**Summary for Public Release**

**Applicants:** Washington State University (WSU, Pullman, WA), Pacific Northwest National Laboratory (PNNL, Sequim, WA) and Integrated Lipid Biofuels (ILB) LLC (Airway Heights, WA)
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**Project Title: Advancing Efficient Flue Gas $CO_2$ Capture and Conversion (EC3) for Extremophile Algae to Produce Cattle Feed and Biodegradable Mulch for Low-Carbon Agriculture**

This project proposes an Efficient $CO_2$ Capture and Conversion (EC3) system to mitigate carbon emissions from industrial sources by cultivating algal biomass as a renewable feedstock. The algal biomass will be used to produce environmentally responsible, equitable, and economically valuable products such as cattle feed and biodegradable agricultural mulch (BDM). The EC3 technology platform aims to achieve $CO_2$ capture and conversion efficiency exceeding 90% and robust algal growth of 20 g/m² per day ash-free dry weight (AFDW).

The project includes five key objectives: (1) Optimize algal biomass production with enhanced quality and productivity using an alkaline cultural system; (2) Implement Sequential Hydrothermal Liquefaction Process (SEQHTL) to extract valuable components from microalgae biomass for targeted applications; (3) Conduct tests to assess microalgae extract efficacy in reducing cattle methane emissions and improving milk quality; (4) Develop and evaluate BDM using microalgae extract solid residues. (5) Demonstrate $CO_2$ capture and conversion (CCU) with an alkaline cultural system using flue gas at pilot scales, and conduct techno-economic and life cycle analyses for EC3.

The deliverables of the project include technical reports and publications documenting the performance of the EC3 technology and providing TEA and LCA results for system scale-up. These efforts will optimize the technology to meet major performance targets, offering EC3 as a cost-effective option within DOE's technology portfolio and demonstrating its viability at a higher technology readiness level (TRL). The project outcomes will yield pivotal data, advancing the technology from TRL 4 to TRL 5, thereby diminishing commercialization risks. Success in this endeavor will eliminate key technical obstacles and stimulate economic growth by harnessing value from microalgae biomass. Additionally, the project aligns closely with the priorities of various governmental agencies, particularly the FECM and EERE of DOE, presenting significant benefits to the federal government.

Long-term impacts include revolutionizing flue gas capture and conversion for the mitigation of greenhouse gas (GHG) emissions, contributing to environmental justice and energy equity, and creating job opportunities. Our commitment to Diversity, Equity, Inclusion, and Accessibility (DEIA) includes training students from underrepresented groups, disseminating findings to underserved communities, and promoting equity-minded practices.