The University of Georgia

Center for Agribusiness and Economic Development

College of Agricultural and Environmental Sciences

The Economic Feasibility of Operating an Ethanol Production Facility in Southeast Georgia

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The Economic Feasibility of Operating an Ethanol Production Facility in Southeast Georgia

Executive Summary

The current industry standard ethanol plant is a dry grind facility where the entire corn kernel is run through the conversion process. This type plant typically relies on natural gas for the generation of heat to dry the co-product distillers dried grains and solubles (DDGS) and for the production of ethanol. A 30 million gallon plant of this type would be expected to have a capital cost of about $52.5 million with annual operating costs of around $48.9 million. The average net income of an ethanol plant in Southeast Georgia was determined to be a negative $943,953 using five year average prices for the co-products and the feedstock corn.

However, it is important to note that this model does not include two variables that could potentially generate an additional $2.1 million in revenue. The federal government subsidy of $0.10 per gallon for the first 15 million gallons would be worth $1.5 million, while the carbon dioxide the plant would produce could be worth another $600 to $800 thousand. The reason these two items were not included was that they depend too heavily on other entities to be relied on.

Sensitivity analysis revealed that the most significant factors in determining the level of profitability were ethanol price, corn price and utility costs. For these factors, a five percent increase in their price will change net income by $2.2 million for ethanol, $1.6 million for corn and $400,000 for utility costs. Although there is a large capital outlay for this project, increases or decreases in this cost did not significantly impact net income. A five percent change in capital cost changed net income by $90,000.

The current market conditions for ethanol are somewhat different than what the feasibility study suggests. The rationale behind using five-year average prices is to show the profitability of the plant over the period of time required to pay back the loan. This takes the peaks and valleys out of the input and output prices. In this case the current market conditions shows the plant to be profitable with a net income of over $18 million dollars, while using the five-year averages shows that the plant would have a negative net income.

The conventional dry grind method is proven technology. The benefits of this technology are that the capital cost estimates are going to be very close to those in this study and this type plant will be able to produce at the rated capacity given quality management personnel. The downside is that it uses over $8 million worth of natural gas to operate annually and produces a low protein DDGS that would need to be dried in order to be fed to chickens in Georgia.

Introduction and Reason for Study

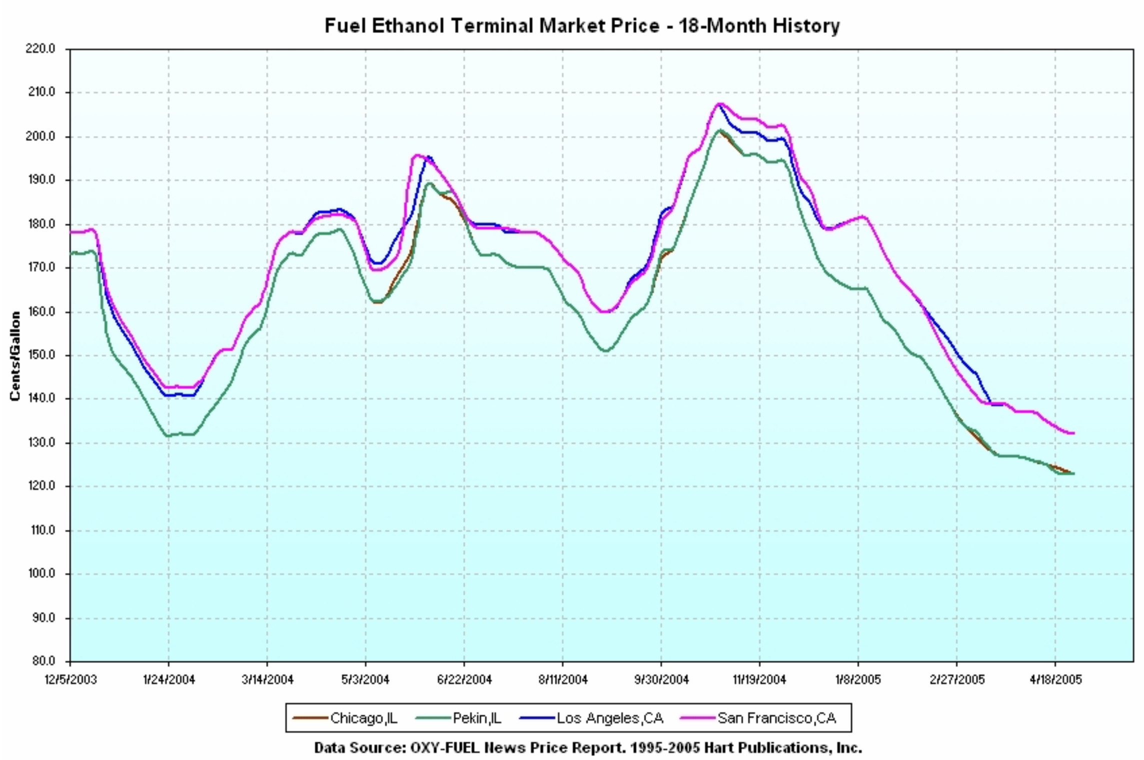
The Center for Agribusiness and Economic Development was asked to study the feasibility of a proposed ethanol plant in southeast Georgia. A group of farmers from Alma, GA wanted the Center to investigate the profitability of a conventional dry grind facility that would produce, at full capacity, about 30 million gallons of ethanol annually. The Center for Agribusiness and Economic Development, UGA subcontracted a portion of the task leading to the estimation of the production costs and capital expenditures to Frazier, Barnes and Associates (FB & A). FB & A provided the cost estimates for the conventional ethanol plant construction and operation. These cost estimates were then utilized by the Center to determine the potential profit of the facility and to do sensitivity analysis for the economically significant variables. Frazier, Barnes and Associates is well known for their work in the ethanol and oilseed processing industries. FB & A also performed the initial feasibility analysis that led to the construction of the Commonwealth Agri-Energy plant in Hopkinsville, KY that is in its second year of operation and is currently producing between 23 and 30 million gallons annually.

Co-Product Markets

The conventional ethanol plant produces three co-products that have potential markets in Georgia. Ethanol, Distillers Dried Grains and Solubles (DDGS) a feedstock for monogastric animals and Carbon Dioxide all have markets available to the ethanol plant at some level.

The co-product of most significance would be ethanol. The market for ethanol has been volatile over the last several years with the market price moving around a five year average of $1.35 per gallon. Figure 1 below shows the prices over the 18 month period prior to May 2005. There are many reasons that the ethanol market has been so volatile recently. Ethanol production in 2004 surged to a record 3.4 billion gallons. Since that time the addition of 16 new ethanol facilities and the expansion of two existing facilities will bring US total capacity to 4.4 billion gallons annually. These supply increases along with the volatility of the gasoline market have contributed to the volatility in the ethanol market. The market for ethanol has many components and thus makes it difficult to understand sometimes. The 1990 Clean Air Act Amendments required that reformulated gasoline sold for consumption in areas of the U.S. that do not meet the Clean Air Act standards must contain at least two percent oxygen by weight. There are two primary sources of oxygenate for gasoline. One, Methyl Tertiary Butyl Ether (MTBE) has been banned in 20 states, leaving the other, ethanol, as the primary oxygenate in those states. The market for ethanol will grow if additional states ban MTBE's. At the current time, Atlanta, GA does not require the blending of an oxygenate with their gasoline.

Figure 1. Ethanol Terminal Market Prices



One of the major issues facing potential Georgia ethanol producers is whether or not the metropolitan areas like Atlanta and Jacksonville, FL will have to start blending an oxygenate with their gasoline. The gasoline market in the greater Atlanta area is very large at about three billion gallons sold per year. This would make the potential ethanol market around 300 million gallons once the oxygenation of gasoline is required. With this potentially occurring in the coming year or two, the market could obviously support many ethanol plants the size of the one being studied here. However, one of the drawbacks to producing ethanol in Georgia is being able to obtain reasonably priced high quality feed stock that the managers of ethanol plants desire. A solution is that Georgia could ship corn in from the Midwest to get the necessary quantity and quality, but transporting this corn might prove to be costly and thus provides a rationale for this study. However, producing ethanol in Georgia eliminates the cost of transporting the ethanol into the area from distant production and provides savings on that side.

The second most valuable co-product for this production facility would be distillers dried grains (DDGS). The current United States DDGS production is approaching four million tons per year. It is estimated that in the next three to five years the production will climb to eight million tons per year. A major concern in the industry today is where to market the growing DDGS supply.

DDGS is commercially used as a livestock feed and could potentially be utilized by cattle feedlots (for which there are relatively few) and poultry producers (which there are many) in Georgia. The protein level of the DDGS is estimated to be around 27 percent which according to some research would make it valuable to both poultry and cattle producers. This protein estimate puts its value on the marketplace at a level around $101 a ton. The value is based on comparisons with the current market for soybean meal, which would be its main competitor. The soybean meal price over the past five years in central Georgia has averaged about $202 per ton.

According to Dale and Batal, University of Georgia Poultry Scientists, DDGS has only rarely been a component of broiler and layer feeds, despite the dramatic growth of both the poultry and ethanol industries in the U.S. It can be said, however, that the lack of DDGS interest in Georgia seems to stem from a relatively limited supply, competing use in ruminant feeds without having to dry the product, and concerns over an occasionally inconsistent composition. Dale and Batal research on DDGS (with 27 percent protein) in poultry rations showed that the product was highly acceptable feed ingredient for both broilers and layers. This was in agreement with earlier research conducted at the University of Minnesota. They also determined that poultry rations containing six to twelve percent DDGS can be used safely in starter feeds.

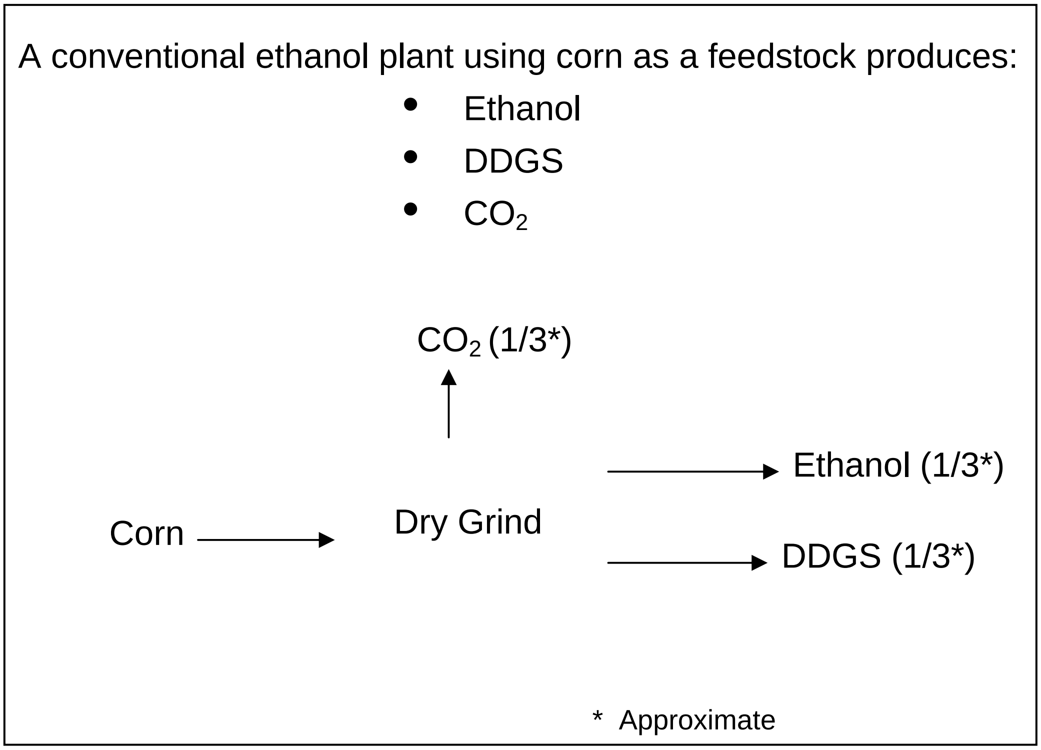
The last saleable co-product of the conventional ethanol plant is Carbon Dioxide. It has uses in both the carbonated beverage industry and the dry ice industry. The value of this co-product is variable but can amount to hundreds of thousands of dollars. However, one must be able to find a company willing to locate adjacent to the plant in order to have a saleable product due to inherent transportation problems. This is a valuable co-product that some plants find easier to just vent to the atmosphere. Over time, given the food beverage industry in Georgia, one would think that this would be a valuable co-product for an ethanol plant. Since Carbon Dioxide needs to be utilized in close proximate to where it is produced, this study assumes that none will be sold initially. If a purchaser is found after the plant starts production, the current value for CO_2 is around eight dollars a ton.

Co-Product Yields

The typical ethanol plant uses corn as a feedstock and produces three co-products: Ethanol, DDGS and Carbon Dioxide (CO_2). The dry grind production process produces these co-products in approximately equal quantities as shown in Figure 2. This would mean that approximately one-third of the output would be in the form of ethanol, one-third carbon dioxide and one-third DDGS.

During the operation of a 30 million gallon per year, the amount of denatured ethanol actually produced is 31.5 million gallons (102,000 tons) because of gasoline being blended in to change it from pure ethanol to denatured ethanol. The quantity of DDGS will be 106,000 tons annually, along with 96,000 tons of CO_2.

Figure 2. Conventional Ethanol Plant Co-Product Production



Technology and Costs of Production for Conventional Ethanol Plants

Cost estimates of a 30 million gallon ethanol plant were obtained from Frazier, Barnes and Associates. Figure 3 shows the conventional ethanol plant flow diagram. From this figure one can tell that this ethanol plant is of the conventional variety with a hammer mill and a traditional drum dryer.

Table 1 shows the estimated costs associated with the construction and startup of a conventional 30 MMGPY ethanol plant. The total capital cost associated with the construction and startup comes to approximately $52.5 million. This includes $2.5 million dollars for grain receiving and storage and $9 million for working capital and startup costs.

Figure 3. Conventional Ethanol Plant Flow Diagram

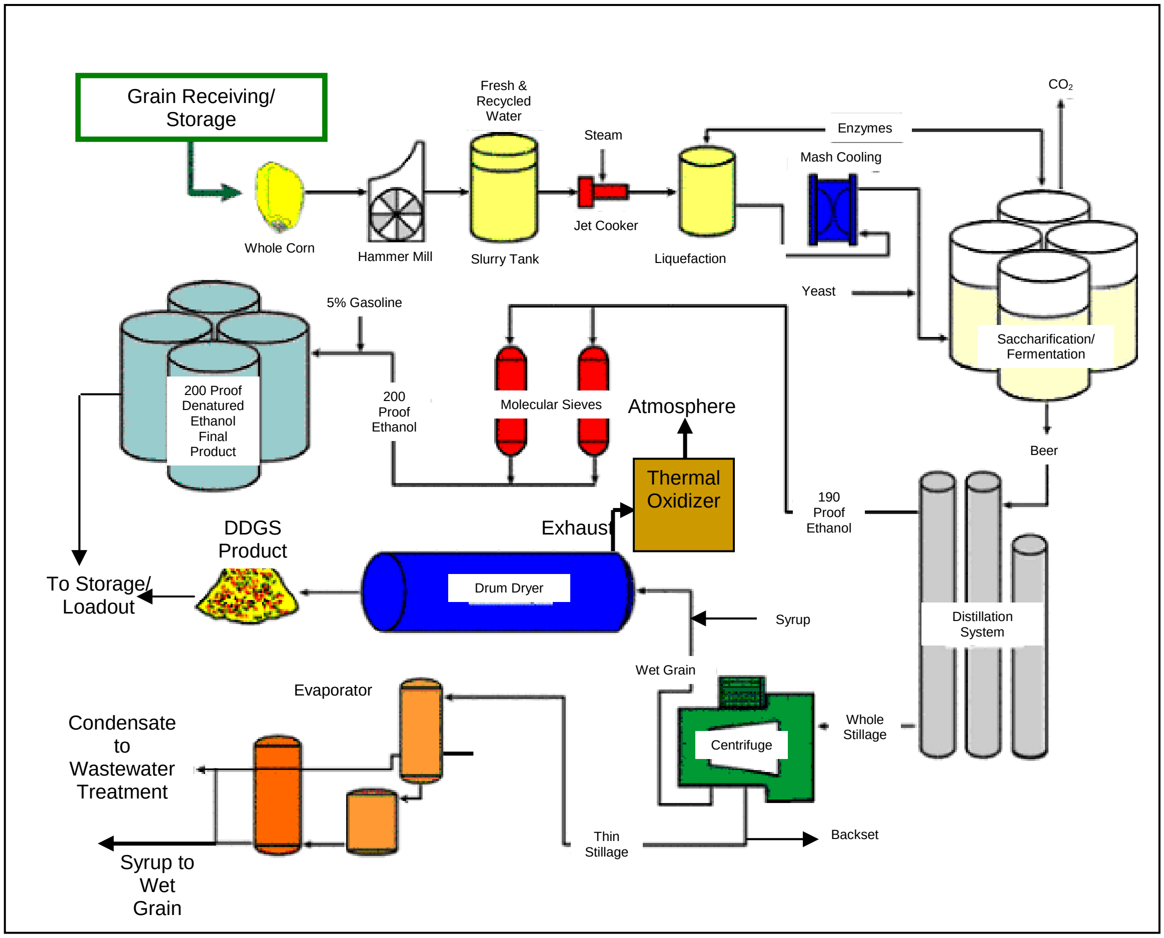


Table 1. Conventional Ethanol Plant Capital Cost Projections (30MMGPY)

Component	Capital Cost
Ethanol Plant (30 MMGPY --Includes Natural Gas Boiler)	$34,000,000
Electrical Substation & Utilities	$1,500,000
Professional Services & Permitting	$500,000
Land (80 Acres)	$1,000,000
Construction Contingency	$4,000,000
Feedstock/Product Working Capital & Start-up Cost	$9,000,000
Grain Receiving and Storage	$2,500,000
Projected Conventional Total Capital Cost	**$52,500,000**

Pro Forma Income Statement for the Conventional Ethanol Plant

Using the F B & A capital cost estimates and the estimates for the other fixed and variable costs associated with a 30 MMGPY ethanol plant, a pro forma income statement was derived for the plant. This pro forma income statement is also the basis for the sensitivity analysis that will come later in this study. It is important to remember that some of these costs are just estimates and that contingencies are allowed for that reason. The income statement shows the income derived from the sale of ethanol and DDGS. Potential carbon dioxide revenue is not included because it may or may not be an immediate contributor to income. Table 2, shows the co-product incomes as well as the fixed and variable costs associated with the ethanol plant. The plant was assumed to run 24 hours a day, seven days a week, fifty weeks a year. At 100 percent efficiency that plant would produce 90,000 gallons a day or 31.5 million gallons annually. The income from the two saleable co-products is estimated to be a little over $53.2 million, with the sale of ethanol making up $42.5 million of that total.

Processing costs which include labor, chemical, and utility costs totaled around $16.1 million, with utilities making up around $8.5 million of that total. The corn feedstock used for this plant is totals a little over 11.2 million bushels annually amounting to a little over $32.8 million annually.

Fixed costs which include taxes, insurance, interest on investment and depreciation totaled a little over $5.27 million. Taxes and insurance make up $600,000 of that with the interest on the investment being $1.84 million. The largest portion of the fixed costs comes from depreciation at $2.83 million.

Net income is calculated by taking the difference between total revenue and total cost. When the total costs of production were calculated and subtracted from the co-products' income it was determined that the net income was a negative ($943,953) for the plant.

Table 2. Pro forma Income Statement for the Conventional Ethanol Plant

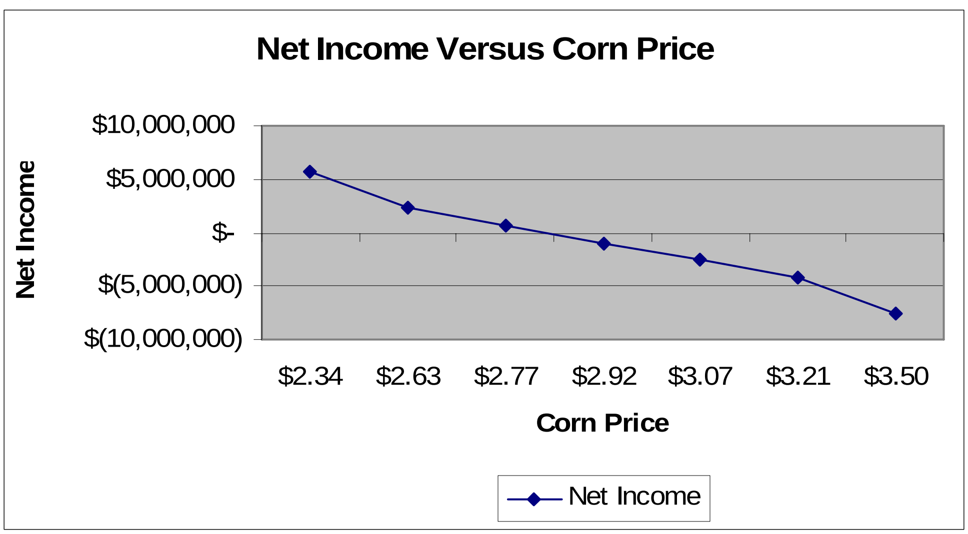
Pro forma Income Statement for the Conventional Ethanol Plant						
3,750	Gallons ethanol per hour					
90,000	Gallons ethanol per day		100%	Capacity		
7	Days per week		224,000	Bushels Corn a Week		
50	Weeks per year		11,236,000	Bushels Corn Required		
31,500,000	Gallons ethanol per year					
Income:		**Quantity**		**Unit Price**	**Total $**	**Value/ bushel**
Ethanol		31,500,000	Gallons	$ 1.35	42,525,000	$ 3.78
DDGS		106,000	Tons	$ 101.00	10,706,000	$ 0.95
CO2		96,776	Tons	$ 0	0	$ 0.00
Total					**$53,231,000**	**$ 4.77**
Processing Costs:				**Cost Per Gallon**	**Total**	
Maintenance and Supplies				$ 0.036	$ 1,134,000	
Utilities				$ 0.150	$ 8,505,000	
Chemicals				$ 0.070	$ 2,205,000	
Denaturants				$ 0.040	$ 1,260,000	
Labor and Benefits				$ 0.070	$ 2,205,000	
Sales and General Administration (S&GA)				$ 0.015	$ 472,500	
Total Processing and S&GA				**$ 0.381**	**$ 16,096,500**	
Feedstock Cost:		**Quantity**		**Cost Per Gallon**	**Total Cost**	**Cost Per Bu.**
Corn (bushels)		11,236,000		$ 1.04	$ 32,809,120	$ 2.88
Total Feedstock Cost					32,809,120	
Total Direct Cost					**$ 48,905,620**	
Fixed Costs:	**Cost Per Gallon**				**Total Costs**	
Insurance and Taxes	$ 0.019				$ 598,500	
Depreciation - Plant Equipment	$ 0.127				$ 2,833,000	
Interest on Investment – Plant Equipment	$ 0.078			7.00%	$ 1,837,500	
Total Fixed Costs					**$ 5,269,333**	
Total Cost					**$ 54,174,953**	
Profit/Loss					**$ -943,953**	
% Equity					**50.00%**	
Financed Portion					**$ 26,250,000**	

Sensitivity Analysis on Critical Variables

Nine variables were deemed significant enough to analyze what might happen to the net income or profit of the plant if they turned out to be something different that in the original analysis. This sensitivity analysis is done in order to assess a level of risk associated with potential future changes in these variable's prices.

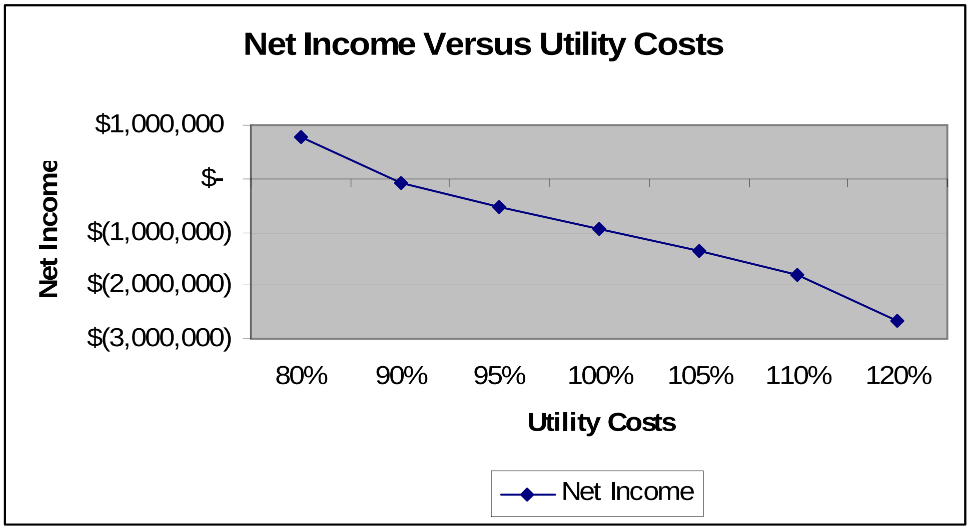
Corn price has the potential to make a big impact on the profitability of a 30 million gallon ethanol plant since the plant utilizes a little over 11,000,000 bushels annually. Figure 4, below, shows how the profitability is affected when corn prices are five, ten and twenty percent higher and lower than the past five year average railed in price of $2.92 per bushel. As can be seen from the figure, the ethanol plant becomes profitable at $2.83 per bushel of corn. It is important to note that a five percent change in the price of corn from the five year average leads to an increase or decrease in the profitability of the ethanol plant by around $1.6 million. It would also be important to note here that the price of $2.92 over the last five years for railed in corn to southeast Georgia, may not be the price the company would have to pay for the corn. When purchasing the large volumes of corn that would be required to produce 30 million gallons of ethanol, one can expect to pay a discounted price. Estimates of these discounts range from five to ten percent. This is equivalent to the price being somewhere between $2.63 and $2.77. At those prices the plant would be profitable. The return on equity for these corn prices range from 21 percent for $2.34 a bushel to a minus 29 percent for $3.50 a bushel.

Figure 4. Corn Price Sensitivity Analysis



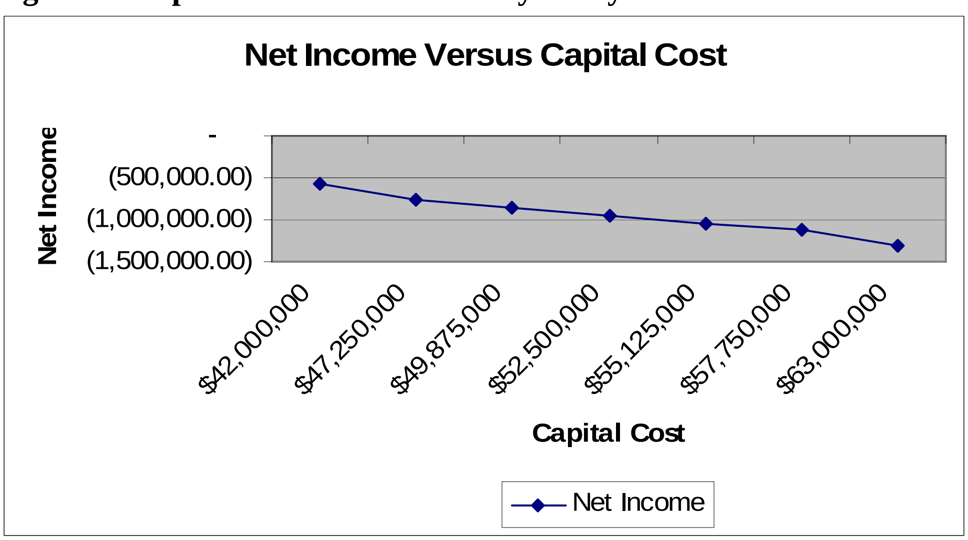
Utility cost is the next highest cost associated with the production of ethanol and therefore has the potential to impact net income. Figure 5 shows that the facility breaks even when utility costs decrease to 90% of their estimated level. If the utility costs were 20 percent higher than estimated, then the plant could lose over $2.5 million.

Figure 5. Utility Cost Sensitivity Analysis



Capital cost is another critically important variable in determining the economic feasibility of a production process. Material costs can and do change during the construction phase of many projects. Costs also can increase or decrease from the planning phase on into the construction phase, therefore it is important to see what the impact can be from these cost changes. However, in the case of a typical "cookie cutter" variety of ethanol plant the costs of construction can be narrowed to a number that is more predictable since the construction and operation unknowns are reduced. The cost estimate for this plant was at $52.5 million dollars. Figure 6 shows the effect on profitability of incremental changes in the cost of production by five, ten and twenty percent in both directions. For each change of five percent, the profit increases or decreases a little over $90,000. This shows that small changes ($2.375 million increments) in the capital cost have relatively little impact on the profitability of the ethanol plant.

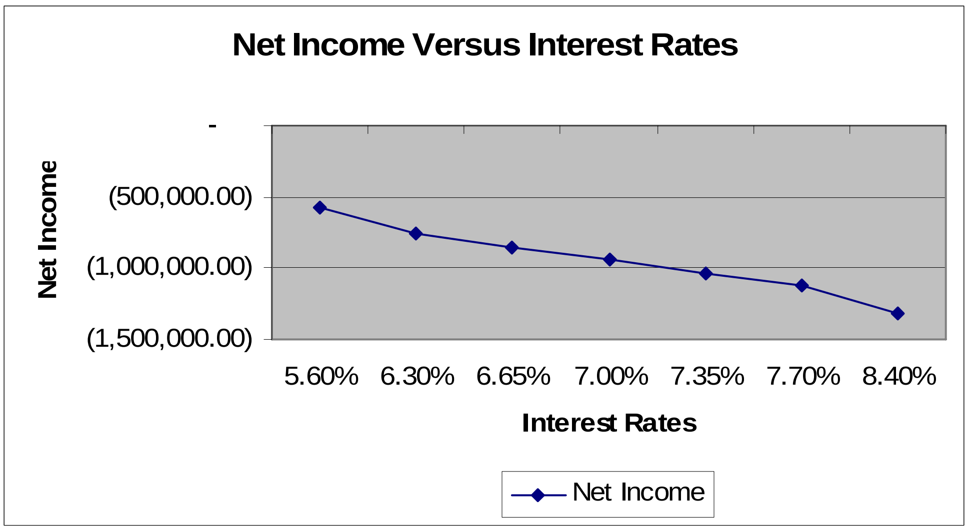
Figure 6. Capital Cost Price Sensitivity Analysis



Over the range of varying capital costs the plant was never profitable. It is also important to note at this point that it is assumed that half of the capital cost for this plant will be shared by investors, and the other half will come from borrowed funds.

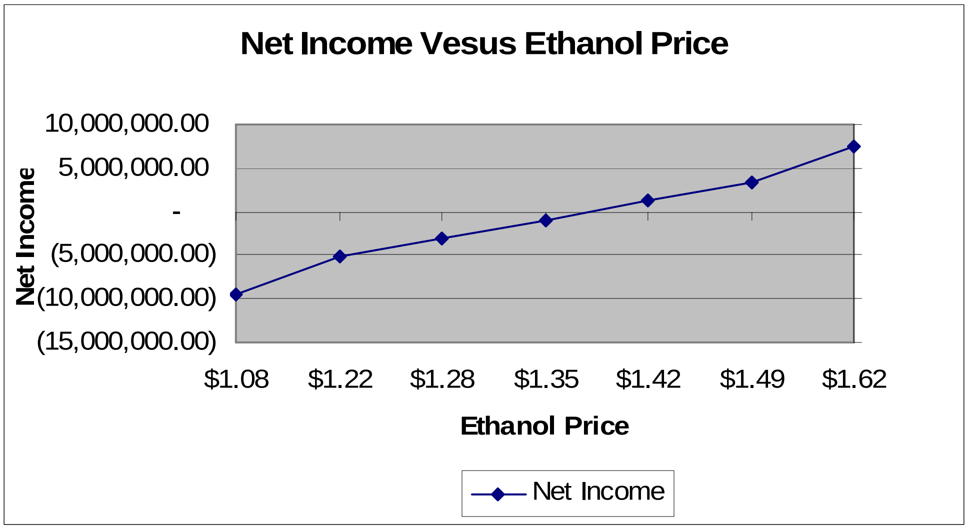
Interest rate fluctuations can be seen as quite similar to the fluctuations in the capital costs of constructing an ethanol plant. For the feasibility study, it was assumed that an interest rate of seven percent was attainable. The sensitivity analysis again analyzed the impact of changes in the cost of capital on the profitability of the plant. Figure 7, on the following page, shows the results from assumed five, ten and twenty percent changes in the interest rate from the base case. This gave a range in interest costs from 5.6 percent to 8.4 percent. Over this range the plant was not profitable.

Figure 7. Interest Rate Sensitivity Analysis



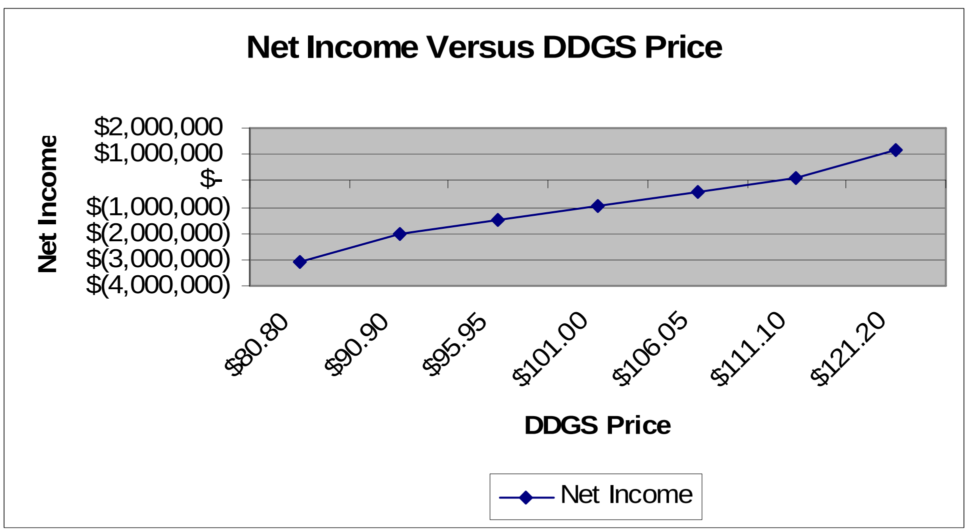
The plant's main purpose is the production of ethanol, therefore making its price a significant determinant of profitability. One of the problems with predicting the profitability of ethanol production is determining the price of the primary product. Profitability is determined by two fairly unrelated markets, one the petroleum market and the other the corn market. The price of ethanol is not directly related to the petroleum market but does seem to move in the same direction most of the time. It is also not tied to the corn market directly either. This puts ethanol producers in the position that could create a squeeze when corn prices are high and ethanol prices low. Recently, ethanol prices have been quite attractive with the surge in oil prices, however with the number of ethanol plants coming on line in the last two years, ethanol prices haven't always moved with directly or proportionally with gas prices. Figure 8 below, shows how the profitability of the proposed ethanol plant changes with the level of ethanol price. The average price over the last five years for ethanol has been $1.35. The net income was calculated for a range of ethanol prices that went from $1.08 a gallon to $1.62 a gallon. This represents both a five, ten and twenty percent increase and decrease in ethanol prices. As can be seen from the figure, the plant breaks even at $1.38 per gallon of ethanol

Figure 8. Ethanol Price Sensitivity Analysis



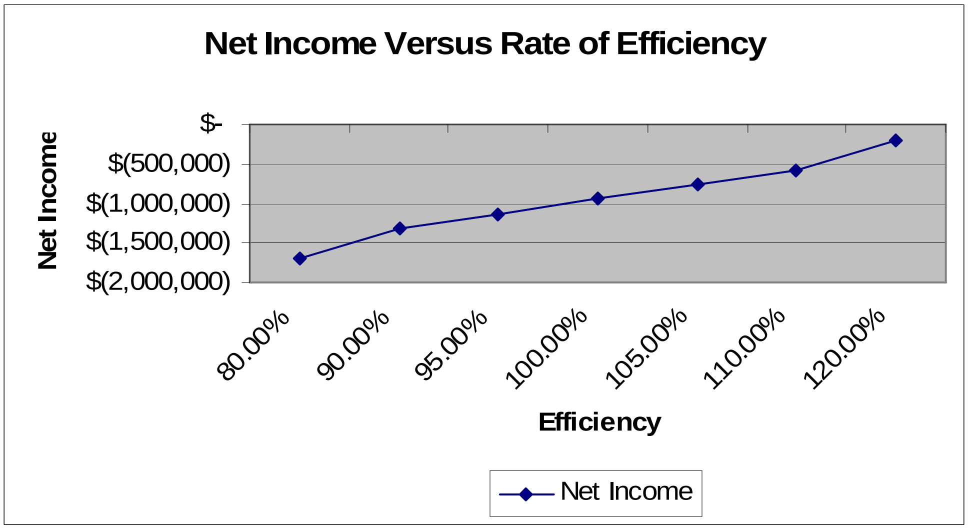
The DDGS is a product that has potential as a poultry feed ingredient in the state of Georgia. The current price that ethanol plants are receiving for their DDGS is around $101.00 a ton. This price is very much related to a soybean meal that livestock producers can use in their feed rations. This price is variable with some plants receiving as little as $81.00 a ton due to local competition. This makes it important to analyze the profitability's sensitivity to DDGS price. Since DDGS makes up about one-third of the plant's output, changes in its price can mean significant changes in the plant's profitability. Figure 9 shows that at the DDGS price of $101.00 per ton, the plant loses a little over $900,000. When DDGS price rises to $110.00 the plant reaches its break-even point.

Figure 9. Distillers Dried Grain Price Sensitivity Analysis



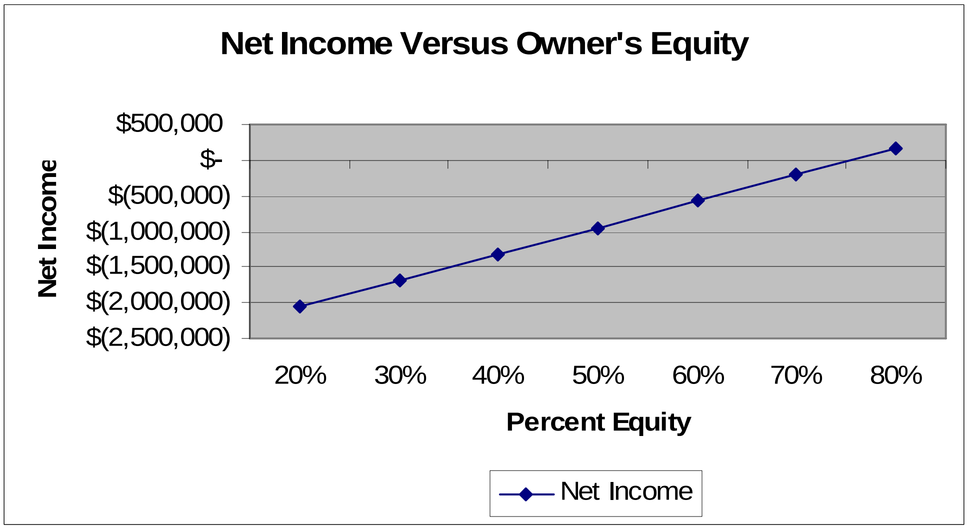
Plant efficiency for a conventional plant is not ever expected to get beyond 100 percent without any modifications to the plant. However, it is expected that the plant will probably operate at some efficiency level less than 100 percent in its first year. It takes time for management and workers to learn to operate the facility and there will be problems that occur with any new plant that will reduce efficiency. It is to be expected that this new plant may only operate at 75 percent efficiency in the first year. Figure 10 shows what happens to net income if the plant does not achieve 100 percent efficiency. Losses can drop into the $1.75 million range at the 75 percent efficiency level. For every decrease in efficiency of 10 percent, net income decreases by $373 thousand.

Figure 10. Plant Efficiency Sensitivity Analysis



The amount of capital raised to move forward with a project like this can also impact net income for the plant. It is normally accepted by the ethanol industry that half of the investment cost needs to come from non-borrowed funds. The Pro Forma Income Statement assumed equity of one-half of the estimated $52.5 million dollar cost of the facility. Figure 11 shows what happens if AgriEnergy South, LLC is able to raise money in addition to the $26.25 million that lenders will likely require. At 50 percent non-borrowed funds invested, the ethanol plant generates a negative net income. As can be seen from the figure, it takes a 75 percent investment for the plant to break even. At 80 percent equity, the plant makes around $200 thousand in net income.

Figure 11. Percent Owner's Equity Sensitivity Analysis



Net Income Versus Change in Ethanol Price and Corn Cost

Table 3 shows the combined impact of changes in ethanol price and corn price. To use Table 3, find the cell where corn price equals $2.50 and the ethanol price equals $1.40. Those price combinations generate a profit potential of $5.35 million dollars. Net income potential can be determined with this table for corn prices ranging from $2.50 to $3.20 per bushel and ethanol prices from $1.00 to $2.40 per gallon.

Table 3. Net Income vs. Change in Ethanol Price and Corn Cost (Millions of Dollars)

	Ethanol Price/gallon							
Corn Price	**$1.00**	**$1.20**	**$1.40**	**$1.60**	**$1.80**	**$2.00**	**$2.20**	**$2.40**
$2.50	$-7.249 *	$-0.949	$5.350	$11.650	$17.950	$24.250	$30.550	$36.850
$2.60	$-8.373	$-2.073	$4.226	$10.526	$16.826	$23.126	$29.426	$35.726
$2.70	$-9.497	$-3.197	$3.102	$9.402	$15.702	$22.002	$28.302	$34.602
$2.80	$-10.620	$-4.320	$1.979	$8.279	$14.579	$20.879	$27.179	$33.479
$2.90	$-11.744	$-5.444	$0.855	$7.155	$13.455	$19.755	$26.055	$32.355
$3.00	$-12.867	$-6.567	$-0.267	$6.032	$12.332	$18.632	$24.932	$31.232
$3.10	$-13.991	$-7.691	$-1.391	$4.908	$11.208	$17.508	$23.808	$30.108
$3.20	$-15.115	$-8.815	$-2.515	$3.784	$10.084	$16.384	$22.684	$28.984

Profitability Given Current Market Conditions

Unfortunately, this study was conducted at a time in which the five year average prices for many of the variables in ethanol production were different from the current market level. Ethanol prices are currently about $1.95 per gallon, well above the past five year average while corn prices are a little lower than the five year average. For this reason, the clients asked that the CAED also demonstrate the conventional plant's profit potential given current market conditions. Table 4 shows the impact of these two major price changes. Total income increases to over $72 million with the $0.60 increase in price per gallon of ethanol. The feedstock costs decrease to $32.36 million dollars with the $0.05 per bushel decrease in the price of corn. It is worth noting that this current price of corn does not include any potential volume discounts as well. Thus, given current market conditions, the conventional plant is profitable with a net income of almost $18.5 million. This is a significant difference from the previous analysis in this study.

Profitability Assuming a Large Quantity Corn Purchasing Discount

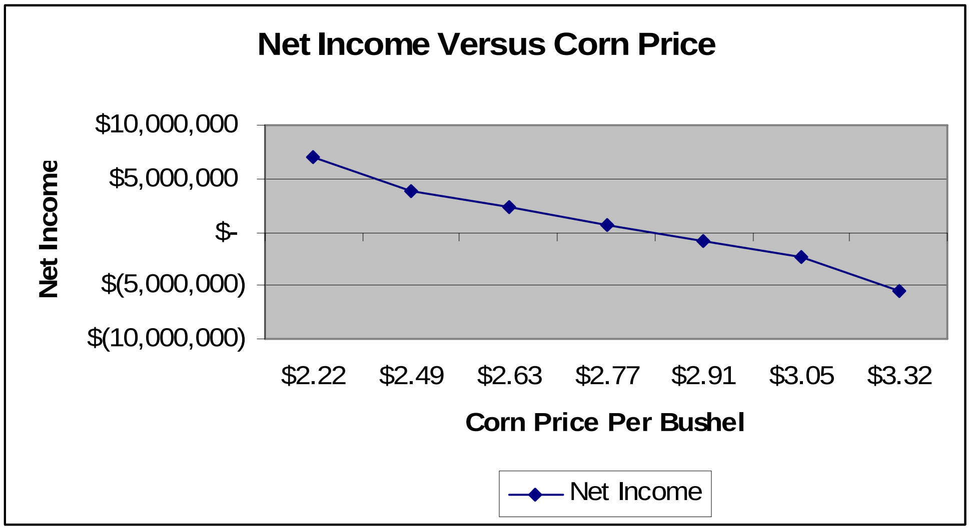
When purchasing large quantities of any input, businesses would expect to be able to receive a discounted price. This would most likely be the case with this ethanol plant, considering that it would be purchasing over 11 million bushels annually. These discounts are negotiable and also depend on how much the company purchases for delivery at one time. The numbers used previously in this document were based on small numbers of cars (3-5 car lots). Larger numbers of cars can be purchased at a discount, but we can't confirm the typical size of the discount.

For this additional analysis, it will be assumed that AgriEnergy South, LLC will be able to negotiate a five percent discount on the price of Midwest corn shipped in to Southeast Georgia. This would put the price of the feedstock at around $2.77 per bushel. A price of $2.77 reduces the cost of the feedstock input by $1.685 million to a total of $31.124 million and total production cost to $52.5 and increases the net income to $741,446. Assuming the discount on the feedstock, the net return of $741,446 makes the return on equity (ROE) a positive 2.82 percent. If prices were to decrease to $2.63 per bushel of corn, ROE would be nine percent and the company would have a net income of $2.3 million.

Table 4. Pro Forma Income Statement at Current Price Levels

Pro forma Income Statement for the Conventional Ethanol Plant							
3,750	Gallons ethanol per hour						
90,000	Gallons ethanol per day			100%	Capacity		
7	Days per week			224,000	Bushels Corn a Week		
50	Weeks per year			11,236,000	Bushels Corn Required		
31,500,000	Gallons ethanol per year						
Income:		**Quantity**		**Unit Price**		**Total $**	**Value/ bushel**
Ethanol		31,500,000	Gallons	$ 1.95		61,425,000	$ 5.47
DDGS		106,000	Tons	$ 101.00		10,706,000	$ 0.95
CO2		96,776	Tons	$ 0		0	$ 0.00
Total						**$72,131,000**	**$ 6.42**
Processing Costs:				**Cost Per Gallon**			
Maintenance and Supplies				$ 0.036		$ 1,134,000	
Utilities				$ 0.150		$ 8,505,000	
Chemicals				$ 0.070		$ 2,205,000	
Denaturants				$ 0.040		$ 1,260,000	
Labor and Benefits				$ 0.070		$ 2,205,000	
Sales and General Administration (S&GA)				$ 0.015		$ 472,500	
Total Processing and S&GA				**$ 0.381**		**$ 16,096,500**	
Feedstock Cost:		**Quantity**		**Cost Per Gallon**		**Total Cost**	**Cost Per Bu. Or Tn.**
Corn (bushels)		11,236,000		$ 1.03		$ 32,247,320	$ 2.87
Total Feedstock Cost						32,247,320	
Total Direct Cost						**$ 48,343,820**	
Fixed Costs:		**Cost Per Gallon**				**Total Costs**	
Insurance and Taxes		$ 0.019				$ 598,500	
Depreciation - Plant Equipment		$ 0.127				$ 2,833,000	
Interest on Investment – Plant Equipment		$ 0.078			7.00%	$ 1,837,500	
Total Fixed Costs						**$ 5,269,333**	
Total Cost						**$ 53,613,153**	
Profit/Loss						**$ 18,517,846**	
% Equity						**50.00%**	
Financed Portion						**$ 26,250,000**	
Return on Equity						**70%**	
Return on Investment						**35%**	

Figure 12. Discounted Corn Price Sensitivity Analysis



Summary and Conclusions

The current industry standard ethanol plant is a dry grind facility where the entire corn kernel is run through the conversion process. This type plant relies on natural gas for the generation of heat to dry the co-product distillers dried grains and solubles (DDGS) and for the production of ethanol. A 30 million gallon plant of this type would be expected to have a capital cost of about $52.5 million with annual operating costs of around $48.9 million. The average net income of an ethanol plant in Southeast Georgia was determined to be a negative ($943,953) using five year average prices for the co-products and the feedstock corn.

However, it is important to note that this model does not include two variables that could potentially generate an additional $2.1 million in revenue. The federal government subsidy of $0.10 per gallon for the first 15 million gallons would be worth $1.5 million, while the carbon dioxide the plant would produce could be worth another $600 thousand plus. The reason these two items were not included was that they depend too heavily on other entities to be relied on.

Sensitivity Analysis revealed that the most significant factors in determining the level of profitability were corn price, ethanol price and utility costs. For these factors, a five percent increase in their price will change net income by $2.2 million for ethanol, $1.6 million for corn and $400,000 for utility costs. Although there is a large capital outlay for this project, increases or decreases in this cost did not impact the net income significantly. A five percent change in capital cost only changed net income by $90,000.

The current market conditions for ethanol are somewhat different than what the feasibility study suggests. The rationale behind using five-year average prices is to show the profitability of the plant over an extended period of time. This takes the peaks and valleys out of the input and output prices. Using current market conditions for ethanol and corn suggests the plant to be profitable with a net income of over $18 million dollars, while using the five-year averages shows that the plant would have a negative net income.

The conventional dry grind technology is older and proven in its performance. The benefits of this are that the capital cost estimates are going to be very close to those in this study and this type plant will be able to produce at the rated capacity given quality management personnel. The downside is that it uses over $8 million worth of natural gas to operate annually, and produces a low protein DDGS that would need to be dried in order to be fed to chickens in Georgia.

An Economic Impact Analysis of Ethanol Production in Georgia

An economic impact analysis evaluates the effects, or economic impacts, of a production enterprise. This economic impact analysis measures projected economic impacts of potential ethanol production due to economic activity associated with plant construction and production in Georgia. Corn is produced throughout the state, and utilizing corn as an input has the potential to stimulate further economic activity in Georgia. Corn is the primary input in ethanol production, and impacts due to increased corn production are isolated in a separate analysis.

IMPLAN is an economic input-output modeling program applied for impact estimation. IMPLAN can interpret the effects of a new enterprise in a number of ways including output (sales), labor income (employee compensation and proprietary income), employment (jobs), and tax revenue. An IMPLAN model can be constructed for the economy of a single county, multi-county, or state region. In general, input-output models work by separating the economy into various sectors, such as agriculture, construction, manufacturing, trade, and services. The model then captures how a change in one industry changes output, labor income, and employment in other industries. These changes, or impacts, are expressed in terms of direct, indirect, and induced effects.

- *Direct effects* represent the initial impact on the economy of some feature (i.e. construction or operations) of a new enterprise.
- *Indirect effects* are changes in other industries caused by the direct effect of a new enterprise.
- *Induced effects* are changes in household spending due to the changes in economic activity generated by both the direct and indirect effects.

Thus, the total economic impact is the sum of the direct, indirect, and induced effects.

The state of Georgia has designated 12 state service delivery regions *(SDR)* in order to foster regional collaboration in economic development. Impact analysis of a conventional ethanol plant in Bacon County includes *SDRs* 9, 11, and 12 as the local impact area. An ethanol plant utilizes 12,097,000 bushels of corn per year. An average yield of 150 bushels leads to 80,647 acres of corn production to meet demand. Corn acreage for included counties is presented in the appendix.

Economic Impact of Conventional Ethanol Plant Construction in Southeastern Georgia

Costs of constructing a conventional ethanol plant are estimated as $38.5 million. Estimated construction impacts from output, labor income, employment, as well as state and local taxes are presented in Table 5. Direct output represents total projected construction cost of all buildings, as well as the purchase and installation of all operational equipment. The infusion of $38.5 million in the regional economy causes an indirect effect of $8.145 million among supporting industries. The indirect effect represents business-to-business purchases between businesses constructing the facility. In addition, the construction project will induce $12.549 million in sales as construction personnel and impacted employees spend their income on consumer products and services. The total economic impact on southeastern Georgia from construction of a conventional ethanol plant is $59.194 million.

Table 5. Conventional Plant Construction: One Time Economic Benefits to SE Georgia

	Direct Effect	Indirect Effect	Induced Effect	Total Effect
Output	$38,500,000	$8,144,862	$12,548,976	$59,193,837
Labor Income	$16,992,772	$2,974,584	$4,099,003	$24,066,359
Employment	587	92	161	839
Tax				$1,987,888

In Table 5, labor income indicates the money that households will earn due to the construction project. The direct effect of labor income supported by construction is $16.993 million for southeastern Georgia. Combining the direct, indirect and induced effects, total labor income is estimated as $24.066 million.

The construction project is estimated to generate a total of 839 full and part time jobs throughout the region, with 587 jobs involved directly in the building project. Indirectly, 92 jobs will be created as a result of business-to-business activity associated with construction. An additional 161 jobs will be created to support increased household spending by those workers affected directly and indirectly by the construction project. Economic activity from construction will have an impact on state and local tax revenues totaling $1.988 million.

Table 6 illustrates the total economic impact of construction on all major industrial sectors in southeastern Georgia. Output, labor income, and employment impacts are greatest in the construction sector. Services have the second largest impact in each category, while wholesale and retail are significantly impacted by construction.

Table 6. Conventional Plant Construction: One Time Economic Benefits to Major Sectors, SE Georgia

Sector	Output	Labor Income	Employment
Agriculture	$279,018	$80,023	4
MU[1]	$566,735	$124,976	1
Construction	$38,634,660	$17,045,094	589
Manufacturing	$2,251,538	$414,801	12
Transportation	$1,316,088	$496,151	13
Trade	$3,542,417	$1,551,856	62
FIRE[2]	$2,760,356	$631,327	20
Services	$7,582,909	$3,637,970	136
Government	$2,260,117	$84,161	2
Total	$59,193,837	$24,066,359	839

[1]Mining and Utilities
[2]Finance, Insurance, and Real Estate

Economic Impact of Operating a Conventional Ethanol Plant in Southeastern Georgia

Table 7 shows the itemized costs and other input data for an IMPLAN model of operating a conventional ethanol plant. Employee compensation includes wages and benefits for 24 production workers, as well as 6 workers in sales and administration. Other property income includes capital payments, interest paid, as well as net returns to production. With net returns included in other property income, all items listed in Table 7 are equal to total revenue (output) for the plant. Total revenue of $53.231 million represents the first round of impacts due to production. Subsequent rounds of indirect spending caused by the plant purchasing inputs are specified in Table 7.

Table 7. IMPLAN Input-Output Data for Conventional Ethanol Plant

Category	*-dollars-*
Maintenance and Supplies	1,134,000
Utilities	8,505,000
Chemicals	2,205,000
Denaturants (Gasoline)	1,260,000
Corn	31,123,720
Insurance	388,500
Labor and Benefits	2,205,000
Sales and Administrative Staff	472,500
Indirect Business Taxes	210,000
Other Property Income	5,727,280
Output	53,231,000

An assumption of the impact model is that the 12,097,000 bushels of corn are purchased at quantity discounts so that purchase price is $2.77 per bushel. Southeastern Georgia corn acreage in the appendix indicates that the region would likely not produce enough corn to supply the annual demand from an ethanol plant while meeting current needs of corn utilization. For the Bacon County ethanol plant model it is assumed that 33% of corn purchased is produced within the region.

Table 8 shows the economic impact of a conventional ethanol plant operating in southeastern Georgia. The direct effect associated with output creates another $22.310 million indirectly as the operation purchases products and services from other businesses in the region. The result of increased household income from the creation of new jobs is an induced effect of $4.763 million. Total economic impact in southeastern Georgia is $80.304 million and indicates an output multiplier of 1.51.

Table 8. Conventional Plant Operations: Annual Economic Benefits to SE Georgia

	Direct Effect	Indirect Effect	Induced Effect	Total Effect
Output	$53,231,000	$22,310,417	$4,762,774	$80,304,191
Labor Income	$5,744,288	$1,500,020	$1,555,943	$8,800,251
Employment	30	549	61	640
Tax				$1,432,041

Employment includes 30 workers at the plant, as well as another 549 jobs in supporting businesses. An additional 61 jobs are created due to induced spending, for a total of 640 full and part time jobs due to operation of the ethanol plant. Total labor income associated with the ethanol plant is $8.8 million. State and local taxes increase by $1.432 million annually.

Table 9 shows how economic sectors are impacted by ethanol production. Manufacturing has the greatest impact of $55.644 million. Agriculture has the second greatest impact of $10.947 million. Employment in agriculture has the greatest impact with 470 of the 640 jobs that are created. Labor income in agriculture increases by $4.584 million.

Table 9. Conventional Plant Operations: Annual Economic Benefits to Major Sectors, SE Georgia

Sector	Output	Labor Income	Employment
Agriculture	$10,946,537	$4,584,464	470
MC[1]	$106,682	$41,726	1
Utilities	$3,718,578	$545,497	8
Manufacturing	$55,644,473	$404,321	38
Transportation, Warehousing	$880,814	$280,467	7
Trade	$1,589,897	$695,724	28
FIRE[2]	$1,821,379	$393,203	14
Services	$4,200,314	$1,793,191	72
Government	$1,395,517	$61,659	2
Total	$80,304,191	$8,800,251	640

[1]Mining and Construction
[2]Finance, Insurance, and Real Estate

Economic Impact of Corn Production in Southeastern Georgia

Analyzing the impact of corn production shows the impacts in Table 8 and Table 9 that are attributable to corn production. An assumption of this analysis is that 33% of corn inputs are purchased in southeastern Georgia. Table 10 shows that $16.614 million of the output impact in Table 8 is due to corn production. Labor income increases by $6.268 million due to increased corn production, while full and part time jobs total 530. State and local taxes are $0.795 million per year.

Table 10. Corn Production - Conventional Plant: Annual Economic Benefits to SE Georgia

	Direct Effect	Indirect Effect	Induced Effect	Total Effect
Output	$10,270,828	$2,890,994	$3,452,408	$16,614,230
Labor Income	$4,137,608	$1,002,799	$1,127,937	$6,268,345
Employment	445	41	44	530
Tax				$794,733

Impacts of corn production on sectors are presented in Table 11. Almost all of the agricultural impacts for output, labor income, and employment in Table 9 are due to corn production. More than 99% of agricultural output in Table 9 is due to corn production in Table 11. All but one agricultural job is due to corn production.

Table 11. Corn Production - Conventional Plant: Annual Economic Benefits to Major Sectors, SE Georgia

Sector	Output	Labor Income	Employment
Agriculture	$10,891,675	$4,568,050	469
MC[1]	$56,479	$22,130	1
Utilities	$217,199	$48,683	1
Manufacturing	$794,146	$128,798	3
Transportation	$371,389	$146,148	4
Trade	$839,474	$364,532	14
FIRE[2]	$1,127,102	$224,628	9
Services	$1,595,289	$725,525	29
Government	$721,479	$39,851	1
Total	$16,614,230	$6,268,345	530

[1]Mining and Construction
[2]Finance, Insurance, and Real Estate

Economic Impact of Operating a Conventional Ethanol Plant in Southeastern Georgia to the Economy of Georgia

An ethanol plant constructed in Bacon County will have statewide benefits that extend beyond the local impact area of southeastern Georgia. Regions within a state often purchase inputs from elsewhere in the state, and indirect impacts of a region are diminished by a limited capacity to provide goods and services. As the local impact area of the plant is expanded to include all of Georgia, more supporting inputs come from within the state and the output multiplier increases.

Data indicate that corn acreage harvested for grain is trending downward. Recent acreage averages less than 300,000 acres after averaging over 500,000 acres in the early 1990's. Thus, Georgia not only has the capacity to supply corn for an ethanol plant with current production, but has the potential to expand production in order to fulfill additional demands for Georgia corn for grain.

Table 12 presents output for the ethanol plant in Table 7 when Georgia is considered as the local impact area. All corn is assumed purchased from Georgia corn producers. This is in contrast to the previous impact on southeastern Georgia where only 33% of corn is from within the local impact area composed of *SDRs* 9, 11, and 12. Total Georgia output effects are $125.508 million, resulting in an output multiplier of 2.36. Comparing this multiplier with the multiplier for the region shows the importance of corn production for total economic impact.

Table 12. Conventional Plant Operations: Annual Economic Benefits to Georgia

	Direct Effect	Indirect Effect	Induced Effect	Total Effect
Output	$53,231,000	$55,477,991	$16,799,091	$125,508,083
Labor Income	$14,974,746	$4,656,252	$5,694,643	$25,325,641
Employment	30	1395	172	1598
Tax				$4,061,800

Table 13 shows impacts of the ethanol plant on economic sectors of Georgia. Comparisons with Table 9 show greater impacts in agriculture because of the assumption of all corn coming from within the local impact area which consists of Georgia. Other sectors in Table 13 have greater impacts because relatively more input purchases in these sectors are from within the local impact area than was the case for the southeastern Georgia impact.

Table 13. Conventional Plant Operations: Annual Economic Benefits to Major Sectors, Georgia

Sector	Output	Labor Income	Employment
Agriculture	$32,818,212	$13,701,438	1274
MC[1]	$456,302	$177,366	4
Utilities	$7,754,384	$1,413,503	13
Manufacturing	$57,601,929	$908,264	45
Transportation, Warehousing	$1,768,337	$688,462	15
Trade	$5,295,400	$2,250,238	63
FIRE[2]	$7,401,837	$1,703,483	41
Services	$9,336,220	$4,338,349	139
Government	$3,075,463	$144,538	4
Total	$125,508,083	$25,325,641	1598

[1]Mining and Construction
[2]Finance, Insurance, and Real Estate

Summary

Ethanol production is a potential source of increased demand for Georgia corn producers. Manufacturing of ethanol requires inputs from other industrial sectors that cause indirect economic benefits from businesses and their employees. A conventional ethanol plant in Bacon County would have an impact on southeastern Georgia as ethanol sales cause indirect economic activity. Output valued at $53.231 million is estimated to cause an additional $27.073 million in economic activity for a total impact of $80.304 million for the region. This plant would lead to economic throughout the state as many operational inputs come from outside of the southeastern region, but elsewhere in Georgia. Total economic benefits to Georgia are 2.36 times greater than output value of the plant for a total impact of $125.508 million.

Appendix A. Corn Acreage in Southeastern Georgia

County	SDR	Acres
APPLING	9	6,300
BLECKLEY	9	1,891
CANDLER	9	2,287
DODGE	9	2,000
EMANUEL	9	2,262
JEFF DAVIS	9	1,654
JOHNSON	9	1,078
LAURENS	9	4,912
MONTGOMERY	9	1,379
TELFAIR	9	896
TOOMBS	9	2,194
TREUTLEN	9	446
WAYNE	9	7,500
WHEELER	9	532
WILCOX	9	2,553
		37,884
ATKINSON	11	2,285
BACON	11	4,100
BEN HILL	11	5,004
BERRIEN	11	5,759
BRANTLEY	11	1,000
BROOKS	11	3,300
CHARLTON	11	650
CLINCH	11	444
COFFEE	11	5,031
COOK	11	1,300
ECHOLS	11	607
IRWIN	11	12,539
LANIER	11	1,200
LOWNDES	11	5,000
PIERCE	11	13,000
TIFT	11	1,910
TURNER	11	2,429
WARE	11	2,956
		68,514

County	SDR	Acres
BRYAN	12	500
BULLOCH	12	8,044
CAMDEN	12	0
CHATHAM	12	100
EFFINGHAM	12	4,300
EVANS	12	1,557
GLYNN	12	0
LIBERTY	12	165
LONG	12	620
MCINTOSH	12	0
TATTNALL	12	4,375
		19,661
Region		126,059

Source: Georgia Farm Gate Value Report, 2004

Appendix B

Conventional Ethanol Plant Process Description

Technology Assessment

A conventional ethanol plant using corn as a feedstock produces ethanol, DDGS, and CO_2, which is typical of most of the dry grind ethanol plants operating in the United States. The conventional ethanol process consists of the following:

Grain Receiving and Milling

Incoming corn is sampled & weighed then unloaded from truck or railcar into silos. Typical corn specifications for an ethanol plant are as follows:

- (1) bushel corn = 56 lb.
- Moisture content ~ 15%
- Mold free

Whole corn is transferred from corn storage and reduced in size by hammer mills. Corn is sized to meet the process requirements; typically 1/8" screen openings are used.

Mash Preparation

The ground corn is mixed with water and heated. The initial slurry is typically prepared with ground corn, water, backset (recycled water) and alpha amylase. Alpha amylase is added to reduce the viscosity so that the mixture can be agitated and pumped. Ammonia is also added here for pH adjustment.

Alpha amylase is the 1st enzyme used to begin breaking down the starch and it reduces viscosity making the mixture easier to pump.

Mash Cooking and Liquefaction

In order to complete the gelatinization (exploding of starch particles creating a thick viscous mush) of the starch, the mash is sent through a hydro heater (adds steam) and raised to an elevated temperature. This elevated temperature also helps to sanitize the mixture. The mixture is then cooled to the preferred liquefaction temperature (temp at which starch starts to break down into sugars). Alpha Amylase is added here to begin the conversion of the starch to dextrins.

Saccharification & Fermentation

The mash is then cooled using a heat exchanger to the preferred saccharification (last step in the conversion of starch to sugar) temperature (~90). The final conversion of starch to simple sugars is done in the saccharification step with the addition of glucoamylase. The mixture is then further cooled and sent to fermentation.

The fermentation of sugar to ethanol involves two key steps, the growth of yeast and the production of ethanol. Alcohol production increases during the fermentation cycle until most of the fermentable sugars have been consumed. This process generates heat that must be removed to keep the yeast active. This is typically done with recirculation through plate and frame heat exchangers.

The final product from the fermentation process is called beer. The beer is typically 10% to 11% ethanol by weight; however, most plants run higher than this at approximately 12% to 14% ethanol by weight. The balance of the mixture is water and non-fermentable components.

Distillation
Ethanol has a lower boiling point (174˚F) than water and it is easily boiled off in distillation until it reaches a 95% concentration (190 proof). At this point the ethanol and water form an azeotrope (firmly bonded water and ethanol) that cannot be further separated by conventional distillation.

Dehydration
To break the azeotrope and remove the remaining water, molecular sieves are used. The molecular sieve material has a controlled pore size that allows water to be adsorbed while allowing ethanol to pass through. The remaining 5% of the water is removed in this step to produce 200 proof ethanol.

Stillage Separation
After removal of the ethanol from the beer mixture during distillation, a mixture referred to as whole stillage is produced. This mixture consists of un-fermentable solids and liquid (stillage). Decanter centrifuges are used to separate the suspended solids (wet cake) from the stillage. The wet cake typically contains 35% solids and 65% moisture.

Evaporation
The thin stillage components are further concentrated into condensed distillers solubles (CDS) or more commonly known as syrup. The amount of concentration differs in the industry. Typical syrup solid concentration ranges from 33% to 38% (which indicates a moisture level of 67% to 62%, respectively).

DDGS Drying/Cooling
The wet cake from the decanters is mixed with syrup and sent to the DDGS Dryer. Here the final DDGS product is dried to approximately 10% moisture. The final product discharges from the DDGS dryer and is typically cooled before being sent to storage.

Alcohol Storage and Loadout
Ethanol from the mole sieves is cooled and sent to storage. A denaturant such as gasoline must be added to the ethanol prior to loadout. The blended product is loaded into trucks and/or railcars.

DDGS Storage and Loadout
The cooled DDGS is sent to storage. Two of the most common ways to store DDGS is flat storage using a front-end loader to load trucks, or specially designed silos which allow for automatic loading.

Carbon Dioxide Production
Carbon Dioxide (CO_2) is generated during the fermentation cycle. This gas typically contains ethanol, VOC's, and other contaminants. A wet scrubber is used to remove the ethanol and other organic components prior to discharge of the CO_2 into the atmosphere. This CO_2 stream has a 98% purity level that can be piped to a CO_2 plant for purification and marketing or vented to the atmosphere.

Waste Water Discharge

Some technology providers utilize an anaerobic treatment system to reduce the amount of waste water discharging from the plant. This in turn produces a small amount of methane gas that can be used as a fuel. The major benefit of this system is to reduce the organic acids to a safe level that allows evaporator condensate to be recycled back to the front of the plant. This reduces the fresh water required as well as the discharge water. This results in a zero discharge plant with respect to process water. The only excess water streams from these facilities are sanitary sewage, cooling water blow down (recycled cleaned water), Reverse Osmosis (RO) reject water, and boiler blow down.

Ethanol Plant Air Emissions

A typical 30 mmgpy fuel ethanol plant should be designed to limit Volatile Organic Compounds (VOCs), particulate emissions, odor, noise, and wastewater. The recommended facility will not be considered a major source under Prevention of Significant Deterioration (PSD) regulations because the potential emissions for each criteria pollutant is below the major source threshold (shown on the following page). Likewise, the facility is not a major source under Title V regulations because its potential emissions of each criteria pollutant is below the major source threshold: its emission of any single hazardous air pollutant (HAP) is below 10 tons per year, and its emission of multiple HAPs is below 25 tons per year. Please see the estimated plant emissions provided in the Addenda of this report.

Major Source Emission Thresholds

VOC: 100 ton/yr (Volatile Organic Compounds)
NO_X: 100 ton/yr (Nitrogen Oxides)
SO_X: 100 ton/yr (Sulfur Oxides)
CO: 100 ton/yr (Carbon Monoxide)
PM-10: 100 ton/yr (Total Particulate Matter)

The ethanol plant should be permitted for at least 50 MMGPY. This will be under the major source threshold limits listed above. This will allow greater operating flexibility for increased future production increase while requiring no additional permitting cost.

Utility Requirements

The utilities listed below are for a 30 mmgpy corn to ethanol plant

Fresh Water Source

Service water of approximately 300 to 400 gallons per minute will be required for the plant. This number varies depending on the technology provider and local water quality. Most of this will be lost to evaporation in the cooling tower.

Natural Gas

The advanced plant will require substantially less natural gas than the conventional ethanol plant. The natural gas can be purchased from the local utility. Line pressure is typically not an issue. Fifty to 100 psi is normal for the ethanol plant. Some technology providers prefer the higher pressure (100 psi); this allows smaller pipes in the ethanol plant. The average usage is 137.5 mmBtu/hr for the conventional plant.

Electricity

The average operating load for an ethanol plant is 0.75 kW/denatured gallon. This plant would use approximately 2800 kW/h (2.8 MW). These numbers vary depending on the technology provider.

Utilities

WATER DISCHARGE

Wastewater

The ethanol plant will have several discharge streams that are considered “non-contact”. This means that these streams do not come into direct contact with the process production streams.

The non-contact wastewater discharge will include:

- Boiler blowdown
- Cooling tower blowdown
- Water softener blowdown (if applicable)
- Reverse osmosis reject (if applicable)
- Storm water
- Sanitary sewage

If your plant is designed for zero process discharge (as discussed in the technical section) there will be no process contact water leaving the facility. All process water is treated and recycled back into the ethanol plant.

Utilities

Storm Water

Storm water control and management systems will be incorporated into the plant design and also the plant operations. The goal is to eliminate or minimize storm water contact with potential pollutants.

To minimize the possibility of a process spill leaving the site, all process operations that require periodic maintenance and regular wash downs are typically placed inside a building or curbed area. Also, the ethanol storage tanks are typically in a diked area to contain any spills.

The storm water management system typically includes a retention pond that must be designed in accordance with EPA requirements.

Utilities

Sanitary Sewage

Typically sanitary sewage is sent to the local wastewater treatment facility. If this is not possible, a septic system must be constructed to handle this waste.

Thus, there are several considerations required when designing each facility's water system:

Water source, water quality and water permit required.
Storm water retention, control and storm water release permit.
Discharge water quality, location and discharge permit.

31,500,000 Gallon Per Year
Corn to Ethanol Plant Summary

Plant Operations	Gallons/yr (denatured)	Days Per Year	Hrs/Year
	31,500,000	350	8,400

Plant Inputs:

	Unit	Annual	Hourly
Feedstock			
Rate	bushels /	12,096,774	1,440
Energy			
Natural Gas	MMBtu/Hr	Annual	Hourly
Boilers	34	285,306	34
Dryers	31	259,592	31
Misc. Heating	0.38	3,191	0.4
Total		548,088	65
Electricity *	kW/ den. Gal		
Operating Load	0.75	23,815,524	2,835
Water			
Fresh Water	GPM	Annual	Hourly
Boiler	35	17,842,742	2,124
Cooling Tower	177	89,213,710	10,621
Process	48	24,193,548	2,880
Misc and Potable	40	20,160,000	2,400
Total	300	131,250,000	15,625

Note: Water quality affects required flowrates
** Does not include chiller or fire water pump*

The Center for Agribusiness and Economic Development

The Center for Agribusiness and Economic Development is a unit of the College of Agricultural and Environmental Sciences of the University of Georgia, combining the missions of research and extension. The Center has among its objectives:

> To provide feasibility and other short term studies for current or potential Georgia agribusiness firms and/or emerging food and fiber industries.
>
> To provide agricultural, natural resource, and demographic data for private and public decision makers.

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Josef Broder, Interim Dean and Director