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Advancing Algal Productivity through Innovation in Cultivation Operation and Strain Traits (ADAPT-COST)

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Project Description: The goal of this project is to improve the productivity and improve the biomass quality of *Nannochloropsis oceanica* CCAP84910 based on traditional CO_2 supply (Subtopic 2a) by implementing strain improvements and new technologies for improving cultivation operations using sensors and innovative cultivation management. The strain improvement tasks begin with a recently developed mutant with research focused on continued advancements. Improvements are projected from a parallel set of high and low risk tasks. The cultivation improvement work uses the development of novel sensors for monitoring biomass and nutrients to support a new continuous/near-continuous operational strategy.

Objectives of the Project: The project objectives are (1) Perform genetic modifications to improve biomass productivity and quality via increased photon and carbon use efficiencies; (2) Develop strategies for improved cultivation operations; (3) Integrate and deploy strain and operational improvements; and (4) Assess progress toward economic and environmental metrics. The overall result will be >20% increase in areal productivity to >18 g $m^{-2}{\cdot}d^{-1}$ for *N. oceanica* in spring with biomass quality improved to achieve a modeled fuel yield of >85 GGE/ton of biomass while hitting DOE economic goals ($2.50 GGE^{-1}). Two toolkits will be delivered to the algae community related to strain improvements and pond operations.

Project Methods: During the first technical phase, the team will implement strain improvement approaches, develop sensors for biomass and nutrients, develop models, cultivation improvement strategies, baseline productivity data, and conduct initial TEA and LCA. The expected results at the end of this research phase includes a second *N. oceanica* mutant with increased productivity, laboratory-validated sensors, and a laboratory-validated cultivation management strategy, all ready to be deployed in the field. The second phase of the project will be focused on continued strain improvements and development of the strain improvement and operational toolkit, integration and deployment of the improved strain and cultivation management strategies in outdoor ponds, and final TEA and LCA.

Project Impact: This project combines innovation in strain development and novel cultivation management, the integration of approaches that are successful in laboratory settings, and the deployment of a combined technology suite at two large-scale outdoor cultivation sites.

Project Team: The multidisciplinary team consists of personnel from Colorado State University, Arizona State University, Los Alamos National Laboratory, Qualitas Health, OptiEnz Sensors LLC, and Quantitative BioSciences, Inc. The team members have collaborated on several projects over the past decade and the group has broad expertise in algal biotechnology.