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Clerk of the Board
California Air Resources Board
1001 I Street
Sacramento, California 96814

Re: Comments by Blue Planet Ltd. on Proposed Amendments to the Low Carbon Fuel Standard Regulation and to the Regulation on Commercialization of Alternative Diesel Fuels (Item 18-3-3)

Members of the California Air Resources Board:

Thank you for the opportunity to provide comments on ARB's draft Low Carbon Fuel Standard
Regulation Order ("LCFS"). Blue Planet[1] strongly supports the LCFS and efforts to encourage the use and production of cleaner low-carbon fuels in California. In crafting rules to support this goal, however, we urge the Board to include mineralization of CO_2 as a form of CCS, including qualifying for credits under ARB's LCFS.

Comment: CCS is typically thought of as a series of complicated and energy intensive processes whereby waste carbon dioxide is extracted from the flue gases of large emission point sources, compressed to a supercritical state, transported to an appropriate disposal site, and pumped into deep geological formations for storage. Once in the ground, long term predictions about storage security are difficult and highly uncertain. In other words, continued monitoring is necessary as there remains the very real risk that the CO_2 might leak back into the atmosphere.

Geologists have long known, though, that in nature carbon dioxide is captured and permanently sequestered via the process of "CO_2 mineralization". When certain types of rocks are exposed to air and water, they undergo a chemical weathering reaction that transforms CO_2 into a stable carbon-based, 'carbonate' rock. The geochemistry of mineralization reactions is fairly well understood: metal ions (such as magnesium or calcium) react with carbonate and bicarbonate ions derived from carbon dioxide and water to mineralize as magnesium and calcium carbonate rocks (e.g. common limestone). Most of the carbon on Earth is in the form of carbonate minerals in carbonate rocks such as limestone. For example, this is how the cliffs of Dover were formed from calcareous

1 Blue Planet is a California company that has developed a patented process technology that captures carbon dioxide from raw industrial flue gas emissions and permanently sequesters it as construction aggregate, allowing for the world's lowest net CO2 footprint concrete.

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marine phytoplankton, and the way clams, oysters and other mollusks form their shells.[2] Thus, the process of CO_2 mineralization can be thought of a type of biomimicry in which carbon dioxide is permanently sequestered the same way that the natural world has captured this molecule for hundreds of millions of years.

Significantly, according to the Intergovernmental Panel on Climate Change:

> The products of mineral carbonation are naturally occurring stable solids that would provide storage capacity on a geological time scale. Moreover, magnesium and calcium silicate deposits are sufficient to fix the CO_2 that could be produced from the combustion of all fossil fuels resources.[3]

The National Energy Technology Laboratory put it this way:

> Carbon sequestration by reacting naturally occurring Mg and Ca containing minerals with CO_2 to form carbonates has many unique advantages. Most notably is the fact that carbonates have a lower energy state than CO_2, which is why mineral carbonation is thermodynamically favorable and occurs naturally (e.g., the weathering of rock over geologic time periods). Secondly, the raw materials such as magnesium based minerals are abundant. Finally, the produced carbonates are unarguably stable and thus re-release of CO_2 into the atmosphere is not an issue.[4]

In sum, carbon sequestration via mineralization (which is sometimes called carbonation) offers all of the benefits that the ARB has identified as being necessary to meet the goals of AB32, namely it is a real, permanent, additional, quantifiable, verifiable, and enforceable carbon capture process.

From a regulatory perspective, carbon mineralization offers the significant advantage over traditional CCS in that it is a much simpler task to quantify, verify and enforce the carbon capture process. And, it is truly permanent with no monitoring required. Once CO_2 is converted into limestone/dolomite, it is permanently sequestered.

In light of this potential to meaningfully and permanently impact the carbon intensity of fuels used in California, we ask that the Board:

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2 https://www.scientificamerican.com/article/how-are-seashells-created/

3 IPCC, 2005 - Bert Metz, Ogunlade Davidson, Heleen de Coninck, Manuela Loos and Leo Meyer (Eds.). Cambridge University Press, UK. pp 431. (http://www.ipcc.ch/pdf/special-reports/srccs/srccs_wholereport.pdf).

4 https://www.netl.doe.gov/publications/proceedings/01/carbon_seq/6c1.pdf

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1. Specifically include carbon mineralization as a technology available for LCFS credits.
2. Craft rules to ease the implementation of carbon mineralization as a means of achieving CCS.

Thank you for your consideration of our comments.

Sincerely,

Jim Atkins, Esq.
Counsel/VP of Government Affairs