Summary

Title: Photosynthesis-driven microalgal system to mitigate carbon dioxide emission from power plant flue gases

With an established microalgal culture platform, this project aims to engineer microalgal polyculture through a photosynthesis-driven process to capture and sequester CO_2 from power plant flue gases in the form of algae biomass and calcium carbonate precipitates. Algae biomass will be exploited for production of non-energy products such as aquaculture feed, while calcium carbonate will be exploited in a novel biocementation process to produce biocement. The specific objectives are:
1) Laboratory development of algal cultivation systems with injection of micro- or nano-bubbles to improve CO_2 mass transfer and sequestration;
2) Optimization of algal culture microbiome and the biocementation process;
3) Pilot-scale testing of the algal carbon sequestration system at the partnering power plant;
4) Development of TEA and LCA models to evaluate and guide research and testing activities.

Impact: The annual carbon released into the atmosphere globally is increasing at an alarming rate, contributing to climate change that is causing damage to the world economy. Reduction in the amounts of CO_2 emissions is urgently needed globally if humanity is to avoid loss of life and property on a historically unprecedented scale. Our technology offers the opportunity for companies to install a technology that quickly covers its costs and generates a positive revenue stream for the business. It's modular and scalable design allows a small installation to grow into a major CO_2 mitigation system with its expansion paid for by the technology itself. Starting with landfills, wastewater treatment plants and cement factories around the world will ensure a continuous march to greater levels of CO_2 mitigation globally while producing large volumes of algal feedstocks for food additives, nutraceutical products, bioplastics and biofuels.

The expected outcome: 1) to reach Carbon Utilization Efficiency (CUE) >50% (kg carbon in harvested algae biomass) and CUE >70% (kg carbon in harvested algae biomass + extra carbon sequestration through calcium carbonate); 2) to increase algal biomass productivity from our baseline of 22 g/m^2/day to over 35 g/m^2/day on ash free dry weight (AFDW) basis at pilot scale (1,000 L reactors); 3) to develop TEA and LCA models to evaluate and guide research and scaling-up field test activities.

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