



August 16, 2021

Ms. Rajinder Sahota
California Air Resources Board
1001 I St.
Sacramento, CA 95814

Re: Blue Planet Comments on Engineered Carbon Removal Technical Workshop

Dear Ms. Sahota:

Blue Planet Systems Corporation (Blue Planet) appreciates the California Air Resources Board (CARB) hosting the August 2 technical workshop on engineered carbon removal and the opportunity to comment on it.

Blue Planet is a California company developing technology and products related to economically sustainable carbon capture. Our goal is to solve the carbon capture problem by converting CO₂ into high-value building materials. We hope CARB will recognize the promising role that carbon capture, utilization and storage (CCUS) in aggregates and concrete can play in helping to achieve carbon neutrality and net-negative emissions in California, and take steps to advance this important strategy in the Scoping Plan and other forums. We are currently constructing and beginning operations of a plant in Pittsburg, California on the Sacramento Delta and our carbon sequestered aggregate has been utilized at San Francisco International Airport where carbon sequestered concrete is specified.

Our Level of Commitment to CCUS Defines Our Climate Ambition

CCUS is one of the best, and sometimes only, ways to decarbonize stationary sources of emissions, such as cement facilities and other industrial operations. As outlined in the Stanford presentation, deploying CCUS in just 4 geographic industrial hubs could quickly reduce greenhouse gas (GHG) emissions by 60 million metric tons per year (MMTCO₂e/yr). This is equivalent to about half of the combined GHG emissions from all industrial facilities and power plants in California. It's not hard to imagine that the rate of GHG emissions reductions from these "hard-to-abate" sectors could quickly outpace that from other sectors, such as buildings and transportation – if we embrace CCUS and strategies to deploy it at scale.

What's more, as outlined in the LLNL presentation and associated report, *Getting to Neutral*, biomass with CCUS could quickly remove 83 MMTCO₂e/yr from the atmosphere, while delivering an additional about 60 MMTCO₂e/yr in avoided emissions, and direct air capture of

carbon dioxide is essentially infinitely scalable, but pairs especially well with CCUS at industrial facilities.

The State has clearly defined goals and intentions for transitioning the power sector, transportation sector and buildings sector to zero GHG emissions over time. (Actually, in the SB 100 Report, the energy agencies suggest ongoing GHG emissions of about 24 MMTCO₂e/yr from 2045 on in an SB 100-compliant future, largely because they don't consider CCUS on natural gas power plants. We hope CARB will look more deeply at how to quickly achieve near-zero, zero, or even net-negative GHG emissions in the power sector in the 2022 Scoping Plan Update.)

It does not have clearly defined goals and intentions for transitioning the industrial sector, which CARB should establish in the Scoping Plan. Ultimately, while decarbonizing tens of millions of buildings and vehicles will take several decades – no matter how quickly the state pushes on electrification – decarbonizing the industrial sector can be relatively quick and straight forward. By comparison, the state just needs to address dozens of facilities, mostly in and around a few key regional hubs, to quickly and deeply decarbonize California's industrial sector. Getting there, however, requires CARB and the state to enable CCUS.

CARB Should Avoid Treating Carbon Neutrality as a Zero-Sum Game

We disagree with suggestions that CCUS might be at odds with California's climate targets. As described above, it is a necessary strategy to decarbonize the industrial sector and the last of the power sector. And we hope that CARB and all stakeholders now clearly appreciate the urgency with which we must address climate change and that we shouldn't take any strategy – especially what might be the most important one! – off the table.

The only way CCUS conflicts with other strategies to address climate change is if we constrain our ambition to address the problem. When we were focused on just reducing emissions to 1990 levels, and then 40 percent below 1990 levels, CARB could pick and choose among sectors and strategies to achieve incremental emissions reductions. Accordingly, to date, the state has clearly prioritized emissions reductions and strategies outside of the industrial sector.

With carbon neutrality, that is no longer the case. CARB's charge is to achieve carbon neutrality as soon as possible and then to achieve and maintain net negative emissions. While some may still try to imagine limiting the role of CCUS by constraining our ambition to be just net-zero GHG emissions by 2045 and simply wishing away certain industrial sectors by then, the carbon neutrality Executive Order – and the threats posed by climate change – now direct CARB to break free of artificial constraints on our ambition.

Rather than picking and choosing among strategies to achieve a specific constrained target – such as net zero emissions by 2045, or even 2035 per Governor Newsom's recent letter – CARB should remove constraints on our ambition, imagine deploying all reasonable strategies to their full extent, and therefore achieving carbon neutrality as soon as possible and then achieving the

greatest possible net-negative emissions thereafter. If we design to minimize the impacts of climate change by minimizing our cumulative climate footprint, rather than to just meet specific targets in the fairly distant future, the inescapable conclusion is that we need to quickly deploy CCUS. And whatever level of CCUS we assume in our planning will define our ambitions – or the constraints we choose to place on them – to address the threats of climate change.

Rocks Provide Infinite and Permanent Carbon Storage

Almost all of earth's carbon – more than 99 percent – is stored naturally through the process of mineralization forming limestone rock. In fact, trillions of tons of CO₂ have been safely and naturally stored in a permanent crystalline form as carbonate mineral in the lithosphere for over 100 million years. Much less than 1 percent of the earth's carbon resides in the atmosphere, biomass and hydrosphere combined.¹

We appreciate Heirloom's presentation, which touched on the promise of mineralization, but much of the state's focus, and that of the other presentations, continues to be on geological sequestration. A limited focus on geological sequestration makes CCUS appear to be a more costly and difficult proposition than it needs to be.

For example, Blue Planet's CCUS technology produces coarse and fine limestone aggregate made from sequestered CO₂ utilizing the carbon mineralization process. It allows lower-cost carbon capture, including from direct air capture, by avoiding the need to purify and enrich captured CO₂ before use. This reduces the cost and energy needs associated with carbon capture. It is also fully scalable and can be applied to any facility in regions in any part of the state where concrete is utilized, regardless of its proximity or access to a geological sequestration site.

As described in our July 9 comments related to the Scoping Plan kickoff workshops, and validated in peer-reviewed research,² the mineralization process permanently stores carbon in rock, which can then be used in concrete and stored in our built environment. Concrete is the most widely used building material on earth, and every year, California (and the world) uses enough rocks in concrete that we could store all emissions from major industrial sources in our buildings and roads. Compared to geological sequestration, which only entails cost and requires ongoing public subsidy, CCUS, and in particular carbon storage in concrete, provides a value-added market that can make carbon capture cost effective without additional public subsidy.

If we add CCUS in rocks into our climate neutrality framework, we can introduce a game-changing, cost-effective and virtually infinite solution for addressing climate change. We hope

¹ Kayler, Z., Janowiak, M., Swanston, C. (2017). "The Global Carbon Cycle". [Considering Forest and Grassland Carbon in Land Management](#). General Technical Report WTO-GTR-95. United States Department of Agriculture, Forest Service. pp. 3–9.

² For example, see: Xi, F., Davis, S., Ciais, P. et al. Substantial global carbon uptake by cement carbonation. *Nature Geosci* 9, 880–883 (2016). <https://doi.org/10.1038/ngeo2840>

CARB will fully evaluate the promising opportunities offered by storing carbon in rock in the 2022 Scoping Plan Update.

Mineralization and other CCUS Strategies Reduce Criteria Air Pollutants, Too

What's more, Blue Planet's mineralization technology captures and stores other pollutants, as well. Based on years of data gathered from our in-field demonstration at the Moss Landing Power plant, the mineralization process captured and reduced 40% - 100% of toxic air contaminants including, mercury, silver, arsenic, cadmium, chrome, copper, nickel, lead, selenium, vanadium, and zinc. It also captures over 50% of NO_x and nearly 100% of SO_x, which are incorporated as a solid solution in carbonate minerals of limestone at safe concentrations, similarly as they occur in natural limestone where these levels are commonly higher. These pollutants are thus captured and permanently stored in our produced limestone aggregate for permanent storage in concrete just like CO₂.

Accordingly, the faster and more deeply we deploy CCUS, the faster we will achieve air pollution benefits in the communities in and around industrial operations. We encourage CARB to deeply evaluate the science on this topic and open a dialogue around it with environmental justice and other community groups. Blue Planet would be eager to support such an evaluation and participate in related conversations.

Public Procurement of Low Carbon Concrete that Accounts for Carbon Sequestered in Aggregate Can Unleash this Critical CCUS Solution, Without Additional Subsidy

Key to enabling this promising opportunity is including it in accounting for the State's climate programs and public procurement. CARB should include CO₂ mineralization and sequestration in rock as an eligible CO₂ storage solution in its CCUS protocol under the Low Carbon Fuel Standard (LCFS), and extend those protocols to the Cap-and-Trade Program.

Given the promise and infinite scalability to permanently store carbon in California's built environment, CARB should set a target to store at least 50 MMTCO₂e/yr in California's buildings and roads by 2030. CARB should also highlight in the Scoping Plan the role that public procurement can play in supporting CCUS from the industrial, cement and power sectors, and encourage Caltrans, the Department of General Services (DGS), the High Speed Rail Authority, and other state and local public procurement agencies to account for embodied carbon in concrete and other building materials – including CO₂ sequestered in aggregate – and prioritize procurement for materials that have the lowest embodied emissions *and* that utilize CO₂-sequestered aggregate. Current industry practice, using Environmental Product Declarations to account for emissions associated with concrete production, are incomplete and do not include accounting for the captured carbon stored in limestone aggregate. They therefore limit scope of potential emissions reductions opportunities associated with concrete use and the benefits that can be gained from potential public procurement programs like Buy Clean.

Given the opportunity for a value-added climate solution, and assuming CO₂ sequestered in aggregate is fully accounted for in the State's programs, California can leverage public procurement to enable wide-ranging CCUS solutions. Combined with the 45Q tax credit (\$35/MTCO₂ for utilized CO₂), the value of Cap-and-Trade allowances assuming CCUS in aggregate is included (conservatively, \$20-30/MTCO₂ through 2030), and a prioritization in public procurement for concrete using aggregate with sequestered CO₂ (likely indistinguishable for taxpayers, but critically important for enabling greenhouse gas reductions) – California can establish a sustainable framework to support rapid and sustainable deployment of CCUS, without additional subsidy.

We Look Forward to the Ongoing Dialogue around CCUS

We are grateful for your attention and consideration of our comments and thank you again for hosting this important workshop. We look forward to engaging in the ongoing Scoping Plan process and with CARB and other agencies in various forums around CCUS. Please do not hesitate to reach out if you have any questions about Blue Planet, our technology, or the recommendations and comments offered in this letter.

Thank you,



Brent R. Constantz, Ph.D.
Chief Executive Officer
Blue Planet Systems Corporation