Peanut Based Biodiesel Production in Georgia: An Economic Feasibility Study

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Abstract: An increased emphasis on renewable energy in recent years stems from diminishing supplies of fossil fuels. Add to that an ever-increasing global demand for energy and the conditions for a sustained push towards alternative, renewable forms of energy are clearly present. Biodiesel can be regarded as one such source of alternate energy. It is a renewable diesel fuel substitute that can be manufactured from a variety of naturally occurring oils and fats, primarily through the process of trans-esterification. Peanuts constitute one of the main sources of biodiesel. From the national perspective, Georgia is leading state in the country for producing peanuts. It accounts for approximately 45 percent of the crop's national acreage and production. Last year Georgia farmers harvested 755,000 acres of peanuts, for a yield of 2.2 billion pounds (EPA, 2010). Southern Georgia is the most productive region due to its coastal plain region, which runs from Columbus through Macon to Augusta. However, for mainstream adoption of biodiesel to be successful, the economic case for production needs to be examined carefully. This paper analyzes and presents the economic feasibility of biodiesel production, with a focus on southeast Georgia.

Keywords: Economic feasibility, Biodiesel, Yield

1. Introduction

Bio-diesel fuels have existed before the first functional diesel engine was invented. In 1853 two scientists, E. Duffy and J. Patrick used transesterification of vegetable oil to create fuel. The first diesel engine ran on its own power in Augsburg, Germany on August 10, 1893. Peanut based biodiesel was the first fuel of its kind to power a diesel engine (Arvizu, 2001). The first spike of bio-diesel usage was during World War II, but little came from this. This was attributable to low gas prices, thus minimizing the need for non-petroleum based fuel. During the energy crisis of the 1970's, significant research pertaining to the use of trans esterified oils from different vegetables was performed. This was done in an attempt to find a cost effective method to reduce energy dependence on other countries. Many different methods were invented during this period, some of which are still being researched today. Throughout the 1990's many Europeans pushed for local production of bio-diesel. These included Germany, Sweden, and France. They gradually experimented with blends of mixed bio-diesel with petroleum diesel. Research indicates that in the European Union there are currently twenty-one countries with commercial bio-diesel projects (Foust, 2007). In 2005 Minnesota announced that it would be the first state to follow Europe's trend and mandated that all diesel sold in the state must contain at least 2% bio-diesel (Foust, 2007). With the growing emphasis on clean air as well as reduction of foreign oil dependency, bio-diesel technology has become a lot more conventional in the last few years. As petroleum based fuel prices continue to rise and become more unpredictable, American consumers are becoming more cognizant of advancements in alternative fuel technology. As a result of this new found awareness, the use of hybrid technologies has become more accessible to the consumer. Higher availability of cleaner renewable energy should lead to increased acceptance. The understanding of the opportunities and environmental benefits of bio-diesel and other renewable energies is a great negotiation tool to help the public understand long-term benefits of these technologies. The following section presents the different variations of bio-diesels in terms of their chemical composition. It is vital to understand the background of bio-diesel in terms of its history, economic and environmental benefits as well as different product mix variations in order to fully appreciate the importance of achieving large-scale bio-diesel technology transfer to the market place.

2. Biodiesel: Blending and Commercial Exploitation

Bio-diesel can be made from many different kinds of vegetables and animals fats, each having its own properties and individual elements. Most bio-diesels are made from reacting lipids from either vegetable oils or animal fats with alcohol. In the United States bio-diesel is standardized as a mono-alkyl ester. This reaction is constant across most different vegetable oils and fatty acids retained from animal fats. There are various ways to blend and mix bio-diesel with other petroleum based diesels. The blending amount is commonly known as the "B-factor", fuel that contains 25 percent bio-diesel is known as B-25 and fuel that contains 85 percent bio-diesel is known as B-85. This blending can occur in various ways as presented below (Van Gerpen, 2004):

- In-line mixing
- Mixing in tanks at the manufacturing plant
- Splash mixing
- Mixing at the pump

In order to make the aforementioned technologies commercially available, a method must be found that distinguishes issues that are preventing mass production and consumption. It can be recognized that the first challenge is acceptance within the market. If the technology is not accepted it does not need to be produced. Preparation for conversion is not necessary and neither is any other significant measure to prepare for the change from the current technology. Once the technology is accepted and the consumers develop a demand for the product. It can then become feasible to create a supply to accompany the demand. To do this an adequate amount of testing and development needs to be done in order to ensure the product is safe and serves its purpose without any undesirable effects (Van Gerpen, 2004).

After the need for supply is determined, a cost conscious method of production is needed to make it commercially available at a reasonable cost. The concern with new technologies is that the cost of production and profit margins increase the product far higher than it's worth. Petroleum based fuels have been around for such a long time, its production process has nearly been perfected. The general public is unwilling to change their consumption habits substantially, especially in the face of high cost related to the change. With the unpredictable but constant rise in gas prices, it is inevitable that the price of both fuels will be more comparable as the limitation of natural resources causes the price of fossil fuels to rise until it is cost efficient to use renewable fuels. The support of these methods now can preserve resources and cut cost today and in the future.

Once the technology can be developed within reason it must then be tested for both quality and safety. Numerous trials must be conducted including failure testing, statistical analysis, wear and tolerance analysis, stress analysis, and environmental reactions to the product especially those dealing with fuels that cause emissions of toxic chemicals and particles. Burning of fuel causes indirect and long-term effect on the engine and the environment. These different variables must be manipulated and results analyzed before any type of mass production could begin. Most bio-fuels are very environmentally friendly and release little to no harmful emissions. As for bio-diesel, it lets out far less carbon dioxide but in turn produces 10% more nitrogen oxide than convention diesel. Nitrogen oxide emissions can be reduced with the use of a catalytic converter, thus making it more efficient and more economically viable than petroleum based fuels (Van Gerpen, 2004).

Bio-diesels offer economically and environmentally conscious long-term benefits. Appropriate steps need to be taken to make this technology available to more people so there will be a smaller environmental footprint. The availability and consumption of bio-diesels is on the rise but new age manufacturing and conversion techniques could make this increase at an even faster rate. At $3.08 per gallon bio-diesel is currently 40 cents cheaper than petroleum diesel, with a more efficient production method; this price could see even more price decreases. The following section examines the economic impact of energy in general and biodiesel in particular.

3. Economic Impact of Energy and Biodiesel

Energy is an important component in the global economy, and 90% of the commercially produced energy can be traced to fossil fuels such as crude oil, coal, and gas, which are non-renewable in nature (Sourie et al, 2006). Much of the energy supply in the world comes from politically volatile regions of the world. In order to enhance energy security, many countries, including the US, have been emphasizing production and use of renewable energy sources such as bio-fuels, which is emerging as a growth industry in the current economic environment. This section of the paper sheds light on the drivers of the current bio-fuel boom as well as its impacts on agricultural markets (Birur et al, 2007).

Energy consumption and modes of energy production have a direct as well as an indirect effect on the economy. Everything consumed must be transported from some remote location. If the cost of gas is low, then it costs less to transport these materials, resulting in a lower cost for the consumer. Lower fuel cost on the other hand translates into substantially lower prices down the supply chain. This is attributable primarily to lower transportation costs. If the price of gas rises, then so does the price of all transported goods. It can thus be appreciated that gas prices and consequently energy prices constitute a major force in driving the economy.

The introduction of bio-diesel could stimulate the economy while at the same time offer reduced dependence on a diminishing energy source (fossil fuels). As the interest grows in the product it will start to become accepted more and more and rise exponentially until it has a majority market share. The inevitable fluctuation of gas price is something that cannot be controlled. If bio-diesel were introduced into the mainstream market, dependence on foreign countries would diminish.

Bio-fuels could serve as a means to reinvigorate the flaccid US economy over the next few years, according to a new report focused on the economics of biotechnology (Grant, 2009). Conversion to bio-fuels could result in the following advantages:

Direct job creation from advanced bio-fuels production could reach 29,000 by 2012, 94,000 by 2016, and 190,000 by 2022. Total job creation, accounting for economic multiplier effects, could reach 123,000 in 2012, 383,000 in 2016, and 807,000 by 2022. Direct economic output from the advanced bio-fuels industry is estimated to rise to $5.5 billion in 2012, $17.4 billion in 2016, and $37 billion by 2022.

Taking into consideration the indirect and induced economic effects, the total economic output effect for the U.S. economy is estimated to be $20.2 billion in 2012, $64.2 billion in 2016, and $148.7 billion in 2022. Advanced bio-fuels production under the renewable fuel standards (RFS) could reduce U.S. petroleum imports by approximately $5.5 billion in 2012, $23 billion in 2016, and nearly $70 billion by 2022.

The cumulative total of avoided petroleum imports over the period 2010–2022 would exceed $350 billion (Grant, 2009). Increasing advanced bio-fuel production to a modest target of 45 billion gallons by 2030, which can be achieved by maintaining the same pace of technology development, could create more than 400,000 jobs within the industry and 1.9 million new jobs throughout the economy. Further, it could provide an economic boost of $300 billion. Continued federal support can help the industry quicken the development of the necessary technology and weather the risk of oil price volatility (Bio-era, 2009).

Given the importance of energy sources 9including biodiesel) to the economy, it is imperative to look for feasible sources of the fuel. Peanuts are one such source. They are one of the chief crops of Georgia. In view of their prime position in Georgia agriculture, it is only natural to build a biodiesel extraction infrastructure around this important source. The following section presents peanut production figures from the state of Georgia.

4. Peanut Production in Georgia

Georgia is the leading producer of peanuts in the US. It accounts for almost 45 percent of the crop's national acreage and production. In 2009, 755,000 acres of peanuts were harvested in Georgia, corresponding to a yield of 2.2 billion pounds (EPA, 2010). The southern region of Georgia is the most productive region for peanuts. This is due to its coastal plain region, spanning from Columbus through Macon to Augusta. Only a few counties in the southern half of the state do not grow peanuts due to their unique geographical features. Below is a map showing the location of the peanut crop production. It can be noted that these southern regions are prominent to a flat plain like regions that are rich in minerals that promote peanut growth. Figure 1 depicts peanut production rates in the state by county.

Starting from the beginning process of the production of the peanut based bio-diesel, the actual cost and availability of the peanut as a raw material serves as a major constraint. Once the raw material is available at the correct price to make the manufacturing process profitable, the next process is creating a place to store the product during the different steps of the process. Peanut production costs are tabulated in table 1.

Table 1. Peanut Production Costs in South Georgia (Shumaker, 2007).

Variable Costs	Unit	Number of Units	$/Unit	Cost/Acre	$/Ton
Seed	lb.	115	$0.52	$59.80	$42.71
Inoculant	lb.	5	$1.40	$7.00	$5.00
Lime/Gypsum	Ton	0.5	$63.00	$31.50	$22.50
Fertilizer					
Phospate (P2O5)	lb.	20	$0.31	$6.20	$4.43

Variable Costs	Unit	Number of Units	$/Unit	Cost/Acre	$/Ton
Potash (K2O)	lb.	40	$0.23	$9.20	$6.57
Boron	lb.	0.5	$3.75	$1.88	$1.34
Weed Control	Acre	1	$41.46	$41.46	$29.61
Insect Control	Acre	1	$25.48	$25.48	$18.20
Disease Control*	Acre	1	$68.40	$68.40	$48.86
Machinery: Pre-harvest					
Fuel	Gallon	9.48	$2.25	$21.32	$15.23
Repairs & Maintenance	Acre	8.19	$2.25	$18.43	$13.16
Machinery: Harvest					
Fuel	Gallon	1	$13.80	$13.80	$9.86
Repairs & Maintenance	Acre	1	$16.28	$16.28	$11.63
Labor	Hrs	2.53	$10.00	$25.29	$18.06
Crop Insurance	Dol.	1	$15.00	$15.00	$10.71
Land Rental	Acre	1			
Interest on Operating capital	Percent	$180.51	8.00%	$14.44	$10.32
Cleaning	Ton	0.47	$10.50	$4.90	$3.50
Drying	Ton	0.93	$26.00	$24.28	$17.34
GPC&GPPA State	Ton	1.4	$3.00	$4.20	$3.00
NPB Check off	Dol.	1%	$532.00	$5.32	$3.80
Total variable Cost				$414.16	$295.83

The first activity in the process is to shell the peanut so that the shells will not be included in the crushing process. In the first step of the shelling process, peanuts are cleaned; removing stones, soil, bits of vines and other foreign materials that are commonly harvested along with the nuts. The cleaned peanuts move by conveyor to shelling machines where peanuts are de-hulled as they are forced through perforated grates. The peanuts then pass through updraft air columns that separate the kernels from the hulls. Specific gravity machines separate the kernels and the unshelled pods. The kernels are then passed over the various perforated grading screens where they are sorted by size into market grades. Selecting a process in which the hull is not wasted is also important because the hull can also be sold and used to make other products such as chemicals and flour. This helps utilize all parts of the raw material and decrease waste and create a more sustainable market. The next part of the process is the extraction of oil by crushing the peanuts; this is done with various compression and crushing procedures that extract the oil for use. Once the oil is extracted it can then be refined and used for production.

One of the biggest challenges with respect to biodiesel production is not with biodiesel itself. The main cause of concern is the major by-product arising as a consequence of biodiesel production, namely, glycerol. The process of biodiesel production generates approximately 10% weight crude glycerol. Glycerol, when purified is termed as glycerin. It is a chemical with a substantially high-value and has been historically valued at $0.60–$0.90/lb. Glycerin is mainly used to manufacture a range of foods, beverages, pharmaceuticals, cosmetics, and other personal care products. There has not been much progress with respect to the commercial development of alternative processes that can utilize glycerol. Also, the high price of glycerol has rendered it economically unattractive to be used as a feedstock chemical. Recently, however, the price of crude glycerol has fallen to about $0.05 per lb, primarily because of the increased production of biodiesel. Because of this significant price decrease, glycerol is poised to emerge as an important building block chemical. Transporting these large quantities of glycerol are a logistical nightmare. In view of the fact that the current U.S. market for glycerol is about 600 million lbs./year, conventional uses of glycerol are not able to accommodate an excess supply. Consequently, increasing biodiesel production has resulted in creating a significant glut of glycerol in the market (Johnson, *et al* 2007).

From a production stand point, the excess glycerol from creating bio-diesel has the potential to be used as an energy source. Glycerol can be placed in a convection oven that can be used to heat and even used to convert to electricity. The oven will burn glycerol and peanut shells, this process offers potential for a more sustainable production process that creates less waste and cuts cost at the same time. The investment of the equipment necessary to reintroduce glycerol into the production process would be very effective and would quickly pay itself off. This process also leaves the opportunity for growth and efficiency. The following section examines the economic feasibility of biodiesel production.

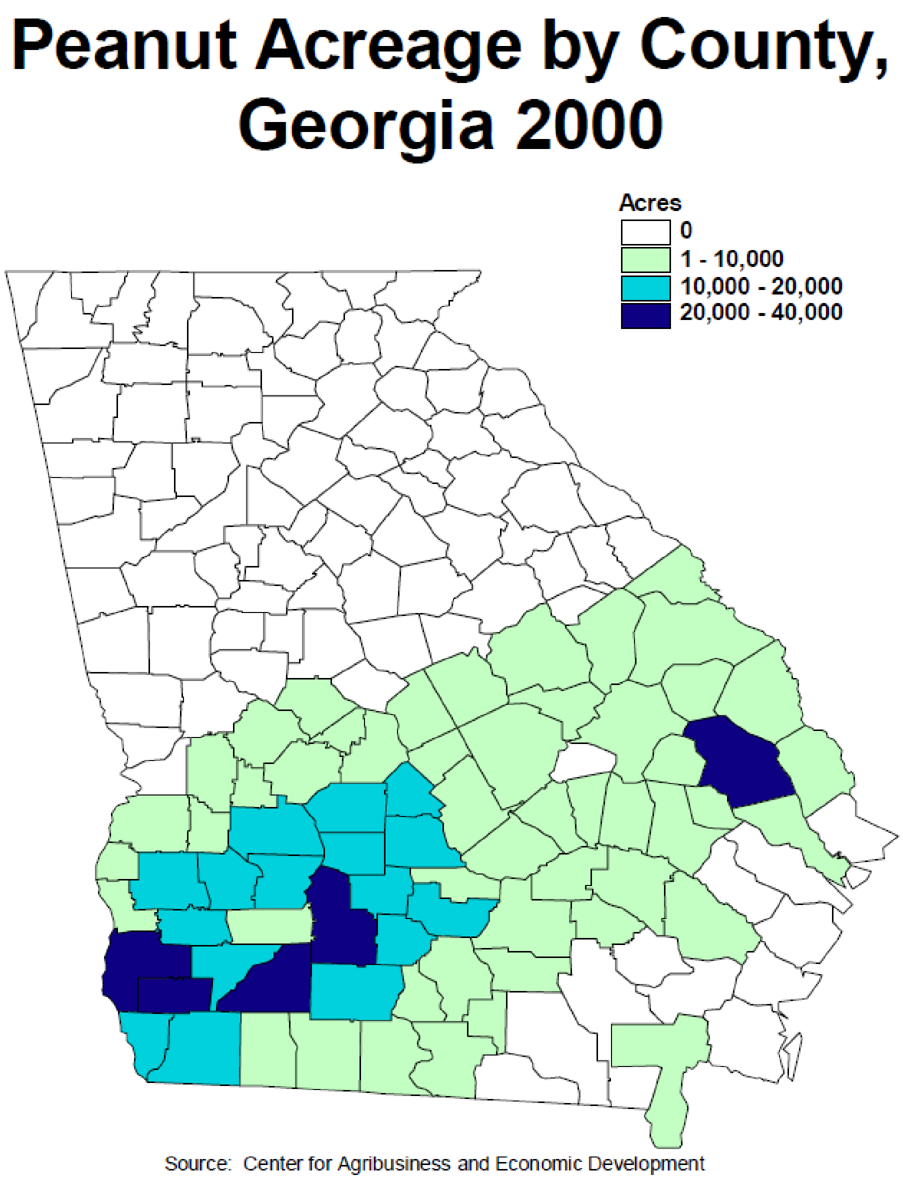

Figure 1. Georgia Peanut Production by County (Van Gerpen, 2004).

5. Economics of Biodiesel Production

The Center for Agribusiness and Economic Development at the University of Georgia secured the services of Frazier, Barnes & Associates (FBA, 2005) of Memphis, TN. FBA is a consulting firm. They specialize in vegetable oil processing with a view to assessing the capital cost of different sized facilities to produce biodiesel. Each of the plant cost estimates are for a facility capable of handling a wide variety of feed stocks for biodiesel production. The capital cost estimates include the cost of facilities needed to pre-process any feedstock such that it could be converted to biodiesel using the aforementioned methyl ester process. FBA evaluated four different sized biodiesel site production plants looking at estimated construction and operating costs (tables 2 and 3).

Table 2. Capital Cost comparison of various plant sizes based on capacity (FBA, 2005).

Estimated Capital Cost Comparison of Various Plant Sizes.				
Plant Size (million gallon/yr)	0.5	3	15	30
Capital Cost	$950,000	3.4 million	$9.6 million	$15 million
Feedstock Needed Pounds Gallons	 3.75 million 500,000	 22.5 million 3 million	 112.5 million 15 million	 225 million 30 million

Table 3. Production Cost Sensitivity to Feedstock Cost Based on Plant Size.

Production Cost Sensitivity to Feedstock Cost by Plant Size, Dollars Per Gallon of Biodiesel.				
Plant Size (million gallon/yr)	0.5	3	15	30
$0.10 per lb cost	$1.96	$1.33	$1.11	$1.10
$0.15 per lb cost	$2.34	$1.70	$1.48	$1.48
$0.20 per lb cost	$2.72	$2.08	$1.85	$1.85
$0.25 per lb cost	$3.09	$2.46	**$2.21	$2.21

Based on the data provided in Tables 2 and 3, it appears the most appropriate size facility for Georgia is the one that produces about 15 million gallons of biodiesel per year with a capital cost of about $9.6 million. In Table 9 we see that most of the economies of scale are realized in a 15 million gallon plant. Unit costs of production do not appear to fall by doubling the size to 30 million gallons. Table 4 presents a list of equipment and relevant costs necessary to establish a biodiesel processing facility.

Table 4. Biodiesel Capital Costs Estimate.

Estimated Biodiesel Capital Cost Details for a 15 Million Gallon Capacity Plant.	
Equipment	$3,600,000
Convection Oven	$1,000,000
Buildings	$1,200,000
Utilities	$720,000
Civil/Mechanical/Electrical	$2,736,000
Land/Prep/Trans Access	$192,000
Engineering/Permitting	$192,000

Estimated Biodiesel Capital Cost Details for a 15 Million Gallon Capacity Plant.	
Set-up Consulting	$3,000
Contingency (10%)	$960,000
Total Installed Cost	$10,603,000

The operating costs of a 15 million gallons per year bio-diesel production plant using peanuts as a source are presented in table 5. This analysis incorporates all factors that contribute to operation cost. Failure to incorporate contributions to operation cost can create unreliable and incorrect results. Also the cost and quantity of these factors will need to be up to date and accurate given their imperative correlation to the final cost of production. It is also important to incorporate human labor, depreciation, and subtraction of sales of byproducts left over from the production processes.

Table 5. Operating Cost of a 15 Million Gallon per Year Bio-diesel Plant Using Peanuts

Raw Material	**Price/Unit $**	**Unit per gallon of Diesel**	**Units/year**	**Cost/Year ($)**	**Cost per gallon of Diesel**
Peanut Oil (lbs)	$0.2500	7.5000	112,500,000.0000	$28,125,000.00	1.8750
Transportation (rail Cars)	$3,000.0000		500.0000	$ 1,500,000.00	$0.1000
Methanol (gal)	$1.2800	0.1400	2,100,000.0000	$2,688,000.00	$0.1792
Catalyst (lb.)	$1.9600	0.0800	1,200,000.0000	$ 2,352,000.00	$0.1568
Utilities					
Natural gas/diesel (decatherms)	$7.0000	0.0077	115,500.00	$808,500.00	$0.0809
Water	$0.0030	0.3822	5,733,000.00	$17,199.00	$0.0017
Labor					
Manager/Operator	$59,000.0000		1.00	$65,000.00	$0.0039
Operator	$40,000.0000		6.00	$240,000.00	$0.0160
Lab technician	$36,000.0000		1.00	$35,000.00	$0.0027
Maintenance	$30,000.0000		2.00	$60,000.00	$0.0040
Sales	$40,500.0000		1.00	$35,500.00	$0.0027
Support Staff	$18,000.0000		1.00	$ 18,000.00	$ 0.0012
Benefits @32%				$ 145,120.00	$ 0.0145
Misc					
Maintenance				$ 150,000.00	$ 0.0100
Insurance				$ 375,000.00	$ 0.0250
Marketing				$ 150,000.00	$ 0.0100
Permits				$ 45,000.00	$ 0.0030

Raw Material	Price/Unit $	Unit per gallon of Diesel	Units/year	Cost/Year ($)	Cost per gallon of Diesel
Waste Disposal (tons)	$35.0000		600.00	$ 21,000.00	$ 0.0014
Waste Water Treatment	$0.0110		2,000,000.00	$ 22,000.00	$ 0.0015
Depreciation					
Building				$ 24,478.00	$ 0.00168
Equipment				$ 571,600.00	$ 0.0381
Storage Tanks				$ 46,000.00	$ 0.00298
Byproducts					
Soap Stock (lb.)	$0.0100		6,000,000.00	$ (60,000.00)	$ (0.0040)
Total				$ 37,434,397.00	**$ 2.5280**

From this analysis, it can be recognized that a 15 million gallon per year bio-diesel production facility would have an annual cost of $37,497,097 and a production cost of $2.50 per gallon. It must also be recognized that this analysis does not account for potential measures to increase sustainability within the manufacturing process. The excess glycerol from the process can be reprocessed for electricity by adding a convection oven to the installed cost presented in Table 11 which can be easily paid off by the recurring benefit of a sustainable source of energy. The small loss of sales of glycerol will also be consumed by the recurring benefit of the sustainable energy production process. It can also be noted that waste from peanut shells will decrease but will not have nearly any significant effect on the cost waste disposal. The cost of marketing is less than 0.5% of total cost which is considered low for a product with such small market share but given its unique market situation this price is fairly adequate. A benefit cost analysis of the biodiesel production process is presented in the following paragraph.

This is done using the 30 year Treasury rate where interest equals 4.5%, it can be noted that the rate is subject to market fluctuations. If the plant was to be started at this moment the full analysis reflects related cash flows. Assuming a standard plant life of 15 years, as mentioned the cost per gallon of biodiesel remains $2.27 with a capacity of 15 million gallons production per year as stated above. The annual cost of operation will be calculated by multiplying the price per gallon of bio-diesel by the amount of gallons production annually. The installed cost will be adapted from Table 11, and the annual revenue will be calculated by the selling price multiplied by the amount of gallons production annually. This selling price will refer to the current average market price of bio-diesel. This analysis will take place over 15 years, and also assuming a uniform demand with no salvage value at the end of the life of the plant.

Annual cost (A) = $2.53 per gallon* 15,000,000 gallons
Recurring Revenue per year = $3.08 per gallon * 15,000,000 gallons
Time = 0-15 years
Installed Cost = $10,603,000

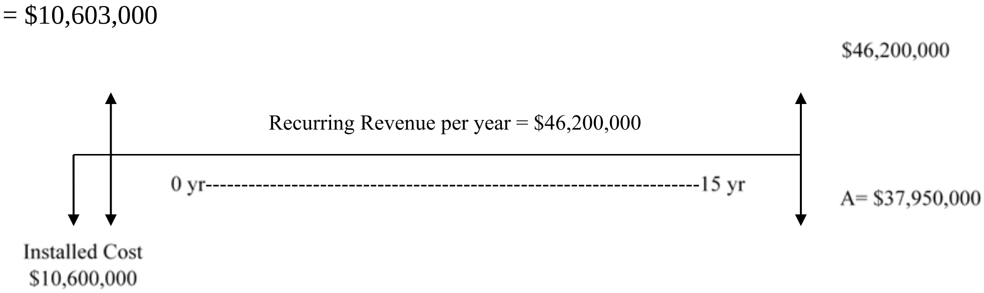

Figure 2. Benefit Cost Analysis of Bio-diesel Production (Assuming $0.00 salvage cost)

Benefit/Cost Analysis with No Salvage Value

Referring to the given information above, the benefit analysis can be calculated using the following formula:
Note: P/A can be obtained in Table 16.
PW (Cost) = Installed Cost + Recurring Cost per Year (P/A, í, n)
PW (Cost) = Installed Cost (10,600,000) + Recurring Cost per Year (37,950,000) * (10.7395)
PW (Cost) = 418,164,025

PW (Benefit) = $ 46,200,000 (P/A, í, n)
PW (Benefit) = $ 46,200,000 * (10.7395)
PW (Benefit) = $ 496,164,900

Benefits/Cost= $496,164,900/$418,164,025=1.1865→ (highly profitable)

It can be noted that as long as PW of benefits is greater than $418,164,025 the situation is profitable, if equal then break even, if less then loss.
418,164,025/10.7395 = (breakeven revenue)
To calculate the breakeven price that determines profit or loss the breakeven revenue shown above will be divided by the gallons produced per year.
(Breakeven price per gallon) = (Breakeven revenue) / $15,000,000 (Gallon produced per year)
The breakeven price of bio-diesel based on the above analysis is $2.59

Benefit/Cost Analysis with 10% Salvage Value

The following analysis is similar to the one above but it incorporates as end of useful life 10% salvage value of equipment and buildings. To do this the salvage value will need to calculate by adding up the cost of the factor in the installed cost that has active depreciation on annual basis:
Annual cost (A) = $2.53 per gallon * 15,000,000 gallons
Recurring Revenue per year = $3.08 per gallon * 15,000,000 gallons
Time = 0-15 years
Installed Cost = $10,600,000
Equipment Cost= $4,600,000
Building Cost = $1,200,000
Total =$5,800,000
Salvage value = 10% of $ 5,800,000
Salvage value =$580,000

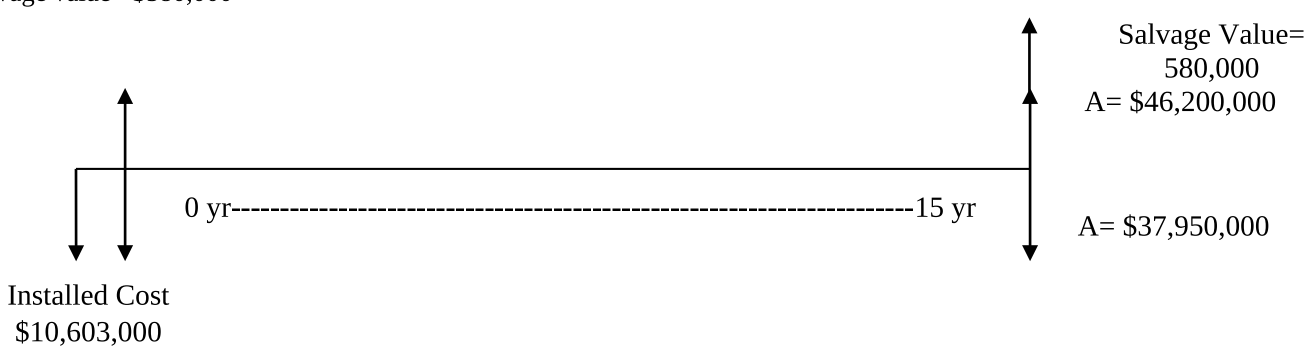

Figure 3. Benefit Cost Analysis of Bio-diesel Production (Assuming 10% salvage cost)

PW (Cost) = $ 418,164,025

PW (Benefit) = $ 46,200,000 + Salvage Value ($ 580,000)* (P/F, í, n)
= $ 46,200,000 * 10.7395 + $ 580,000 * (0.5167)

= $ 496,164,900 + $ 299,686
PW (Benefit) = $ 496,464,586

Benefits/Cost=$ 496,464,586/ $ 418,164,025=1.1872 → (Highly profitable)

The results of this benefit cost analysis show that even with a 10% salvage value the cost using the above processes is highly profitable and cost efficient. This offers profitable opportunities to increase the overall acceptance and viability of the product as bio-diesel integration.

6. Discussion

The results of this benefit cost analysis show that even with a 10% salvage value the cost using the above processes is highly profitable and cost efficient. Furthermore, the fluctuation and invariable rise in interest rates is unlikely to negatively impact the profitability of the production operation. A basic interest rate of 4.5% was assumed in this study. If this rate was increased to 6%, the operation would still be largely viable. Similarly, a 10% salvage value was included in the calculation. The operation was also feasible at a $0 salvage value. Needless to say, this is a worst case situation and thus, highly unlikely to occur. A more realistic situation would be one wherein a higher salvage value (such as that in excess of 20% or so) is likely to be obtained. Practically though, any biodiesel operation would entail periodic up gradation of plant and equipment. Thus, old equipment would have to be sold and new equipment would have to be purchased in order to maintain the operation. In this composite scenario, replacement analysis can be used to ascertain when old equipment should be replaced. This will invariably be a function of not only recurring cash flows but market valuation of existing equipment as well. A more comprehensive study involving a replacement analysis study focusing on biodiesel production can be a subject of a future paper.

7. Conclusion

Following the research and strategic analysis involved with integrating peanut based bio-diesel, it is possible to conclude that feasibility is definitely reasonable and achievable. The processes invested in this paper explain efficient and profitable methods to initiate the integration process within the market range of South Georgia. The existence of a reduced cost per gallon process of integrating a sustainable energy offers tremendous opportunities to stimulate the economy and advance our way of life, while preserving our environment. This research is easily scalable. It can also be noted that this process is more exultant as the expansion grows and consumer investment increases. As consumer investment and commitment increases conversion will also become more profitable creating even more opportunities for growth. Renewable technologies are an investment that open possibilities for exponential growth.

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