

EVALUATION OF ENERGY ALTERNATIVES AT A CORN BASED ETHANOL PLANT

Black & Veatch, an international consulting firm, recently completed a study for Otter Tail Ag Enterprises (OTAE) that evaluated the three leading alternatives for increasing the energy production and overall profitability for corn based ethanol plants. They concluded that the Struvite/Anaerobic Digestion process using thin stillage as a feed-stock produced the greatest rate of return.

After the cost of corn, utilities are the largest component of the overall cost of producing ethanol. Based on pricing at the time of the study (2008), OTAE paid \$1.6 mil/month for natural gas and \$1.0 mil/month for electricity. The three alternatives evaluated for reducing this cost were (1) burning syrup and wet cake to generate steam, (2) creating a renewable fuel (biogas to off-set natural gas) through anaerobic digestion of thin stillage, and (3) using the Struvite/Digestion process to produce not only biogas, but also a renewable fertilizer (struvite) ahead of the anaerobic digestion process.

To determine the financial viability of the three alternatives, Black & Veatch developed an economic model for the potential operating scenarios. This model calculated the revenues and costs associated with each alternative relative to the current ethanol production process. The model also established the internal rate of return (IRR) under the specified conditions.

Black & Veatch used a spreadsheet-based, 20-year annual cash flow model that took into account the project's capital and operating costs, performance characteristics (e.g., capacity factor), added or lost product sales (e.g. DDGS, struvite), off-set natural gas consumption (drying of the solubles with the DDG), financing terms, and other income streams to calculate the amount of revenue available each year to service the debt and cover operating expenses. The primary revenue streams used in the model were the offset cost of natural gas and the sale of struvite. The model then calculated the equity investors' IRR. The model presumed that the project owner had no out-of-pocket tax liability. Black & Veatch concluded that even though the economic model depended on many high-level and preliminary assumptions, the results were sufficient (1) to indicate general project viability, (2) to differentiate between the various options, and (3) to evaluate which project parameters had a significant influence over the economic results.

The results for the conditions at the time of the study are shown in the following table. The Struvite/digestion process clearly has the highest IRR. The sensitivity analysis for the most economically attractive alternative, the Struvite/Digestion process, revealed that the IRR would reach 15% with only a 10% change in the price of the DDGS.

Comparison of Alternatives

	Bubbling Fluidized Bed Combustion	Anaerobic Digestion	Struvite Extraction with Anaerobic Digestion
Average Debt Service Coverage Ratio	1.03	0.99	1.18
Minimum Debt Service Ratio	0.58	0.51	0.86
After-Tax Internal Rate of Return on Equity	3.9%	1.8%	12.5%