

From: Malte Meinshausen <malte.meinshausen@gmail.com>

Sent: Friday, 3 March, 2023 4:16

To: Supervisory-Body <Supervisory-Body@unfccc.int>

Subject: Input to A6.4-SB004-AA-A04 - Tonne-year crediting undermines Art. 2 of the Paris Agreement

Dear Supervisory Body.

This short note constitutes a review comment of your information note "Information note Removal activities under the Article 6.4 mechanism", available

at: <https://unfccc.int/sites/default/files/resource/a64-sb004-aa-a04.pdf>

About my person and credentials: My name is Malte Meinshausen and I am a Professor of Climate Science at the University of Melbourne, Australia. My master thesis at the University of Oxford back in the year 2000 has been focussed on the tonne-year and similar equivalence approaches for how to credit temporary carbon storage. I am now also Lead Author of the IPCC WG1 Report AR6 and one of the Core Writing Team Members of the IPCC Synthesis Report. I teach climate science and climate modelling at the University and am also closely involved in carbon budget, NDC and scenario research in the context of the UNFCCC.

Review comments for consideration by the Board:

The information note has one major problem. In terms of its discussion of the tonne-year approach, it is fundamental at odds with IPCC climate science. For the climate, the one thing that counts are cumulative CO₂ emissions (see IPCC AR6 WG1). Thus, the only way to offset a CO₂ emissions is by an equivalent PERMANENT removal. The terms like permanence period or equivalence period are often inventions by accounting 'experts' from the industry, who make arguments of as to why a temporary carbon storage would be (whether discounted or not) at some point be equivalent with the climate effect of a carbon emissions. It is not.

'Temporary crediting' is the only crediting method suitable for 'temporary storage'. 'Temporary crediting' with expiring credits that need to be renewed by either new temporary or permanent credits, like t-CERs, is the only way outlined in this document (in section 5.1) to appropriately account for (potentially) temporary carbon storage and the liability for re-emissions. Yes, there is a temporary climate service of locking away carbon for 20, 50, or a 100 years, but the temperature climate effect of a temporary carbon storage is ZERO after its re-release. In other words, global mean temperature at any point in time only care about cumulative CO₂ emissions. At the time of the re-release, the temporary carbon storage will also lead to a higher gradient of warming (similar to the 'termination shock' after abandoning solar radiation management) for example. This fact that temporary carbon storage has itself a zero temperature benefit after the activity ended, means that ANY credit that is given for that activity will make the climate worse off afterwards if a CO₂ emissions is 'offset', rather than abated. For more details, see the below paper by Kirschbaum (2006).

Discounting implicitly informs our targets, but must not be inbuilt into the physical emission accounting framework. The UNFCCC informal note seems to argue that there are discount rates and time preferences in the literature and applied in the real world and thus they could form the legitimacy basis for **tonne-year accounting**. They can not. Discounting and time preferences might inform which ultimate climate goals we set (as we implicitly weight the upfront mitigation costs with the long-term avoided damages). Discounting and time preferences then would undermine any cost-effectiveness path to achieve these targets, if they are built with tonne-year accounting into the

accounting framework. On the contrary, under the permissible 'temporary crediting' approach, the market participants will use discounting to weigh up the costs of replacing the expiring tCER or other credit again at the end of its lifetime, which is ok. The accounting system itself however has to represent what the atmosphere sees, and the tonne-year approach does not, i.e. is at odds with the physical realities of the climate system.

A tonne-year approach undermines the long-term climate targets. Under the Paris Agreement, the world has agreed to a temperature target in Art. 2, i.e. pursue the best efforts to limit warming under 1.5C and holding temperatures at all time well below 2C. In most of the IPCC assessed mitigation pathways, that means that we potentially face a limited overshoot - as we reach temperatures around 1.5C by the 2030s. In the latter half of the century, temperatures could however gradually decline again, if the world moves towards net-zero GHG emissions (also well established in IPCC AR6 WGIII and AR6 WGI reports, both of which I contributed to). If a tonne-year approach would be established, this would undermine efforts to achieve temperatures below 1.5C by the end of the century again - as the re-emissions of temporary carbon storage in the second half of the century would create additional obstacles to gradually decrease temperatures - thereby further shifting mitigation effort and/or additional climate impacts into the future.

A tonne-year approach would lead to an emission inventory system, in which IPCC emission milestones would have to be strongly tightened. All the emission milestones established by the IPCC (like a 45% CO2 reduction by 2030) or the 43% below 2019 levels by 2030 or net-zero CO2 by the middle of the century are predicated on an emission accounting framework that is true to the physical realities of the climate system. If a tonne-year or similar 'unphysical' approach were chosen, which does not guarantee FULL permanence, then all these IPCC milestones are too weak. They would have to be re-calculated based on the unphysical accounting framework and tightened potentially considerably, if the tonne-year approach would be used on a larger scale under Art. 6.

Long-established unsuitability of a tonne-year accounting for temporary carbon storage. The above fundamentals of a carbon budget, the fact that cumulative CO2 emissions are what counts, and the fact that temporary carbon storage does not provide long-term climate benefits (and implies additional climate damages, if used as an offset), are well established in the scientific literature since more than 20 years. Just two examples:

Kirschbaum, M.U.F. Temporary Carbon Sequestration Cannot Prevent Climate Change. Mitig Adapt Strat Glob Change 11, 1151–1164 (2006). <https://doi.org/10.1007/s11027-006-9027-8>

Korhonen, R., Kim Pingoud, Ilkka Savolainen, Robert Matthews "The role of carbon sequestration and the tonne-year approach in fulfilling the objective of climate convention" (2002), Environmental Science & Policy, 5 (6), pages 429-441, [https://doi.org/10.1016/S1462-9011\(02\)00091-6](https://doi.org/10.1016/S1462-9011(02)00091-6)

In particular from the second paper you will see that the tonne-year approach has been 'debunked' since more than 20 years, and the only reason that you might not find very recent papers re-iterating that same point is that this fact has been well established in the scientific literature.

Summary:

As a friend of the Secretariat's activities in general, I would like to urge the UNFCCC to withdraw this informal note, which is fundamentally at odds with the IPCC climate science and could help to establish an Art. 6 accounting framework that is at odds with the Art. 2 of the Paris Agreement. When fossil CO2 emissions occur, i.e. carbon is taken out of the geological reservoirs and put into the active carbon pools of the atmosphere, biosphere and oceans, then the only way to counteract

this emission is by inducing an additional, permanent and non-leakage carbon removal that either stores the carbon in perpetuity again - or, if a temporary carbon storage is chosen like afforestation, is intrinsically connected with the liability to maintain that carbon store (or another one) in perpetuity (i.e. temporary crediting, like the t-CER).

A few additional PS points at the end:

- The term 'permanence period' is a paradoxon, as permanence does not know an end date on the time scales (1000s of years) that are of interest to the climate problem).
- The above critique of the tonne-year crediting relates to both the "ex-post" tonne-year crediting and the "advance" tonne-year crediting in your informal note.
- Likewise, the described 'tonne-based' crediting is affected by the same critique and fundamental flaw, unless a 'permanence period' that is 'permanent' is chosen.

Further availability. If the Board would like to seek further expert advice on this matter, I would be more than happy to provide it. During March, I will take part in the IPCC approval process for the Synthesis report, but will be available thereafter.

With best regards,
Prof. Malte Meinshausen
The University of Melbourne

Appendix:

Abstracts of cited scientific articles:

Korhonen, R., Kim Pingoud, Ilkka Savolainen, Robert Matthews "The role of carbon sequestration and the tonne-year approach in fulfilling the objective of climate convention" (2002), Environmental Science & Policy, 5 (6), pages 429-441, [https://doi.org/10.1016/S1462-9011\(02\)00091-6](https://doi.org/10.1016/S1462-9011(02)00091-6)

Abstract

Carbon can be sequestered from the atmosphere to forests in order to lower the atmospheric carbon dioxide concentration. Tonne-years of sequestered carbon have been suggested to be used as a measure of global warming impact for these projects of finite lifetimes. It is illustrated here by simplified example cases that the objective of the stabilisation of the atmospheric greenhouse gas concentrations expressed in the UN Climate convention and the tonne-year approach can be in contradiction. Tonne-years generated by the project can indicate that carbon sequestration helps in the mitigation of climate change even when the impact of the project on the CO₂ concentration is that concentration increases. Hence, the use of the tonne-years might waste resources of fulfilling the objective of the convention. The studied example cases are closely related to the IPCC estimates on global forestation potentials by 2050. It is also illustrated that the use of bioenergy from the reforested areas to replace fossil fuels can in the long term contribute more effectively to the control of carbon dioxide concentrations than permanent sequestration of carbon to forests. However, the estimated benefits depend on the time frame considered, whether we are interested in the decadal scale of controlling of the rate of climate change or in the centennial scale of controlling or halting the climate change.

Kirschbaum, M.U.F. Temporary Carbon Sequestration Cannot Prevent Climate Change. Mitig Adapt Strat Glob Change 11, 1151–1164 (2006). <https://doi.org/10.1007/s11027-006-9027-8>

Abstract

Storing carbon in biosphere sinks can reduce atmospheric CO₂ concentrations in the short term. However, this lowers the concentration gradient between the atmosphere and the oceans and other potential carbon reservoirs, and consequently reduces the rate of CO₂ removal from the atmosphere. If carbon is released again from that temporary storage, subsequent atmospheric CO₂ concentrations will, therefore, be higher than without temporary carbon storage. It is thus important to analyse whether temporary carbon storage in biosphere sinks can mitigate climate-change impacts. To analyse that, climate-change impacts need to be quantified explicitly.

Impacts can be quantified:

1. as the instantaneous effect of increased temperature
2. through the rate of temperature increase
3. as the cumulative effect of increased temperatures.

The analysis presented here shows that temporary carbon storage only reduces climate-change impacts related to the cumulative effect of increased temperature and could even worsen impacts mediated via the instantaneous effect of temperature or the rate of temperature change. This applies under both high and low greenhouse-gas emission scenarios. Because temporary carbon storage improves some, but worsens other, climate-change impacts, it achieves very little on average. For greenhouse mitigation, it is, therefore, not warranted to provide policy incentives for temporary carbon storage.