Techno-economic Feasibility Analysis of Biodiesel and Ethanol Co-production from Lipid-producing Energycane

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Project Goals

Renewable Oil Generated with Ultra-productive Energycanes—or ROGUE—is engineering the two most productive American crops—energycane and Miscanthus—to produce a sustainable supply of biodiesel, biojet fuel, and bioproducts. The goal of this work is to determine the techno-economic feasibility and competitiveness of using engineered energycane as feedstock for biodiesel and ethanol production at commercial scale.

Abstract

Biodiesel is a promising renewable alternative fuel to petro-diesel. However, high feedstock cost and low oil yields per unit land from temperate oilseed crops limits the growth of commercial scale biodiesel production. Through the ROGUE project, energycane, one of the most productive crops in the US, is being engineered to accumulate lipids, which would open the way for production of far more industrial vegetable oil per unit land than previously possible.

The objective of this work is to perform a techno-economic analysis for commercial scale biodiesel production from the engineered energycane. Compared with conventional sugarcane (Saccharum spp.), energycane is dedicated bioenergy feedstock rich in fiber, low in sucrose, and more persistent on marginal soils [1-2]. Energycane contains 22.5% soluble sugars (in juice) and 70.6% fiber on dry mass basis. The fiber consists of 38.8% cellulose, 23.4% hemicellulose, and 21.5% lignin [3]. As first approximation, if all energy from the sucrose that normally accumulates in the stem is diverted to triacylglycerides (TAG), energycane could accumulate up to 8% lipid by weight in its stem (dry mass basis). Comprehensive process models for bio-refinery for coproduction of biodiesel and ethanol from energycane, with 1600,000 MT/year (200 operating days) energycane processing capacity, were developed in SuperPro Designer, assuming 2, 5, and

8% lipid concentration in the harvested stem. The bio-refinery was modeled to produce biodiesel (by transesterification of extracted lipids) and ethanol (from fermentation of sugars in juice and carbohydrates in fiber) as main products, while glycerol and electricity are produced as coproducts. The process simulations results would provide the production yields of biodiesel and ethanol, unit biofuel production cost, and economic profitability, indicating the competitiveness of energycane as a feedstock for biodiesel production compared to conventional oil crops.

Reference

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