37322 Galbraith Road
Box 187
Squamish BC V8B 0A2
www.carbonengineering.com

December 23, 2019

Submitted via Carbon Neutrality Comment Portal

Executive Officer Richard Corey
California Air Resources Board
1001 I Street
Sacramento, CA 95814

Re: Carbon Engineering's Comments on The Role of Carbon Capture, Sequestration, and Options for Utilization

Dear Executive Officer Corey:

We appreciate the effort and resources that the California Air Resources Board (CARB) has invested in the development of the carbon capture and storage (CCS) component of the Low Carbon Fuels Standard (LCFS). Carbon Engineering (CE) strongly believes that carbon capture – both at-source CCS, and direct air capture technologies like that we are developing – must necessarily play an important role in the reduction of fossil carbon emissions and growth in carbon dioxide removal in California to enable achievement of California's climate policy goals. This view is aligned with CARB's 2017 Climate Change Scoping Plan, and particularly CARB's recent work on Deep Decarbonization Scenarios.[1]

The Energy Futures Initiative (EFI) was established in 2017 by former Secretary of Energy Ernest J. Moniz, and is dedicated to addressing the imperatives of climate change by driving innovation in energy technology, policy and business models. EFI submitted its report entitled "Pathways for Deep Decarbonization in California" and presented at CARB's recent Deep Decarbonization workshop. The EFI report recognizes that there are several highly valuable cross-cutting technologies that can help meet the large-scale decarbonization needs for multiple economic sectors. Carbon capture, utilization and storage enables large-scale carbon management and is one of these essential technologies. The EFI report concludes that,

> *"Developing these technologies is a necessity because of the need to mitigate emissions from difficult-to-decarbonize sectors that may lack other suitable decarbonization options (e.g., heavy industry), as well as the need for carbon dioxide removal from the environment at the scale of 100 to 1,000 gigatons by 2100."*[2]

[1] See generally CARB Presentation and Supporting Presentations, "Public Workshop to Discuss Carbon Neutrality: Scenarios for Deep Decarbonization," August 15, 2019, at https://ww3.arb.ca.gov/cc/scopingplan/meetings/meetings.htm

[2] Energy Futures Initiative, "Pathways for Deep Decarbonization in California," available at https://static1.squarespace.com/static/58ec123cb3db2bd94e057628/t/5ced6fc515fcc0b190b60cd2/1559064542876/EFI_CA_Decarbonization_Full.pdf, Major Findings at p. xx.

Carbon Engineering

37322 Galbraith Road
Box 187
Squamish BC V8B 0A2
www.carbonengineering.com

The Energy Future Initiative has since released a separate report on Carbon Dioxide Removal entitled "Clearing the Air", in which a US Federal RD&D program in excess of $15B is recommended. The report articulates the importance of carbon dioxide removal in achieving deep decarbonization goals and net-zero economies. Direct air capture coupled with geological sequestration is highlighted as a key pathway to permanent, verifiable carbon dioxide removal.[3]

Carbon Engineering has been developing direct air capture technology since 2009, and is now moving forward with plans for an initial 1,000,000 tonne-CO2 per year facility in partnership with Occidental Petroleum. The facility is intended to be deployed in the US Permian Basin, and to capture atmospheric carbon dioxide which will be permanently sequestered via enhanced oil recovery (EOR) operations. This initial facility is intended to scale up CE's technology, after which the intent is to expand to upwards of 12,000,000 tonnes-CO2 per year in this particular region of the Permian basin. CE sees partnership with Occidental and provision of CO2 for storage via EOR as an early and advantageous proving ground, but Direct Air Capture also has use for carbon dioxide storage in other regions with saline formations (including California) and for use in enabling direct synthesis of liquid fuels from atmospheric CO2 and renewable electricity.

In their report entitled "Negative Emissions Technologies and Reliable Sequestration: A Research Agenda," the National Academies of Sciences, Engineering, and Medicine concluded that there are no fundamental barriers to the scale up and deployment of direct air capture technology. Their conclusion, which our internal work at CE echoes, is that the only limitation to the scale up and use of direct air capture for carbon dioxide removal is market-based[4]. In CE's view, if the right market conditions are created to enable broad deployment of direct air capture, a fleet of facilities could reach Giga-tonne scale carbon removal.

Fortunately, California already has several of the right ingredients to rectify this limitation and create market pull for direct air capture and other carbon removal pathway. CE recognizes CARB's ground-breaking work in developing both the LCFS and the robust CCS Protocol. These policy innovations by CARB have accelerated the development of large-scale CCS projects and have advanced the entire industry. Inclusion of Direct Air Capture in the LCFS and CCS Protocol has materially increased interest in our technology, and has accelerated our scale-up and commercialization. However, even with this newly established policy support, commercial CCS projects on the megaton scale (1 MMT of sequestration per year) still require massive capital investments on the order of one billion dollars per project and many will represent first of a kind advanced technology projects. As a result, developers like CE must overcome high hurdles in order to obtain financing and move these projects forward to commercial development.

[3] Energy Futures Initiative, "Clearing the Air: A Federal RD&D Initiative and Management Plan for Carbon Dioxide Removal Technologies, Summary Report" (September 2019), available at https://static1.squarespace.com/static/58ec123cb3db2bd94e057628/t/5d899dcd22a4747095bc04d5/1569299950841/EFI+Clearing+the+Air+Summary.pdf

[4] National Academies of Sciences, Engineering, And Medicine, "Negative Emissions Technologies and Reliable Sequestration: A Research Agenda" (2019), available at: http://nas-sites.org/dels/studies/cdr/

37322 Galbraith Road
Box 187
Squamish BC V8B 0A2
www.carbonengineering.com

In its recent CCS workshop, CARB posed the following question to the industry, "What are the biggest barriers to near-term deployment of capture technology, and what actions can industry and policy-makers undertake to overcome these barriers?"[5]

While recognizing that the CCS Protocol that CARB has developed is now the world's leading CCS protocol, there are two policy actions that CARB can take to remove the two primary remaining barriers to near-term deployment of capture technology that exist in the Protocol:

1. Revisit the mandatory minimum buffer account contribution for all CCS projects now set at 8% to evaluate to what extent this contribution exceeds the risk profile presented by projects that can meet the exacting qualifying standards and obtain the Executive Orders required by the CCS Protocol.
2. For direct air capture CCS projects, integrate the carbon intensity of bundled renewable energy sourced by power purchase agreement into the lifecycle analysis. This approach is authorized by the plain language of the accounting methodology contained in the CCS Protocol. It would eliminate project reliance on regional grid power which is predominantly fossil fuel based and is therefore counterproductive to the objective of deep decarbonization.

CE has already engaged with CARB staff in the discussion of these issues. We look forward to continued engagement with the agency to scale down or eliminate these barriers to near-term deployment of capture technologies.

We appreciate the opportunity to comment on these important issues.

Sincerely,

Geoffrey Holmes
Director, Regulatory Engagement
Carbon Engineering
gholmes@carbonengineering.com

cc: James Duffy
Alexander Mitchell

[5] CARB, "Carbon Neutrality: The Role of Carbon Capture, Sequestration, and Options for Utilization," staff presentation for December 11, 2019 workshop, available at https://ww3.arb.ca.gov/cc/scopingplan/meetings/121119/carb_cn_ccapture_dec2019.pdf ,query posed at slide 7.