# Biorefining

*By: Tony Tran, Tejas Patel, Trenika Iland, John Truong, Bambo I-Obe, and Jeremy Constantino*

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## Executive Summary

The demand of fermentation chemicals in the United States is steadily growing as many chemical processing industries aim to take advantage of the environmentally friendly profile of biochemicals and products. Therefore, the purpose of this report is to evaluate the most economically favorable fermentation process as well as the raw material choice that will best produce the end products and propose a business plan for a biorefining plant. The chemicals evaluated that can be produced by fermentation are succinic acid, fumaric acid, propionic acid, and ethanol, each with various end uses. Characteristics of good bio based products are those that are biodegradable, non toxic, and generate less volatile organic compounds. By investigating these characteristics, we proved that upstream and downstream chemical production by fermentation is more environmentally sound, can pass environmental regulations, stimulates rural economic growth, and lowers overall economic costs.

Input parameters were provided into a reducible mathematical model to determine which biorefining investments are most profitable, what raw materials should be used, as well as their location and demand. As a result, it was determined that the process should include the milling of corn into sugar, which is fermented to produce chemicals that can be used to develop plastics and solvents. Different potential plant locations and production rates were analyzed to determine the most profitable scenario.

The model considered the variation of the total capital investment to determine the investment that would maximize the net present value. From the total capital investment, the investment opportunities for each process were determined from the mathematical model. This model considered the mass balances, equipment cost, material demands and supplies, and the market prices for each potential process. The material balances and equipment cost pricing was determined based on simulation of the process flow.

The total initial capital investment available at the beginning of the project is $150 million. With this initial capital, the net present value for this investment is $321 million. This plant will be built in Dubuque, Iowa with corn as the agricultural source of the biorefining process. The initial annual total capacity for the project should be 180 million pounds, but with expansion opportunities, the final annual total capacity is 550 million pounds. The plant will include the production of succinic acid, ethanol, propionic acid, and fumaric acid.

It is recommended that a more thorough analysis be performed to determine different investment possibilities and future expenditures.