CO$_2$RE THE GREENHOUSE GAS REMOVAL HUB

CO$_2$RE - UK's national research hub on carbon dioxide removal

Response to call for input 2023: Issues included in the annotated agenda and related annexes of the fifth meeting of the Article 6.4 Supervisory Body

Introduction

CO$_2$RE is pleased to respond to this call for input by the Article 6.4 Supervisory Body.

CO$_2$RE is the UK's national research hub on carbon dioxide removal (CDR). Funded by UK Research and Innovation (the UK's national research funding agency), we conduct research on CDR, co-ordinate demonstration projects around the UK, and connect to other national and international programmes. Our research aims to help ensure that CDR techniques develop rapidly, effectively and responsibly, alongside action to reduce emissions.

Backed by seven institutions and led by the Smith School of Enterprise and the Environment, University of Oxford, CO$_2$RE comprises some of the UK's leading academic experts on GGR. It includes the lead author, contributing authors and reviewers of the State of CDR report. It also includes the lead authors and contributing authors involved in IPCC AR6 WGIII and special reports on Global warming of 1.5 deg C and Climate Change and Land.

Key messages:

1. We recommend that individual "engineering-based" CDR activities should be made eligible for Article 6.4, subject to them meeting the requirements regarding monitoring, reporting, accounting, addressing of reversals, avoidance of leakage and avoidance of other negative impacts, as set out in the Information note *Removal activities under the Article 6.4 mechanism* (version 4). This should be the approach rather than a blanket inclusion or exclusion of activities as a result of being labelled "engineering-based."

2. All pros and cons should be considered for each activity including land-based activities (noting that BECCS could be considered both "land-based" and "engineering-based"). It should be made clear that the balance of pros and cons for land-based mitigation depends on various factors, and that sustainable management is vital to incentivise co-benefits (pros) and avoid trade-offs (cons).

Our detailed comments follow below. Please do get in touch if you have any questions about the content of this response by emailing p.westbury@imperial.ac.uk .

Comments on Information note *Removal activities under the Article 6.4 mechanism*

Here we provide detailed comments on the Information note titled "Removal activities under the Article 6.4 mechanism" version 4, available at: https://unfccc.int/sites/default/files/resource/a64-sb005-aa-a09.pdf.

Our comments are specific to **Table 3, *Pros and cons of the different activity types being made eligible under the mechanism***, from the note, copied below:

Activity type	Pros and cons
Engineering-based activities	**Pros** – Engineering-based removal activities result in permanent net removal of carbon dioxide from the atmosphere. **Cons** – Engineering-based removal activities are technologically and economically unproven, especially at scale, and pose unknown environmental and social risks (P-12, R-83:a, R-84:a, R-50:c,d). Currently these activities account for removals equivalent to 0.01 $MtCO_2$ per year (P15:a) compared to 2,000 $MtCO_2$ per year removed by land-based activities. – These activities do not contribute to sustainable development, are not suitable for implementation in the developing countries and do not contribute to reducing the global mitigation costs, and therefore do not serve any of the objectives of the Article 6.4 mechanism.
Land-based activities	**Pros** – Land-based activities are proven and safe, have a long history of practice, and are backed by considerable experience under compliance and voluntary carbon market mechanisms. – Land-based activities have the potential to the deliver cost-effective CO_2 mitigation required by 2030, a third of which could be below USD 10 per tCO_2. – Land-based activities generate significant sustainable development co-benefits (P-26:b,R-80): – Economic: increased availability of wood and non-wood products including wood fuels and livestock feed; improved crop yields through soil erosion control, soil fertility improvement, groundwater recharge, water filtration, water quality); sustainable and equitable local employment and livelihoods. – Environmental: biodiversity conservation, reduced air pollution, reduced pressure on natural forests, flood control, and enhanced climate resilience. – Socio-cultural: space for socio-cultural events, nature contemplation, aesthetic appreciation, creativity and learning, recreation, and ecotourism. **Cons** – Removals stored in ecosystem reservoirs can be released back into the atmosphere, thus limiting their mitigation value.

Our detailed comments on Table 3, *Pros and cons of the different activity types being made eligible under the mechanism* are as follows:

1. Ref R-50 (the State of CDR report[1]) does not support the statement that engineering-based activities are technologically unproven and have unknown risks. Instead, Table 1.1 in the State of CDR report provides an expert assessment of Technology Readiness Levels, and known risks as well as co-benefits, for these methods, based on the literature. The data in this table matches that in Table 4 of the Information note, because it is drawn from the same source (IPCC AR6 WGIII). We recommend that the data in Table 4 is used to reflect more accurately the variations across methods, rather than the over-generalised and inaccurate statement in Table 3.

2. The 0.01 $MtCO_2$ per year of current removals cited in P15:a refers to Direct Air Capture only, not all "engineering-based" methods. A more complete estimate is available in the State of CDR report: around 1.8 $MtCO_2$ per year (this differs from the 2 $MtCO_2$ per year reported in the State of CDR for all "novel" activities because it subtracts the estimate for biochar, which is not defined as "engineering-based" in this Information note).

3. Furthermore, the statement that land-based activities currently remove 2,000 $MtCO_2$ per year is currently unattributed, but can be drawn from the State of CDR report, which provides an estimate of 2,000 ± 900 $MtCO_2$ per year.

4. The statement that engineering-based removals do not contribute to sustainable development is inaccurate, based on the Information note's own data in Appendix I. This Appendix gives explicit alignment to Sustainable Development Goals for some activities; for instance, some forms of direct air carbon capture and storage supporting SDG6, and enhanced rock weathering supporting SDGs 2, 15, 14 & 6.

5. The statement in Table 3 that these removals do not contribute to global mitigation costs is inaccurate, given that the majority of global pathways that limit warming to 2°C with a likelihood of 66% or more include "engineering-based" removals as well as "land-based" ones[2]. The IPCC states: "*Modelled mitigation strategies to achieve these reductions include transitioning from fossil fuels without CCS to very low- or zero-carbon energy sources, such as renewables or fossil fuels with CCS, demand side measures and improving efficiency, reducing non-CO_2 emissions, and deploying carbon dioxide removal (CDR) methods to counterbalance residual GHG emissions.*"[3]

6. **Therefore, we recommend that individual "engineering-based" CDR activities should be made eligible for Article 6.4, subject to them meeting the requirements regarding monitoring, reporting, accounting, addressing of reversals, avoidance of leakage and avoidance of other negative impacts, as set out in the Information note *Removal activities under the Article 6.4 mechanism***

[1] Smith, S.M., et al. (2023) The State of Carbon Dioxide Removal - 1st Edition. The State of Carbon Dioxide Removal. doi:10.17605/OSF.IO/W3B4Z

[2] Ibid, Table 7.2.

[3] IPCC, 2022: Summary for Policymakers. In: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, et al., (eds.)]. doi: 10.1017/9781009157926.001

(version 4). This should be the approach rather than a blanket inclusion or exclusion of activities as a result of being labelled "engineering-based."

7. IPCC (2022) WG3 Summary for Policymakers (SPM) further elaborates on the expected contribution of BECCS and DACCS, which combined are greater than the expected contribution of AFOLU land-based removals: Paragraph C.5.3 *"In modelled pathways that report CDR and that limit warming to 1.5°C (>50%) with no or limited overshoot, global cumulative CDR during 2020–2100 from bioenergy with carbon dioxide capture and storage (BECCS) and direct air carbon dioxide capture and storage (DACCS) is 30–780 GtCO2 and 0–310 GtCO2, respectively. In these modelled pathways, the AFOLU sector contributes 20–400 GtCO2 net negative emissions. Total cumulative net negative CO2 emissions including CDR deployment across all options represented in these modelled pathways are 20–660 GtCO2. In modelled pathways that limit warming to 2°C (>67%), global cumulative CDR during 2020–2100 from BECCS and DACCS is 170–650 GtCO2 and 0–250 GtCO2 respectively, the AFOLU sector contributes 10–250 GtCO2 net negative emissions, and total cumulative net negative CO2 emissions are around 40 [0–290] GtCO2. (Table SPM.2) (high confidence) {Table 3.2, 3.3, 3.4}"*

8. We would like to draw attention to IPCC Special report on Climate Change and Land (2019) SPM[4] regarding limits to deployment of land-based CDR (and especially at the low price quoted): B.3.2 *"While land can make a valuable contribution to climate change mitigation, there are limits to the deployment of land-based mitigation measures such as bioenergy crops or afforestation."* This further highlights the need to also consider DAC and other "engineered options" to meet mitigation targets. We suggest that this limitation be included in cons for land-based CDR at scale.

9. IPCC (2022) WG3 SPM, paragraph C.4.6 states *"CO2 capture and subsurface injection is a mature technology for gas processing and enhanced oil recovery. In contrast to the oil and gas sector, CCS is less mature in the power sector, as well as in cement and chemicals production."* Thus CCS is a proven technology at scale. Bioenergy is also proven and a widespread fuel source for many decades. DAC is newer, and has been proven technologically at small scale, but not at large-scale. This is why IPCC scenarios have DAC coming on-stream later than BECCS this century.

10. The limited number of "cons" presented for land-based removals is out of line with IPCC (2022) WG3 chapters 7 and 12, as summarised in the SPM paragraph C9 *"AFOLU mitigation options, **when sustainably implemented**, can deliver large-scale GHG emission reductions and enhanced removals, ……Barriers to implementation and trade-offs may result from the impacts of climate change, competing demands on land, conflicts with food security and livelihoods, the complexity of land ownership and management systems, and cultural aspects. There are many country-specific opportunities to provide co-benefits (such as biodiversity conservation, ecosystem services, and livelihoods) and avoid risks (for example, through adaptation to climate change). (high confidence) {7.4, 7.6, 7.7, 12.5, 12.6}"***.**

11. The IPCC Special report on Climate Change and Land (SRCCL) (2019) chapters 2 and 6 also detail various cons of land-based removals summarised in the SPM. Not all applications of land-based CDR have the pros mentioned, and some of it has cons. Likewise bioenergy can have both pros and cons.

[4] IPCC, 2019: Summary for Policymakers. In: *Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems* [P.R. Shukla et al. (eds.)].

See text below from the SPM and Figure SPM3, *Potential global contribution of response options to mitigation, adaptation, combating desertification and land degradation, and enhancing food security*:

a. Paragraph B3: *Although most response options can be applied without competing for available land, some can increase demand for land conversion (high confidence). At the deployment scale of several GtCO2 yr-1, this increased demand for land conversion could lead to adverse side effects for adaptation, desertification, land degradation and food security (high confidence). If applied on a limited share of total land and integrated into sustainably managed landscapes, there will be fewer adverse side- effects and some positive co-benefits can be realised (high confidence). (Figure SPM.3) {4.5, 6.2, 6.4, Cross-Chapter Box 7 in Chapter 6}.*

b. Paragraph B3.1: *If applied at scales necessary to remove CO2 from the atmosphere at the level of several GtCO2 yr-1, afforestation, reforestation and the use of land to provide feedstock for bioenergy with or without carbon capture and storage, or for biochar, could greatly increase demand for land conversion (high confidence).*

c. Paragraph B.3.2: *While land can make a valuable contribution to climate change mitigation, there are limits to the deployment of land-based mitigation measures such as bioenergy crops or afforestation. Widespread use at the scale of several millions of km2 globally could increase risks for desertification, land degradation, food security and sustainable development (medium confidence). Applied on a limited share of total land, land-based mitigation measures that displace other land uses have fewer adverse side- effects and can have positive co-benefits for adaptation, desertification, land degradation or food security. (high confidence) (Figure SPM.3) {4.2, 4.5, 6.4; Cross-Chapter Box 7 in Chapter 6}*

d. Paragraph B.3.3: *The production and use of biomass for bioenergy can have co-benefits, adverse side-effects, and risks for land degradation, food insecurity, GHG emissions and other environmental and sustainable development goals (high confidence). These impacts are context specific and depend on the scale of deployment, initial land use, land type, bioenergy feedstock, initial carbon stocks, climatic region and management regime, and other land-demanding response options can have a similar range of consequences (high confidence). The use of residues and organic waste as bioenergy feedstock can mitigate land use change pressures associated with bioenergy deployment, but residues are limited and the removal of residues that would otherwise be left on the soil could lead to soil degradation (high confidence). (Figure SPM.3) {2.6.1.5, Cross-Chapter Box 7 in Chapter 6}.*

12. **Therefore all pros and cons should be considered for each activity including land-based activities (noting that BECCS could be considered both "land-based" and "engineering-based"). It should be made clear that the balance of pros and cons for land-based mitigation depends on various factors, and that sustainable management is vital to achieve co-benefits (pros) and avoid trade-offs (cons).**