Introduction

• The next generation of biofeedstock must be critically analyzed to determine their energetic and greenhouse gas (GHG) emission impacts while maintaining the feasibility of a significant level of production (i.e. terawatts of billions of gallons per year).

• Life Cycle Analyses (LCAs) of the microalgae-based biodiesel process exist in the literature, but consensus on the inputs, boundaries and co-product allocation methods appropriate for microalgae-based biofuels is lacking.

• There exists a need to quantify the sustainability effects of the microalgae-to-biofuel process. This study builds on the literature of algae feedstock processing and biofuels LCAs to generate a model of net energy and GHG emissions of the microalgae-to-biofuel process.

Results

• The first results of the microalgae-to-biofuel process model are a tabulation of the consumables and energy consumption of each process stage, as presented in Table 1.

• The quantities and types of these direct consumables are the inputs to the net energy and GHG calculation models which translate these consumables into lifecycle energy consumption and GHG emissions rates, in the GREET model 1.8c.

• The second results of this analysis are the comparison of the net energy ratio (NER) of the microalgae-to-biofuel process to the soy-to-biodiesel process and to a conventional petroleum-to-diesel process and GHG emissions.

Discussion

• The results of the baseline microalgae-to-biofuel processes show sensitivity in the co-product allocation methods, but little to changes in the engineering process model. Scalability of the microalgae-to-biofuel processes, products, and inputs is assessed in Table 2.

• Limits on water consumption, nitrogen consumption, and the engineering co-product market will limit the scale of algae biofuels production. Alternative sources of nitrogen and water, including wastewater, and other uses for the glycine co-product must be considered to achieve process scalability.

• Overall, results demonstrate that the microalgae biodiesel process can represent an improved alternative to conventional biofuel/stock and petroleum-based diesel, and that the proposed microalgae to biofuel processes exhibit significant NER, GHG, and scalability advantages over soybean-based biodiesel.