Jun 25th, 10:40 AM - 12:00 PM

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iEMSs International Congress on Environmental Modelling and Software

9th International Congress on Environmental Modelling and Software
Fort Collins, Colorado, USA, Mazdak Arabi, Olaf David, Jack Carlson, Daniel P. Ames (Eds.)
https://scholarsarchive.byu.edu/iemssconference/2018/

Environmental and Economic Impacts of Producing Alternative Fuels from High Productivity, Low Lipid Algae

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Abstract: As microalgae becomes a feedstock of interest for biofuels production, technologies have advanced to provide a variety of methods for both cultivation and processing. This study explores the economic viability and environmental impact of processing high productivity, low lipid content algae into biofuels using two different production pathways. The two processing pathways explored are, 1) Biochemical Processing via fermentation step to produce high value products, followed by Hydrothermal Liquefaction to produce a biocrude (B&T), and 2) Thermochemical Processing via whole algal Hydrothermal Liquefaction (HTL). For a feedstock, this study considered algae harvested from an Algal Turf Scrubber (ATS), which represents a high productivity system, at the expense of a lower lipid feedstock compared to conventional algae production systems. The ATS technology is used to simultaneously clean contaminated water while producing algae for biofuels. Environmental impacts explored include greenhouse gas emission reduction from the use to algal biofuels. The two identified production pathways resulted in a greenhouse gas emissions of 6.05 g CO2-eq and -10.3 g CO2-eq per MJ fuel produced; this was compared to soybean biodiesel and conventional diesel to show a significant reduction in emissions. Techno-economic analysis was performed to determine the minimum fuel selling prices for each pathway; the results from the two production methods examined were $12.81 and $10.88 per gallon of gasoline equivalent (GGE). Multiple scenarios were considered to identify target areas for additional research, including ash and biomass cost reduction. A combination of these scenarios resulted in a minimum fuel selling price of $3.71/GGE.

***Keywords**:* Techno-economic analysis, life cycle analysis, sustainability, renewable fuels