

**Proposed Agreement between California Energy Commission
and
The Regents of the University of California, - CIEE**

Title: Life Cycle Greenhouse Gas and Energy Analyses of Production of Algae Biofuels
Amount: \$142,747.00
Term: 3 months
Performing Inst: University of California, Merced
Contact: David Effross
Committee Meeting: 2/1/2011

Funding

FY	Program	Area	Initiative	Budget	This Project	Remaining Balance	
06	Natural Gas	Transportation	Research, Develop, and Deploy Alternative Fuels that Reduce Petroleum Consumption and Transportation	\$100,000	\$100,000	\$0	0%
09	Natural Gas	Transportation	Research, Develop, and Deploy Alternative Fuels that Reduce Petroleum Consumption and Transportation	\$50,000	\$42,747	\$7,253	15%

Recommendation

Approve this agreement with The Regents of the University of California, - CIEE for \$149,947.00. Staff recommends placing this item on the discussion agenda of the Commission Business Meeting.

Issue

Algae biofuels directly address the PIER Transportation Research Area objective of increasing alternative fuel uses in California that both reduce oil dependency and reduce climate change. While algae fuels will minimize land use impacts, a high-profile study recently argued that life-cycle inputs in algae production could make algae fuels more carbon-intensive than conventional biofuels. Critics of this study argue that alternative algae processes and energy recovery from waste streams could more than compensate for these inputs. In particular, the efficient use of residual algae biomass and efficient harvesting techniques must be incorporated effectively into the overall process to improve sustainability. The uncertainty looming over the sustainability of algae biofuels suggests that the life-cycle performance of these fuels is a critical knowledge gap.

Background

The objective of this Work Authorization is to provide a better understanding of the energy and environmental implications of algae biofuels by evaluating existing Laboratory's Life-Cycle Assessment studies and comparing them with new analyses of a range of algae production scenarios and process assumptions that have not been considered previously.

Proposed Work

The goal of this Work Authorization is to evaluate existing life-cycle studies and compare our own new analyses of a range of algae production scenarios and process assumptions to improve our understanding of the energy and environmental implications of algae biofuels. A transparent and objective comparison of existing studies with new analysis will be developed to assess the life-cycle greenhouse gas emissions, net energy consumption, and net liquid fuels production. Sensitivity analysis on the variation of these assumptions will also be performed to characterize the most uncertain parameters.

Justification and Goals

This project "[will develop, and help bring to market] advanced transportation technologies that reduce air pollution and greenhouse gas emissions beyond applicable standards, and that benefit electricity and natural gas ratepayers" (Public Resources Code 25620.1.(b)(1)), (Chapter 512, Statutes of 2006)); and supports California's goal to research, develop, and demonstrate alternative fuel production technologies, emphasizing in-state resources per the Integrated Energy Policy Report 2005.

This will be accomplished by:

- Performing algae biofuels literature review
 - Surveying published and grey literature on algae biofuels production.
 - Tabulating previous work using a summary rubric that includes assumed process train, system boundaries, functional units, critical system performance parameters, life-cycle performance results and conclusions stated.
 - Delivering a tabulated literature review
- Presenting the work of previous studies in a transparent framework that can be interpreted by a broad range of scientists and policy makers.
 - Adjusting previous studies so that they have commensurate system boundaries, functional units, and co-product accounting such that a quantitative comparison is possible.
 - Contacting authors of previous studies directly when more information is needed.
 - Producing a quantitative comparison of previous work by constructing a meta-analysis spreadsheet model.
 - Delivering a meta-analysis spreadsheet model.
- Incorporating new scenarios of algae biofuels production into the LCA based on process components and waste stream allocations that have not been previously taken into account.
 - Reviewing new scenarios of algae biofuels production based on process components and waste stream allocation.
 - Considering alternative scenarios and technologies that integrate the complete system from well-to-wheels.
 - Examining energy recovery from algae biomass residuals.
 - Examining use of algae biomass residuals as a fertilizer.
 - Examining compatibility of digestion approach with upstream processes in biodiesel production.
 - Conducting laboratory experiments to determine efficiencies for algae harvesting.

- Evaluating three policy-relevant metrics, net GHG emissions, net energy consumptions, and net petroleum offset.
- Delivering PowerPoint results presentation to California Energy Commission.