To be sent By Email: Supervisory-Body@unfccc.int

Input to SB005 2022 Annotated Agenda and Related Annexes

Dear Supervisory Body:

Carbon Direct Inc. combines scientific expertise and technology to scale carbon removal and utilisation into a major global industry. Our services support our partners in carbon management, including carbon footprinting and carbon removal portfolio procurement, including governments and private entities.

We are pleased to see the UNFCC take up questions concerning CO2 removal (CDR). The IPCC has found with high confidence that ALL forms of CDR are required to avoid the worst consequences of climate change and to restore atmospheric concentrations to safe levels. This suggests an important role under Article 6.4, including a role for engineered pathways. Specifically, the IPCC found that for a 1.5 trajectory, 1.2 Gt/y of engineered CDR are required before 2030!

Carbon Direct has first-hand actual experience with nature-based solutions and engineering-based solutions like Bioenergy Carbon Capture and Storage (BECCS), Direct Air Capture (DAC), and carbon mineralisation. As an example, we have developed the Requests for Carbon Removal Proposals for Microsoft and other customers and published and annually update the Criteria for High-Quality Carbon Dioxide Removal.

We appreciate your call for input and we would like to share some reflections to the Information Note entitled “Removal activities under the Article 6.4 mechanism” (A6.4-SB005-AA-A09 version 0.40), specifically on the status and potential of engineered solutions vis-a-vis nature-based solutions, amongst others, as described in Table 3. Table 3 as it currently stands significantly misrepresents the best scientific understanding of engineered carbon removal, and we ask that it be revised and updated.

From our experience, we believe that there is little scientific justification for excluding engineered removals under Article 6.4 while allowing nature-based solutions. In fact, the science suggests the opposite argument. We base this view on our review of hundreds of credit-generating projects within the voluntary carbon market using a team of more than 30 PhDs, including experts in forestry, soils, biomass, mineralization, and direct air capture.

In general, nature-based credits are less likely to represent one tonne of real CO2e than engineered credits. While nature-based projects can have significant co-benefits, they also have risks of failing to properly engage indigenous people and local communities, displacing people off land, competing for scarce land-based resources, and other impacts. None of these

concerns are well-reflected in the current document, which reads as over-critical of engineered removals and over-positive on nature-based solutions.

If nature-based solutions are allowed under Article 6.4, then engineered solutions should be as well.

We would like to state and substantiate in this input our opinion that Engineered CDR solutions, next to the other high quality CDR technologies, ***can contribute and serve to the objectives of the Article 6.4 Mechanism*** with it potential to mitigate global GHG emissions whilst fostering sustainable development and incentivise and facilitate participation by public and private entities.

- Our assessment is that both DAC and BECCS are at the brink of large scale deployment in First of a Kind plants, substantiating their ***technical feasibility and future economic viability*** , as a "pro".
    - With specific reference to the recently developments from - 1PointFive Stratos 500 kt/a DAC plant, under construction to be expected operational mid 2025, - the Climeworks 36 kt/a Mammoth DAC plant, under construction, - the 430 kt/a Ørsted Kalundborg Hub BECCS project, under development expected to be operational early 2026 and the - 800 kt/a Stockholm Exergi BECCS project, under development.
    - The major projects in Denmark & Sweden are demonstrating the potential value of engineered pathways using biomass through BECCS. Carbon Direct vetted the recent commercial agreement for 2 million tons CDR between Ørsted and Microsoft, validating the life-cycle analysis and carbon removed. A similar project developed by Stockholm Exergi appears equally valid and twice as large. Sweden has added new regulations and guidelines specifically regarding how double counting under Article 6.4 can be avoided.
    - Furthermore, for the CO2 transport and storage components DACCS and BECCS projects can build on the proven operation at scale of multiple CCS projects, as substantiated by Global Status of CCS 2022, IEA's CCUS status.
- With the developments to "on the ground" projects, the ***environmental risks*** will be assessed and addressed with specific permitting, required and progressed for these facilities. The environmental risks and how they are managed to acceptable levels ***will be known*** through the public permitting and compliance processes.
    - Moreover, operational projects will be regularly audited and certified by third parties - the Stockholm Exergi project, for example, will be audited as part of the broader Northern Lights CCUS network and also falls under Sweden's Article 6.4 accounting. Direct air capture hubs in the US are another example of projects

where stringent reporting will be necessary to apply for public incentives, which in the US case corresponds to the 45Q Tax Credit.

- It is recognised that the current engineered removals are in the order of 0.01 MTPA. However with these (and other) projects under development this can change to MTPA scale in the coming years, creating the foundation for ***scale up in volume*** to their GT/a potential as referenced in the IPCC AR6 WG3 full report and for the ***cost reductions*** which follow with deployment and as such ***will contribute to reducing global mitigation costs*** from these permanent removals. The cost reduction potential of engineered removals is significant, and many players and research institutions are forecasting costs can decrease to around $\$100/tCO_2$, or less (see 1, 2, 3, 4, 5)

  Also the costs of replacement of time limited removals, in perpetuity, have not been fully factored in for alternative removal solutions.

- We anticipate that the engineered solutions are also specifically ***suitable for implementation in developing countries***. From a global climate perspective it does not matter where these "atmospheric pumps" are located. DACCS projects are enabled by access to advantaged renewable energy sources, and BECCS projects are enabled by access to advantaged sustainable biomass feedstock sources. Both solutions are also enabled by access to available storage locations. Such projects include the Africa Climate Ventures project to execute DACCS projects in Kenya, which will increase access to renewable power there. It would also allow nations of the global north to meet their obligations through north-south reparations in the form of direct payments for services under Art. 6.4. Such conditions can be and are available in different developing countries. This is amongst others substantiated by the Maghreb example referenced in Appendix I of the note.

In addition to the SDG13 on Climate Action, engineered CDR solutions ***can contribute to other sustainable development goals*** because:

- They have a low land requirement. According to the WRI, "to capture one million tonnes of CO_2, a DAC plant would need 0.4 to 66 km^2 for the plant and the energy resource, while capturing a similar amount of CO_2 from forests would require an estimated 862 km^2."
- They can bring employment and sustainable economic growth, when the projects and their renewable power or sustainable biomass supply chains are developed meeting high quality "Benefits and Justice" requirements.

Like all CDR (and GHG reduction) solutions also engineered CDR solutions come, as referenced in the Appendix 1 of the information note with their specific Strength, Weakness, Threats and Opportunities characteristics which will focus the ***continuous improvement activities*** of the DACCS and BECCS sectors with their developments. Key attention points are the sustainable biomass feedstock supply for BECCS and the energy use and sustainable renewables energy supply for DACCS.

Furthermore, with reference to table 4 Mitigation potential of some removal activity implementations, we would like to share our assessment that the commercial scale BECCS and DAC projects are progressing with their detailed designs on the basis of substantiated (but confidential) feasibility assessments by the developers. As such we expect ***the TRL levels*** of DACCS and BECCS levels to rapidly increase in the coming years from their current levels, with development and deployment. Indeed, with the projects under construction today, both DACCS and BECCS could demonstrate TRL 7 before 2025. Similarly, commercial firms are piloting enhanced weathering and other mineralization pathways today, suggesting TRL5. **In short, table 4 misrepresents the technical readiness of engineered and hybrid pathways.**

Table 4. Mitigation potential of some removal activity implementations ($GtCO_2.yr^{-1}$ to 2050)

			Mitigation potential ($GtCO_2$ per year)		
Activity type	Status (TRL)	Cost (USD tCO_2^{-1})	IPCC AR6 WGIII (R-32)	Roe et al. (R-81)	Fuss et al. (R-85:a)
Land–based activities					
Afforestation/reforestation	8–9	0–240	0.5–10.1	0.5–10	0.5–3.6
Agroforestry	8–9	–	0.3–9.4	0.11–5.68	0.8–2.0
Improved forest management	8–9	–	0.1–2.1	0.44–2.1	0.1–1.5
Soil carbon sequestration	8–9	-45–100	0.6–9.4	0.38–9.5	2.0–5.0
Wetland restoration	8–9		0.5–2.1	0.35–1.6	0.6–2.2
Biochar	6–7	10–345	0.3–6.6	0.03–4.9	0.5–2.0
Engineering–based activities					
Direct air capture (DACCS)	6	100–300	5.0–40.0		0.5–5
Bioenergy with CCS (BECCS)	5–6	15–400	0.5–11.0	0.4–11	0.5–5
Enhanced weathering	3–4	50–200	2.0–4.0		2.0–4.0

In short, including a wide portfolio of CDR options under Article 6.4, including engineered pathways like DACCS, BECCS, BiCRS, enhanced weathering, and carbon mineralization, will increase opportunities in developing nations and stimulate investment globally in innovation and

deployment. It is premature to deny these opportunities that could reduce risk, accelerate removals, and stimulate growth.

Table 3 as it currently stands significantly misrepresents the best scientific understanding of engineered carbon removal, and we ask that it be revised and updated for the next version of the Information Note “Removal activities under the Article 6.4 mechanism ”

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