From: Kel Coulson <kcoulson@carbonengineering.com>
Sent: Wednesday, 12 October, 2022 0:32
To: Supervisory-Body <Supervisory-Body@unfccc.int>
Subject: Call for input 2022 - activities involving removals under the Article 6.4 Mechanism of the Paris Agreement

Good evening-

Carbon Engineering welcomes the work of the UNFCCC to consider technological removals in the creation of the Article 6.4 Mechanism and are fully supportive of its objective to create linkages across international boundaries and signal integrity in carbon markets. Attached please find our response to *UNFCCC's call for input 2022 - activities involving removals under the Article 6.4 Mechanism of the Paris Agreement* .

If we can be of any further assistance supplying information about direct air capture, please reach out - we are always available as a resource.

Kind regards,

Kel

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UNFCCC ARTICLE 6.4 CALL FOR INPUT - ACTIVITIES INVOLVING REMOVALS: CARBON ENGINEERING RESPONSE

October 11, 2022

CONTEXT & INTRODUCTION

Carbon Engineering appreciates the opportunity to respond to the call for input on the UNFCCC's activities involving removals under the Article 6.4 Mechanism of the Paris Agreement. We welcome the work of the UNFCCC to consider technological removals in the creation of the Article 6.4 Mechanism and are fully supportive of its objective to create linkages across international boundaries and signal integrity in carbon markets. This work is critical to modernize carbon markets and ensure that they generate products with environmental integrity needed to mobilize international project finance required to drive climate action.

The Direct Air Capture (DAC) technology we have partnered to deploy at a climate relevant scale will generate high-quality, tangible, and highly durable Carbon Dioxide Removals (CDR) when paired with safe and secure geologic storage. Direct air capture with secure geologic storage (DACCS) plays an important and growing role in potential net-zero pathways. The IEA Net Zero Emissions by 2050 Scenario estimates DAC technologies will need to annually capture more than 85 $MtCO_2$ in 2030 and around 980 $MtCO_2$ in 2050. This will require both rapid technological improvements and unprecedented growth for industrial-scale climate solutions. The rate of CDR adoption from 2050 onward will strongly depend on what is achieved for the first half of the century, with early inaction or emissions overshoot requiring steep adoption after 2050[1].

Carbon Engineering offers the following comments on the in-meeting document, Annex 5 and 6 below for your consideration as part of the call for input 2022 - *activities involving removals under the Article 6.4 Mechanism of the Paris Agreement* specifically focused on *(i) Sustainable Development Goals (SDG), (ii) Life Cycle Assessment, (iii) monitoring and (iv) GHG reporting requirements.* In summary:

- DACCS deployment can support SDG goals including Affordable and Clean Energy (7), Decent Work and Economic Growth (8), Industry, Innovation and Infrastructure (9) and Climate Action (13).
- Cradle to grave life cycle assessment must be used for carbon accounting in order to ensure credits generated by all forms of removal activities (including DAC) are of the highest integrity
- Monitoring requirements for geological storage should rely wherever possible on existing regulatory regimes, where such regimes meet agreed minimum requirements, to avoid a complex layered structure of legal and voluntary market requirements.
- The UNFCCC frameworks for GHG accounting, and determination of national emissions inventories, should be updated to explicitly allow for technological removals.

[1] https://www.wri.org/insights/unlock-potential-direct-air-capture-we-must-invest-now

RESPONSIBLE DAC DEPLOYMENT

Ensuring integrity and quality in carbon markets is a priority for Carbon Engineering, as is ensuring other important social objectives, such as community engagement in siting decisions, environmental justice, strong labor standards, and domestic job creation are considered with the deployment of DAC technology.

Carbon Engineering views Article 6.4 as an opportunity to responsibly deploy DAC technology in countries with high renewable energy potential connecting to countries where there is a demand for CO2 removals but lack appropriate site conditions for DAC deployment. Advantages of deploying DAC technology include:

- Export potential of carbon removal credits to demand markets. Carbon removal credits generated from DACCS are considered high integrity and command a price premium in the Voluntary Carbon Market (VCM) driven by high additionality, permanence and ease of measuring the carbon removed. This supports SDG goals *9) Industry, Innovation and Infrastructure and 13) Climate Action.*
- A significant social impact of DAC is expected to be job creation, both on-site to operate the plant and elsewhere associated with manufacturing components and infrastructure. High quality job creation – a one megatonne plant can generate approximately 300 steady state jobs once operational[2] supporting SDG goal *8) Decent Work and Economic Growth.*
- DAC scale-up will require expanding energy infrastructure to avoid competition with other uses for renewables. DAC facilities offer a long-term base load to support the build out of additional renewable energy infrastructure that can support other decarbonization efforts supporting SDG goal *7) Affordable and Clean Energy.*

Furthermore, Direct Air Capture facilities can absorb 100's of times greater quantities of carbon than biomass-based approaches such as afforestation or BECCS, though DAC is a net energy use while well-designed BECCS facilities are net energy producers. These important trade-offs between engineered removals and biomass-based removals imply that both will be needed in order to deliver adequate quantities of carbon dioxide removal to meet 1.5C climate goals. While biomass-based approaches will be advantageous in specific regions and niches, engineered approaches such as DAC will be a critical compliment to "nature based" solutions to ensure that adequate quantities of CDR can be delivered without risk of running into fundamental limitations of land or water supply. Put simply, the world may not have enough arable land and/or fresh water for biomass-based approaches to supply the quantities of CDR that are predicted to be required to meet climate targets; direct air capture and other engineered approaches will almost certainly be required.

[2] Capturing New Jobs and New Business: Growth Opportunities from Direct Air Capture Scale-Up | Rhodium Group (rhg.com)

LIFE CYCLE ASSESSMENT

Carbon Engineering would like to provide the following comments on the Information note *"Removal activities under the Article 6.4 Mechanism"* (A6.4-SB001-AA-A05).

Under section 5.3, the concept note provides guidance on accounting of removals. We would like to propose a cradle to grave Life Cycle Assessment (LCA) based approach to quantify the net environmental benefit from removal activities. By design, the LCA approach provides a holistic understanding of environmental impact across different life cycle phases of a process or activity. This would reduce subjectivity in the design of accounting mechanism, especially when defining activity boundaries for accounting which are typically broader than the physical boundary of the removal activity.

Carbon Engineering recommends the following literature be reviewed and considered while designing frameworks for inclusion of removals under Article 6.4:

1) U.S. DOE. (2022). Best Practices for Life Cycle Assessment (LCA) of Direct Air Capture with Storage (DACS). U.S. Department of Energy, Office of Fossil Energy and Carbon Management. https://www.energy.gov/fecm/best-practices-LCA-DACS
2) California CCS protocol under the Low Carbon Fuel Standard (LCFS) that describes requirements the CCS projects must meet to generate LCFS credits, including system boundary for LCA
3) Mazzotti et al, Energy & Environmental Science 2021, Life cycle assessment of carbon dioxide removal technologies: a critical review
4) Sick et al, Global CO2 Initiative, Techno-Economic Assessment & Life Cycle Assessment Guidelines for CO2 Utilization (Version 2.0)

MONITORING REQUIREMENTS

Carbon Engineering would like to provide the following comments on Section 3.1 of the Draft Recommendation *"Recommendations for activities involving removals under the Article 6.4 mechanism"* (A6.4-SB002-AA-A05):

- Monitoring requirements for geological storage should rely wherever possible on existing regulatory regimes, where such regimes meet agreed minimum requirements, to avoid a complex layered structure of legal and voluntary market requirements.
- Permanence should be defined as a condition or set of conditions where safe and secure storage can be demonstrated and the associated monitoring commitments to not be defined as a set number of years. The monitoring period length should reflect the security of the storage type chosen for the project and the risk of potential reversal. As an example, in geologic storage the point at which the CO_2 plume has become predictable and reliably contained in line with reservoir modeling results is an important site closure condition that must be proved by the storage site operator prior to receiving a site closure ruling. Depending on the site and the circumstances, such a state could be reached in a matter of a few years after injection is complete, or in an extreme case could take hundreds of years. (*Working Group III of the Intergovernmental Panel on Climate Change (UNEP) 2005*).

GHG REPORTING REQUIREMENTS

DACCS is already being considered in countries' high level policy plans and net-zero targets and updated reporting frameworks. However, the technology and policy ambition have moved faster than the GHG reporting requirements have evolved. The UNFCCC frameworks for GHG accounting, and determination of national emissions inventories, should be updated to explicitly allow for technological removals.

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ABOUT CARBON ENGINEERING

Carbon Engineering is a global leader in the development of Direct Air Capture (DAC) technology capable of removing CO_2 from atmospheric air and, through a series of chemical reactions, delivering it in a pure compressed stream suitable for storage or use.

Carbon Engineering was founded more than a decade ago with the mission to develop and commercialize affordable and highly scalable carbon removal technology. Carbon Engineering is a developer and licensor of direct air capture (DAC) technology. A standard commercial-scale CE DAC facility will annually capture over 1.0 $MtCO_2$ directly from the atmosphere. Carbon Engineering's DAC technology is a liquid-based DAC technology (L-DAC) that deploys an aqueous basic solution to pull CO2 directly from the atmosphere and, after a series of clever chemical looping processes, conditions the atmospheric CO2 into a dense phase that is optimized for transport and final end-use.

Carbon Engineering's DAC technology can provide highly durable CDR when combined with secure geologic storage. This rock-solid combination of DAC+ secure geologic storage (DACCS) provides a highly scalable and verifiable CDR mechanism for safely storing CO_2 for 1,000+ years, all with relatively low land and water use. Today, leading commercial markets are ready and we're working with global partners to deploy large-scale commercial facilities in multiple locations around the world.

The first large-scale commercial facility to utilize our DAC technology is in active development with our partner, 1PointFive, and is expected to have an annual atmospheric capture capacity of 1.0 $MtCO_2$ when complete.[3] It's our goal to have this first plant ignite an industry by demonstrating that megaton-scale DAC technology is feasible, affordable, and available. We envision fleets of DAC facilities working alongside emissions-free electricity, energy efficiency, and clean innovations in all commercial and industrial sectors to fully tackle the climate challenge. Additional information on Carbon Engineering's technology and commercial developments is provided at www.carbonengineering.com.

[3] Occidental, 1PointFive to Begin Construction of World's Largest Direct Air Capture Plant in the Texas Permian Basin