

Biorefinery

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Executive Summary

A biorefinery uses biomass feedstock to produce valuable chemicals and resources that can be used in many applications, including alternate energy sources such as fuels by means of an integration of many processes with the objective of producing many products. By incorporating many different processes into one refinery under one roof, power, energy, utilities, and maintenance costs can be shared and conserved.

Choosing the processes that are the most economical and profitable is a main focus in this project. Starting with one large superstructure of different processes, the net present worth of each of the processes is to be compared and those processes which are unprofitable, eliminated. A mathematical model is constructed to eliminate processes and choose capacities and expansions. In this mathematical model the equations for net present worth, fixed capital investment, operating costs, demand, capacity restraints, material balances, sales, revenue, and material costs, are included. To eliminate the first round of processes, the assumption was made that the operating costs were all equal to zero. From here, based on the inputs and outputs only, the superstructure was narrowed down to a smaller form.

In order to accurately calculate the net present worth, various parameters had to be calculated. By running simulations on each process, the operating costs and fixed capital investments for the processes are found. From these findings, the parameters are used in the model. The market demand and material costs for the chemicals are other parameters that are put into the formulation. These values help to compare the processes to ensure that the decision made is the most economically optimal outcome. The model that is created produces results for very complex problems, such as narrowing down more than 16 million options of different operating conditions. After designating the parameters, the model only takes 90 seconds to run, and gives the optimal results of the investment.

Several case studies are done for different situations. If the initial investment is five million dollars, the model shows us that the NPV is 27.5 million dollars. With a twenty million dollar investment, the model gives an NPV of 24.5 million dollars. The variable investment study, the model picks the best investment by optimizing the trade off between how much we can build in our first year and how much in interest charges we have to pay back at the end. With this option, the model chooses 7 million dollars to be investment, and has a NPV of 28.8 million dollars.

Several things are recommended as further analysis into the projected biorefinery. Location of the biorefinery has a large impact on the fixed capital investment as well as the operating costs. This must be considered when deciding upon the profitability of the refinery. The choice of feedstock must also be carefully considered; whereas, the biomass must be able to be converted to the desired products in the chosen processes.