

CO₂ Utilization

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Research Objective

The objectives of this project are to develop and demonstrate an economically feasible technology for CO₂ utilization with microalgae and transform algal biomass into a sustainable source of energy.

This project aims to accomplish the following sequential goals:

- Identify and culture optimal summer and winter algae strains to be used in the CO₂ mitigation system
- Optimize the culturing process and technology; this should include a demonstration of algae cultivation at pilot-plant scale under summer and winter conditions, incorporating optimized nutrient and water recycling
- Identify and evaluate the possible co-products from the process, including fuels and animal feed
- Use the data gained to construct a techno-economic model to estimate the overall cost of CO₂ fixation and utilization at various scales of operation

Technical Approach

The technical approach focuses on the design of a low- cost, closed-loop photobioreactor, and culminates in a pilot plant demonstration at a coal-fired power plant in Kentucky (Dale Power Station), slated for start-up in early 2012. In the longer term, the research team plans to leverage this expertise and experience with that of the U.S. and Chinese project partners to conduct a detailed techno-economic assessment of the potential of algae for CO₂ mitigation.

Duke Energy and China's ENN Group are conducting similar pilot-plant studies at Duke's East Bend Station, and have captured a slipstream from the plant and are feeding it into a research reactor from China. Field demonstration projects such as ENN's at East Bend and UK's at Dale Power Station are critically important for meaningful comparative analysis and engineering scale-up.

Recent Progress

The design of the Dale Power Station PBR has been completed and significant progress has been made toward its construction. The majority of the parts have been delivered and assembly is almost complete. Separately, laboratory-scale media studies have been conducted in order to fine-tune the media recipe that will be used for algae cultivation at Dale Power Station. Start-up of the PBR is planned for late February 2012.

Expected Outcomes

Construction of the initial phase of the demonstration project will be completed and a fully instrumented, 15,000 L system will be commissioned at Dale Power Station in early 2012. In mid 2012, the system will be expanded to a maximum capacity of 150,000 L. Process data will be collected until the system is taken off-line in November 2012. The accumulated data will be incorporated in a techno-economic model that will enable the costs associated with CO₂ capture and utilization to be calculated at different operating scales. Data sharing between UK and Duke/ENN will enable a range of process configurations to be assessed.

Photobioreactor under construction at Dale Power Station in Kentucky

