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Sensitivity analysis of techno-economic factors in algal biofuel production

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Abstract: Techno-economic analyses of current algal biomass production technologies typically value biomass at $450 to $500 per dry ton of ash-free dry weight (AFDW). However, in order to make algal biomass production economically favorable, the purchase price needs to be reduced by more than half based on current conversion technologies. Often, the most significant factor considered in driving biomass cost down is through biomass productivity improvements. This study leverages a detailed open raceway pond (ORP) growth model and an algal biorefinery model to define a sustainable biomass cost and what is required to achieve this goal in terms of the growth system. Two downstream conversion pathways are considered in this bottom-up analysis: 1) Baseline: ORP coupled with a hydrothermal liquefaction (HTL) process to produce a biodiesel precursor and 2) High Value Pathway: ORP followed by a protein extraction with HTL of the residuals, which adds a high-value protein product to the analysis. Preliminary results with the baseline HTL process show that a minimum biomass selling price of $253/ton AFDW is required to meet the DOE goal of $3 per gallon of gasoline equivalent (GGE). Even as productivity is increased, oft-overlooked effects of other cost- or logistically-prohibitive factors, such as co-location of CO_2, open-channel fluid delivery, raceway pond liners, etc., can severely affect the viability of biomass production from a techno-economic standpoint. The results from this analysis illustrate where significant investment in realistically improving these parameters is required for algal production systems to reach the DOE milestone of $3 per GGE.

***Keywords**:* algae; biofuel; techno-economic assessment