Email to: Supervisory-Body@unfccc.int
Title: Response to consultation on removal activities under the Article 6.4 mechanism
Date: June 19, 2023
Subject: Structured Public Consultation - Removal Activities

Dear Article 6.4 Supervisory Body,

Thank you for opening the public consultation on the information note on guidance and questions for further work on removals detailed in annex 2 to the SB005 meeting report. We appreciate the opportunity to provide a perspective on the role direct air capture technology must play in removal activities necessary to meet the goals of the Paris Agreement.

The Direct Air Capture Coalition (DAC Coalition) is a global non-profit organization consisting of over eighty companies, civil society groups, and research and academic institutions working together to help advance and accelerate the responsible development and deployment of direct air capture technology to address climate change. In the process of writing this response, we have solicited the feedback of stakeholders and experts within our coalition, several of whom have co-signed below.

We write with four objectives:

1) Advise on the definition of "Removal Activities" and provide a more comprehensive definition of direct air carbon dioxide capture and storage (DACCS) as it relates to Removal Activities (Questions on Specific Elements - Question A),
2) Address the minimal risk or reversibility and inherent permanence of DACCS (Questions on Specific Elements - Question E),
3) Emphasize the unique ability to monitor and account for removals with DACCS (Questions on Specific Elements - Questions B.2, C.1), and
4) Provide examples of the positive environmental and socioeconomic impacts of DACCS (Questions on Specific Elements - Question G)

1. Definition of Removals and DACCS (Questions on Specific Elements - Question A)

Regarding A6.4-SB003-AA-A03's definitions of "Removal activities," we note that Option 2a is the most accurate description of carbon dioxide removals as a climate solution that provides truly durable, (i.e., 1,000 years or more), measurable and verifiable net removals. DACCS provides this type of permanent removal. We further note that the Supervisory Body's July 8, 2022 A6.4-SB001-AA-A05 Concept note: Removal activities under the Article 6.4 Mechanism (version 1.0) (the "Concept Note") describes DACCS as "[c]apturing CO_2 from ambient air through chemical processes with the subsequent storage of the CO_2 in geological formations." (Section 3.1.7, paragraph 26). This description of the capture process is too broad, and the description of the storage medium is too limited.

The Concept Note too broadly describes the capture method of direct air carbon dioxide capture as a "chemical process[]," which does not distinguish DACCS from other methods of removal. For example, virtually all forms of non-aquatic nature-based carbon dioxide removal require the chemical process of photosynthesis to remove carbon dioxide from ambient air. In addition, as described in the Concept Note, rock weathering is a form of removal based on a chemical process. In contrast, while direct air carbon dioxide capture can be achieved through a variety of chemical processes, it is more precisely described as "capturing CO_2 from ambient air through a technological or engineered method…" DACCS must be accurately defined, and distinguished from other removal activities, in order to achieve uniform implementation of national laws, rules and regulations, as well as voluntary contracts, regarding removal monitoring, reporting, crediting and accounting.

2. Addressing minimal reversal risk inherent to DACCS (Questions on Specific Elements - Question E)

Permanent carbon dioxide storage is inherent to DACCS. This storage can be both in geological reservoirs, thousands of meters below the earth's surface or in the formation of permanent materials, e.g., minerals and products. This makes DACCS the global standard-setter for permanent carbon dioxide removal and sets it apart from other forms of carbon dioxide removal (CDR). However, the Concept Note limits the medium of direct air carbon dioxide storage to "geological formations," and this does not reflect the breadth of DACCS applications. For example, DAC Coalition members Heirloom and CarbonCure have partnered to store atmospheric CO_2 in concrete, and a number of other entities within the DAC Coalition have commercialized storage through other long-lived durable minerals and products. These forms of storage are far more durable than forestry-based forms of storage. For example, and as noted in the Working Group III Contribution to the Sixth Assessment Report[1] and other peer-reviewed research,[2] carbon mineralization stores CO_2 in concrete for "centuries or more." Similarly, CO_2 mineralized and stored as solid calcium carbonate and aqueous bicarbonate - chemical compounds used in durable products - is stable for at least ~10,000 to 100,000 years.[3] As such, the description of storage should be revised to "storage of the CO_2 in geological formations or long-lived, durable minerals and materials, where the carbon can be conservatively assumed to remain stored within the material over the entire lifetime, including its end of life."

Further, as an engineered and industrial approach to CDR, DACCS provide reduced risk of non-permanence and reversals and therefore require lower risk buffers. Compared with nature-based CDR, DACCS is easier to quantify and, even at this early stage of development, has a track record of no reversals. For example, carbon capture and storage projects such as the Sleipner project in Norway,[4] and the Archer Daniels Midland project in the state of Illinois in the United States,[5] have collectively injected millions of tonnes of CO_2 into rock without ever

[1] https://www.ipcc.ch/report/ar6/wg3/ (pgs. 642, 1265).
[2] *See* https://www.iea.org/reports/putting-co2-to-use; https://pubs.acs.org/doi/10.1021/acs.est.0c07599.
[3] https://doi.org/10.1021/acsestengg.3c00004.
[4] https://www.equinor.com/news/archive/2019-06-12-sleipner-co2-storage-data
[5] https://www.adm.com/en-us/standalone-pages/adm-and-carbon-capture-and-storage/

experiencing a resurfacing of CO_2 to the atmosphere. Indeed no reversals from underground storage have ever been reported globally. A benefit of DACCS, therefore, is that it minimizes the need for buffer pools or other forms of non-permanent risk buffers, and this should be recognized by the Supervisory Body. DAC Coalition members are currently negotiating contracts that do not offer insurance or buffer accounts because of the inherent low-risk of reversibility in DACCS.

Finally, regarding the standardization of criteria for evaluating removal activities, DACCS has the advantage of incorporating processes already vetted by the United Nations Framework Convention on Climate Change (UNFCCC). For example, under Kyoto Protocol (Durban decision), the UNFCCC previously adopted modalities and procedures for carbon dioxide capture and storage in geological formations as a project activity for the clean development mechanism[6] and addressed how liabilities should be documented and allocated in the carbon capture and sequestration context.[7]

3. Monitoring and Accounting Removals Using DACCS (Questions on Specific Elements - Questions B.2, C.1)

The Concept Note provides that "[t]he quantification of removals achieved through engineering and chemical approaches is often accurately known through the very nature of these processes." We agree with this statement and urge the Supervisory Body to identify DACCS as a method of removal capable of providing reliable monitoring and accountability. This is in contract with methods for measuring forest or soil carbon sequestration, which have recently been called into question.[8]

As the form of removal using technological and engineered methods, DACCS allows for discrete and precise measurement of the amount of CO_2 captured within a controlled environment. Removal of CO_2 can be scientifically measured by weight or volumetric flow, using inputs (i.e., energy, sorbent, air) and outputs (e.g., CO_2 and spent materials), coupled with CO_2 sensors to verify the quantity stored.[9] As DACCS is an emerging removal method, monitoring and accounting methodologies are being developed in conjunction with technological advances and business developments. For example, DAC Coalition member Climeworks has partnered with Carbfix and assurance provider DNV to develop the world's first full-chain methodology dedicated to removal via direct air capture and underground mineralization storage.[10] It is also noteworthy that consistent with the Paris Agreement, the Supervisory Body is required to make

[6] https://unfccc.int/resource/docs/2011/cmp7/eng/10a02.pdf#page=13 (Decision 10/CMP.7).
[7] *id.* (Appendix B.5).
[8] *See e.g.,* https://www.theguardian.com/environment/2023/jan/18/revealed-forest-carbon-offsets-biggest-provider-worthless-verra-aoe (regarding forest carbon); https://www.theguardian.com/australia-news/2021/dec/19/soil-carbon-sequestration-on-farms-alone-wont-absolve-our-daily-emission-sins (regarding soil carbon).
[9] *See generally* http://www.enos-project.eu/.
[10] https://climeworks.com/news/climeworks-achievedvalidationfromdnv.

use of existing frameworks,[11] and as noted above, the UNFCCC previously adopted modalities and procedures for carbon dioxide capture and storage in geological formations as a project activity for the clean development mechanism.[12]

4. Environmental and Socioeconomic Impacts of DACCS (Questions on Specific Elements - Question G)

To address Question G (avoidance of other negative environmental, social impacts), we first must address the inaccurate statement made in the Concept Note that DACCS has a lack of environmental and social impact. We urge the Supervisory Body to include reference to the potential co-benefits DACCS can create in local economies and ecosystems where properly implemented. First, at a high level, DACCS by its nature is designed to meet UN Sustainable Development Goal (SDG) 13 (limit and adapt to climate change), and we note DACCS positive contribution to other SDGs throughout this section.

As DACCS relies on technological and engineered processes, DACCS facilities will be a source for job growth, especially for workers currently employed in legacy high-emissions industries whose skill sets are transferable. In fact, much of the underground CO_2 storage capacity exists in the same regions where skilled workers in legacy, extractive fossil industries are facing declining employment rates due to the global energy transition.

Given the ubiquity of CO2 dispersion and the modularity of direct air capture equipment components, DACCS has the benefit of being highly flexible with its siting, allowing DACCS to be sited in locations with minimal environmental impact as well as low-income or developing areas, serving to address SDGs 8 (create decent work and economic growth) and 10 (reduce inequalities). For example, Kenya's vast basaltic reserves along the Great Rift Valley, fast-growing workforce and as much as 92% renewable grid[13] make it an exciting prospect for DACCS development.

In addition, DACCS can contribute to both adaptation and mitigation efforts in low and middle-income countries by providing a source of income and value-added products like freshwater or CO_2 for utilization, contributing to SDG 6 (support clean water and sanitation). For example, Capture6, a direct air capture company, is exploring setting-up facilities in Kenya and Kiribati to produce freshwater while removing CO_2.[14] Furthermore, Octavia Carbon, a Kenyan DAC company, has set out to deploy their technology in the Kenyan Rift to effectively utilize the waste heat generated by geothermal systems to massively lower the cost of DAC. By deploying DAC at scale in Kenya, they hope to increase energy access for ordinary Kenyan citizens.[15]

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[11] *See* https://unfccc.int/sites/default/files/english_paris_agreement.pdf (Article 4, Paragraph 14).
[12] https://unfccc.int/resource/docs/2011/cmp7/eng/10a02.pdf#page=13 (Decision 10/CMP.7).
[13] *See* https://cleantechnica.com/2021/11/04/renewables-provided-92-3-of-kenyas-electricity-generation-in-2020/ (92%); http://www.invest.go.ke/kenyas-renewable-power-generation-hits-86pct-total-output/ (86%).
[14] Many other direct air capture companies are currently exploring deployment in the Global South such as Takachar, Mati, InPlanet and Everest.
[15] https://www.youtube.com/watch?v=CzGu9bP07i0.

DAC Coalition members are actively developing and operating carbon mineralization systems in the Global North and Global South, storing CO_2 in concrete, reducing the industry's hard-to-abate emissions and advancing a green transition without hurting businesses or workers.

Overall, DACCS can also contribute to the following United Nations Sustainable Development Goals:

SDG	Examples of DAC Contribution
SDG 7 - Affordable Clean Energy	By acting as an anchor use case that provides guaranteed clean energy demand via offtake agreements, DACCS can help build out renewable energy infrastructure whereby excess energy produced not used by DAC can be sold back to the grid.
SDG 8 - Decent Work and Economic Growth	High-quality, new green jobs is a key co-benefit to DACCS with estimations of 3,500 jobs across the value chain per megaton facility, include potential for job growth in low-income / developing areas / regions with declining economies
SDG 9 - Industry, Innovation and Infrastructure	As emerging technology, DACCS development is spurring innovation to drive down costs and commercial viability not only within DACCS but in upstream industries such as renewable energy and downstream consumers of carbon for nondurable use such as sustainable aviation fuels. Deploying DACCS in emerging economies with vast amounts of renewable energy, like Kenya's, can spur green industrialization by creating demand for their renewable energy. This demand will lead to an expansion of renewable energy and surrounding infrastructure within these countries which will attract other industries hungry for similar energy. Additionally, as DACCS comes down the cost curve, new innovations underpinned by low-cost DACCS will develop in countries like Kenya. They will be the vanguards for innovations around CO_2-derived commodities such as sustainable aviation fuels and synthetic plastics.
SDG 11 - Sustainable Cities	The use of DACCS technology is not limited to carbon removal with geologic storage, with a number of companies (e.g Heirloom and Mission Zero Technologies) diversifying their approach and revenue streams by aiding the decarbonisation of concrete by permanently mineralizing CO_2 in cement, concrete and concrete plant wash water. This can result in concrete manufacturing with less CO_2 emissions, less fresh water use, less virgin cement and less solid waste.

SDG 13 - Climate Action	Carbon dioxide removal is a climate change mitigation measure that provides us with a critical means to reach net-zero by mid-century (compensating for dispersed or otherwise hard-to-abate emissions) and net-negative in the second half of the century. Without this, the 2 degree scenario will not be met, let alone the 1.5 degree scenario.
SDG 17 - Partnership	Early learnings from project deployment inform deployment in other areas. Early indications of multilateral collaboration for DACCS and other CDR methods is best exemplified by the CDR launchpad of Mission Innovation, a coalition of governments from all over the globe, who have agreed to work together to accelerate the pace of CDR advancements through large demonstration projects and share data and experiences.[16]

We appreciate your focus on the key issues surrounding removals and look forward to continued dialogue.

Best,

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[16] http://mission-innovation.net/missions/carbon-dioxide-removal/.

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