biomass in primary forests is about twice that predicted by GlobBiomass for the site location. DellaSala et al (2022)[10] found that GloBiomass significantly underestimates biomass for old-growth forests in Western Canada (see Table 3). These happen to be some of the same forests that are being logged for pellets by Drax, as explained above.

   Also regarding Roebroeck et al. (2023), an obvious problem with this study is that it assumes that natural disturbance processes that kill trees, such as fire, dramatically limit forest carbon storage potential. However, this is all based on hypothetical modeling assumptions--the study's core assumption is not based on field data. Moreover, it seems (requiring more scrutiny) that the authors of this study may treat trees killed by natural disturbance as carbon emitted/lost, which of course is false. When trees die due to natural disturbance, nearly all of the carbon remains. Even in the biggest, most intense wildfires, less than 2% of tree carbon is consumed (see Harmon, Hanson, and DellaSala 2022[11]), and annual carbon emissions from decay are minimal (see Campbell et al. 2016[12]). Last, it's not clear the extent to which the authors of Roebroek et al. assume post-fire succession will occur. Please see Hanson and Chi (2021) on that subject[13]--even in the largest high-severity fire patches, natural conifer regeneration is quite vigorous

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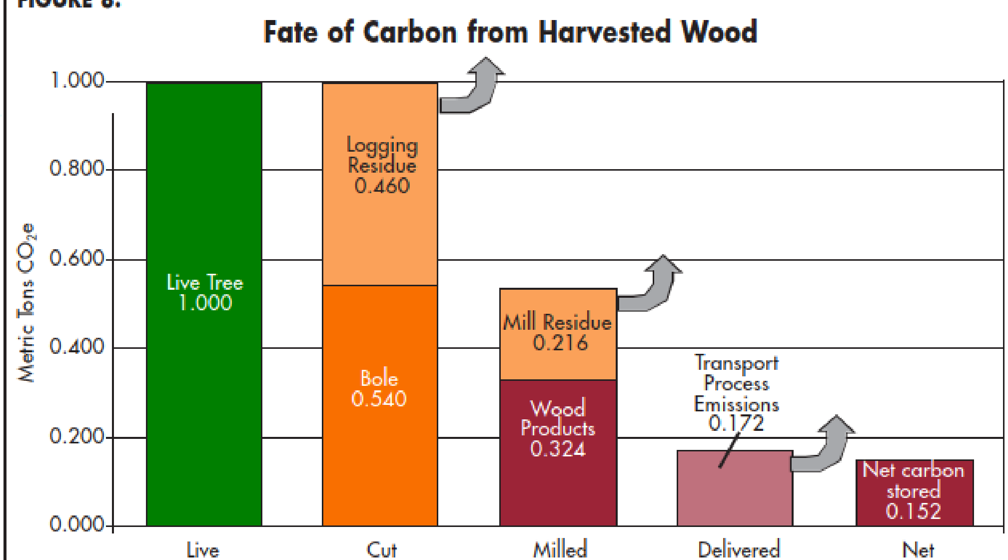
[5] https://doi.org/10.1038/srep15991
[6] https://doi.org/10.1007/s10533-019-00568-3
[7] http://www.sciencedirect.com/science/article/pii/S0378112715001814
[8] https://www.science.org/doi/10.1126/science.add5878
[9] https://www.nature.com/articles/nature25138
[10] https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/ecs2.4020
[11] https://www.researchgate.net/publication/358902925_Combustion_of_Aboveground_Wood_from_Live_Trees_in_Megafires_CA_USA/link/624ac48f7931cc7ccf13dd81/download
[12] https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2015JG003165
[13] https://www.frontiersin.org/articles/10.3389/fevo.2021.596282/full

and consistent, once the major methodological error of previous studies (too small field plot size) is corrected.

37(c)(i). The report states that storage in durable products occurs, and that "*Durable biomass products such as massive timber, engineered timber, and other structural wood used in the construction of buildings, and biochar. Typically, these products can last from decades to centuries*." Decades, maybe. Centuries, almost certainly not, at least for the vast majority of wood products. As the report later notes, the IPCC's residence times for different products are quite low. Even more importantly, however, it is critical to recognize that harvesting forests for products can reduce ecosystem carbon stocks for years to decades to centuries, including often via the loss of soil carbon, thus products generally do not provide net storage.

Most fundamentally, harvested wood products do not "remove" carbon from the atmosphere – growing trees do that. Harvested wood products can be seen as a lateral transfer of forest carbon into another pool – a transfer that is usually extremely leaky, entailing losses of up to 90% of the ecosystem carbon (i.e., sometimes as little as 10 - 15% of the carbon ends up embodied in a wood product that generally has a life of a few decades under a best case scenario). Most of the carbon in logged trees does not end up in wood products--the branches and tops are either burned in piles on site or are burned for energy at biomass facilities, as are mill residues. See Hudiberg et al. (2019)[14] and Ingerson (2007)[15]. Fig. 8 from Ingerson, below, explains the problem.

FIGURE 8.



Data from Smith et al. 2006 and Gower et al. 2006.

[14] https://iopscience.iop.org/article/10.1088/1748-9326/ab28bb
[15] https://climatechange.lta.org/us-forest-carbon-and-climate-change-controversies-and-win-win-policy-approaches/

The tradeoff between storing limited carbon in products with a disproportionately large loss of carbon from forests is illustrated by work done by the European Commission's Joint Research Centre (JRC). Their "bioeconomy" briefing[16] finds that wood products do not offer a net benefit by 2050, which is when the Paris Agreement calls for a balance between sources and sinks. JRC staff co-authored a modelling paper cited in that briefing that found while a 20% increase in harvesting by 2030 compared to 2000 – 2012 levels would increase annual carbon stored in HWP by 8%, it would *decrease* the much larger forest carbon sink by 37%. This is an extremely large decline in the forest carbon sink for a negligible increase in the HWP sink. The model found that only decreasing harvest by 20% allowed the forest carbon sink to increase.[17] Overall, the JRC brief cites a number of studies that conclude that within a short to medium time horizon (apparently meaning out to 2050), "**the additional mitigation potential provided by the material substitution effect is unlikely to compensate for the reduction of the carbon sink in forest ecosystems affected by the increasing harvest**." However, as the briefing points out, the type of product matters, and another way to increase the net carbon stored in products is to "*change how the harvested wood, industrial wood residues and secondary wood are used for different commodities. A shift to wood products with a higher service life, e.g. from paper to construction timber, would slow down the outflow and help conserve or enhance the growth of the HWP pool while maintaining a stable harvest over time*." Table 2, "Examples of implementations of removal activities combining different removal methods with storage methods" last cell.

Storage method	Land-based biological removal	Ocean-based biological removal	Geochemical/ chemical removal
Carbon products from mineralization	BECCS activities driven by sustained harvest of biomass from forests or dedicated energy plantations where the removed CO_2 is mineralized to form concrete aggregates	-	DAC activities with the removed CO_2 mineralized to form concrete aggregates

If the title of the table is to be taken at face value, the authors appear to be endorsing BECCS with "sustainable harvest of biomass from forests" with that from "energy plantations." We've explained above the problems with both these approaches.

73. (in section, "choice of time horizon"). It's noted that the time horizon of 100 years is a commonly accepted normative choice in various climate policy instruments. In the context of bioenergy, however, it should be noted that the biomass industry has often argued that a 100 year timeframe should be utilized for assessing net emissions. Presumably they see this as good for business, because even though burning biomass for energy greatly increases emissions

[16] https://publications.jrc.ec.europa.eu/repository/handle/JRC124374

[17] Pilli, R., et al. (2017). "The European forest sector: Past and future carbon budget and fluxes under different management scenarios." 14: 2387-2405. https://bg.copernicus.org/articles/14/2387/2017/bg-14-2387-2017.pdf

compared to coal for decades (see online model from Laganiere, et al 2017[18]), in some cases the net emissions from bioenergy are able to achieve parity with coal or other fossil fuels after 100 years. Whatever the context for choosing the timeframe, in this context of biogenic carbon accounting, a 100 year time-horizon serves to incentivize logging and burning forests for fuel.

209. This sentence is very alarming: "*On the other hand, a BECCS-supported removal activity that is driven by the objective of unblocking the saturation of the bio-sequestration sink in a vegetation system that provides economic or ecological services is complementary and synergistic with the underlying objective of meeting human needs or providing ecological services, and is therefore less likely to cause adverse environmental and social impacts*."

First, this sentence is unforgivably full of jargon. Second, logging forests does not result in "*unblocking the saturation of the bio-sequestration sink in a vegetation system that provides economic or ecological services."* It simply causes forests to hemorrhage carbon in ways large and small. And as we have stated above, the act of capturing some of that carbon and storing it belowground does not result in "removals."

Appendix H. 1. 1. *Removal activity with bioenergy with carbon capture and storage*
Here we critique this example. This is the worst kind of example of treating ecosystems as if they are machines that can be engineered with predictable results.

1. To illustrate how bioenergy with carbon capture and storage (BECCS) can increase the removal potential of a given area of land, consider the reforestation simulation example described in appendix E with some modifications. An area of 1,000 hectares (ha) is afforested using relatively fast-growing species with a 15-year rotation.

What was growing there before? Was it storing carbon? Or was it producing food?
If it wasn't cropped, what about the ecosystem value of what was there before? Converting lands to monoculture energy crops creates biodiversity deserts. Some such crops, such as eucalypts, can drastically increase fire susceptibility.

To ensure a constant flow of biomass to drive the energy system, the area is planted in 15 stands, each one year apart. After 15 years, the mature stand is harvested each year and the biomass is used for energy purposes.

1,000 hectares is a lot of land. But in fact it seems in this scenario, only one-fifteenth of it is available to provide biomass fuel in any given year. How much wood is this, and how much energy does it translate to? We calculate that for a eucalypt plantation with an average aboveground biomass (dry) of around 200 tonnes per ha, this rotational system would produce about 24,000 tonnes of green wood per year – enough to produce about 2 MW of electricity, or

[18] https://apps-scf-cfs.rncan.gc.ca/calc/en/bioenergy-calculator

enough for 4,735 households at EU average electricity use. Does this seem like a worthwhile tradeoff for monocropping 1,000 hectares of land that was potentially offering carbon storage, ecosystem, or agricultural values previously?

The carbon dioxide from the combustion of biomass is captured and stored in a geological formation. The carbon capture and storage (CCS) facility is assumed to be 80 per cent efficient in capturing and storing the carbon contained in the biomass.

Meaning a significant proportion of that 2 MW of electricity will be allocated to running the CCS infrastructure.

2. Removal activity with storage in durable products

This scenario seems similarly decoupled from reality as the previous one:

"*6. To illustrate how long-lived harvested wood products (HWP) can increase the removal potential of a given area, consider the afforestation simulation example in appendix E with some modification. An area of 1,000 ha is afforested using relatively fast-growing species with a 15-year rotation and a sustained-yield design. To ensure a sustained yield of wood products, the area is planted in 15 stands, each one year apart. After 15 years, the mature stand is harvested each year and the wood products from the harvest are used for their economic value. It is assumed that the annual harvest yields four different types of wood products with the following fractional weights: sawn wood 0.30; veneer 0.20; paper 0.30; and fuelwood and fodder 0.20*."

Fast-growing species that are 15 years old will not yield this suite of products. Such plantations mostly produce energy wood and pulp. These scenarios are not grounded in reality. We need products from the UNFCCC to be grounded in reality.

Thank you for the opportunity to comment.

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