

Minimizing organic carbon losses to improve net productivity in direct air capture cultivation

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Abstract: The ultimate goal of this project is to demonstrate a >20% improvement of Fall and Spring season AFDW productivities over baseline values in indoor controlled (climate-simulated) environments as well as in outdoor raceway pond cultivations. We have the following three objectives that will be performed in an integrated fashion to achieve high overall biomass productivities with favorable composition for biofuel production.

- (1) Employ complementary alkaliphilic algal cultures in an engineered, mixed community to increase culture robustness and productivity.
- (2) Reduce (i) photorespiration and O₂ stress during the day and (ii) nighttime respiration by controlling O₂ concentrations through adaptive mixing, sparging and controlled organic substrate addition.
- (3) Optimize algae microbiome interactions to develop naturally adaptive strategies to control oxygen stress as well as the flux and final allocation of carbon, nitrogen, and other elements (or compounds) in algal and bacterial community members on the culture- and single cell-scales.

Upon successful completion, this project will deliver novel alkaliphilic co-culture strategies for achieving high biomass and biofuel productivities. In addition, our project will result in toolkits related to (i) molecular biology of alkaliphilic cultures, (ii) high productivity alkaliphilic algal cultivation operations, and (iii) outdoor cultivation datasets with productivity, nutrient use, composition data along with insights on the development of the microbiome and metabolome within these cultures.