From: Phil Kithil <pkithil@ocean-based.com>
Sent: Wednesday, 24 May, 2023 19:43
To: Supervisory-Body <Supervisory-Body@unfccc.int>
Subject: Input to SB005 annotated agenda and related annexes.

We refer you to the following scientific study on marine carbon dioxide removal (mCDR) via upwelling of nutrient-rich deep ocean.

Jürchott, M., Oschlies, A., & Koeve, W. (2023). Artificial upwelling—A refined narrative. Geophysical Research Letters, 50, e2022GL101870. https://doi. org/10.1029/2022GL101870.

The abstract, and plain-language summary, are copied below:

Abstract
The current narrative of artificial upwelling (AU) is to translocate nutrient rich deep water to the ocean surface, thereby stimulating the biological carbon pump (BCP). Our refined narrative takes the response of the solubility pump and the CO_2 emission scenario into account. Using global ocean-atmosphere model experiments we show that the effectiveness of a hypothetical maximum AU deployment in all ocean areas where AU is predicted to lower surface pCO_2, the draw down of CO_2 from the atmosphere during years 2020– 2100 depends strongly on the CO_2 emission scenario and ranges from 1.01 Pg C/year (3.70 Pg CO_2/year) under RCP 8.5 to 0.32 Pg C/year (1.17 Pg CO_2/year) under RCP 2.6. The solubility pump becomes equally effective compared to the BCP under the highest emission scenario (RCP 8.5), but responds with CO_2 outgassing under low CO_2 emission scenarios.

Plain Language Summary
Artificial upwelling (AU) is a proposed marine carbon dioxide removal (CDR) method, which suggests deploying pipes in the ocean to pump deep water to the ocean's surface. This process theoretically has several different impacts on the surface layer including an increase in the nutrient concentration, as well as a decrease in surface water temperature. Changes in the carbon cycle and associated with biological components are covered by the biological carbon pump (BCP), while changes via physical-chemical processes are covered by the solubility pump. Using numerical ocean modeling and simulating almost globally applied AU between the years 2020 and 2100 under several different atmospheric CO_2 emission scenarios, we show that AU leads under every simulated emission scenario to an additional CO_2-uptake of the ocean, but the potential increases under higher emission scenarios (up to 1.01 Pg C/year (3.70 Pg CO_2/year) under the high CO_2-emission scenario RCP 8.5). The individual contribution via the BCP is under every emission scenario positive, while the processes associated with the solubility pump can lead to CO_2-uptake under higher emission scenarios and CO_2 outgassing under lower emission scenarios