The University of Georgia

Center for Agribusiness and Economic Development

College of Agricultural and Environmental Sciences

Small Scale Biodiesel Production

What you need to know before you get started.

Prepared by: George A. Shumaker, Audrey Luke-Morgan and John C. McKissick

August 2008
CR-09-03

Small Scale Biodiesel Production
What you need to know before you get started.

Many Georgians are interested in producing their own biodiesel fuel. There are many reasons for the interest including the rapid rise in diesel fuels prices, concern about the environment, concern about our dependence on imported petroleum and just plain old desire to take control of a part of one's own destiny. Whatever the reason for wanting to produce biodiesel, it pays to know what you are getting into before starting. The purpose of this publication is to give an overview of small scale biodiesel production and to explain some of the economic factors involved.

<u>Biodiesel</u>

Biodiesel is the name given to a fuel produced from a chemical reaction between a vegetable oil or animal fat, an alcohol source and a catalyst. The most commonly used process is called *trans-esterification*. The vegetable oils or animal fats are composed of triglyceride molecules that react with the alcohol and catalyst to produce methyl esters (biodiesel), glycerin, some alcohol and some unprocessed waste fat. A typical input-output model of the process would look like the following:

Transesterification Input – Output Model

Input		Output
Oil/Fat 87%	→	**Methyl Esters 86%**
Alcohol 12%		**Glycerin 8%**
Catalyst 1%		**Alcohol 4%**
		Waste Fat 1%

The ratios of inputs to outputs shown above are only examples that are typical with quality ingredients. The actual ratios will vary somewhat dependent upon the type and quality of feedstock, alcohol and catalyst used and the actual methodology employed to foster the reaction. Output results will vary as well.

The basic process is quite scalable and can be used to produce small or large quantities of biodiesel. The same basic process is used to make a cupful in the laboratory as a demonstration or millions of gallons in large commercial operations.

Process Design Considerations

The educated handyman can build a small biodiesel facility from either new parts or recycled items. There may be a period of trial and error before getting the system right. There are also many models available that can facilitate the construction of a small home made system. A search on the World Wide Web will turn up many sellers of biodiesel kits. There are commercially available technologies for producing biodiesel of various sized facilities from the very small to the large commercial operations. The choice of which technology to use is an economic decision based on the choice of feedstock, the amount of biodiesel to be produced, the desired quality of the finished biodiesel and the co-products produced.

Biodiesel is the primary product being produced. Quality of that product must be paramount in the decision process. Poor quality biodiesel will perform poorly and may even damage engines. In the long run, it will likely pay to produce a high quality product even when the level of production is small. Biodiesel produced for sale must meet the American Society for Testing and Materials (ASTM) standards to be sold into the market place. It is important to note that the ASTM standards are not static and can and will change in the future. The process design should incorporate features to meet current and anticipated future ASTM standards.

The feed stock to be used is a critical decision in how to configure the plant. While the basic principles of converting all feed stocks into biodiesel are essentially the same, the reactor design and various pretreatment and auxiliary systems will differ according to different feed stocks. Availability and cost of feed stocks will play a major role in this decision.

Glycerin is the primary co-product in the process. For all practical purposes, there is no or limited market outlets for glycerin produced by the very small operator. It can be burned as a fuel source in some burners.

Basic Production Processes

There are actually two basic biodiesel technologies that are commonly in use.

Trans-esterification - The predominant method is called trans-esterification that converts feed stock low in free fatty acids into biodiesel. The feed stock is typically a single type with free fatty acids (FFA) of less than 0.5 percent and is usually a refined oil product. Some firms do source more than one type of feed stock but they are typically very similar. Feed stocks may also be pretreated to remove the FFAs, called soap, but this has the side effect of effectively raising the cost of the feed stock by both the pretreatment cost and the percent loss of soap removed. The pretreatment may also remove some gums from oils that were not refined. This system works well for the better feed stocks such as refined canola, soybean and other virgin vegetable oils

Esterification - The second basic method is designed for feed stocks high in free fatty acids or feed stocks with varying levels of free fatty acids. This process uses direct esterification along with the trans-esterification reaction to use this type of feed stock. This system provides a higher yield of biodiesel from the high FFA feed stocks. This method works best for the animal fats and other lesser quality fats and oils such as yellow grease.

Water washing – Water is used to remove water soluble impurities such as free glycerin, soaps and traces of methanol from biodiesel. Since water has no affinity for biodiesel it can be easily removed or dried, usually in a flash dryer. Water will not remove any un-reacted glycerides or other oil-soluble materials such as phospholipids and sulfur compounds. The ASTM specifications for biodiesel require very low levels of phosphorous and the best way to accomplish this is to use de-gummed, bleached feed stocks. The sulfur compounds are typically very low in the virgin oils but may be a good bit higher in the animal fats.

Water washing requires constant monitoring as the amount of water used must be adjusted to the impurity load of the product. If the product contains too much soap due to even a small error in the reaction recipe, water washing will be very difficult.

Water washing can be a low energy user if the water is not recycled. However, waste water treatment costs or even disposal costs can off set the energy savings.

Potential Feedstock Supplies

Biodiesel can be produced from fats and oils from a wide variety of plants and animals. The choice of which feedstock to use is not a trivial decision. The cost of the feedstock can amount to more than 75 percent of the total cost of producing biodiesel, depending upon the methods used. Therefore, attention should be given to selecting a low cost, high quality and steadily available feedstock.

While there are many different potential feed stocks that can be converted into biodiesel that will meet ASTM standards, the differences between their physical and molecular structure require differing pre-processing measures to insure a satisfactory product. The varying characteristics of the potential feed stocks require differing technologies and as such, each feed stocks will have a different capital cost for the appropriate equipment and a different cost of production. As a result, most facilities are designed to use just a few potential feed stocks and generally only those feed stocks with the lowest total cost of production and readiest supply.

Feed stocks can be placed into three primary categories:

1) **Virgin Vegetable Oils –** soybean, canola, rapeseed, corn, sunflower, peanut, cottonseed, etc.
2) **Waste vegetable Oils –** used oil collected from primary users such as restaurants, fryers, etc (often called yellow grease)

3) **Rendered Animal Fats –** beef tallow, pork fats, fish oils, poultry fats, etc.

In Georgia there are primary sources for many of the above feed stocks. There are two large soybean crush facilities in Georgia and two nearby in Alabama and one in South Carolina. These five facilities have recently produced an estimated 218 million gallons of soybean oil on an annual basis. There are two cotton seed crush facilities in Georgia with an undisclosed production. There is also some undisclosed peanut crush capacity in Georgia as well.

A favorite feedstock of the very small biodiesel producer is waste vegetable oils from restaurants. Some have been successful in securing the waste oil at little or no cost, however much of this waste oil is sold into the market to recycling companies. The main advantage is the low purchase cost. However, waste oil typically needs some or considerable preprocessing before it can be used to make biodiesel. At a minimum, it must be strained to remove any solids and should be dried to remove any water. Another potential problem with waste oil is that the quality may well vary from batch to batch and thus create problems getting a suitable process recipe that will produce a consistent end product. So, while the initial cost may seem inexpensive, the actual cost may be considerably higher when preprocessing and inconsistent biodiesel quality are considered.

Another potential source of feed stock is yellow grease or the inedible fat, oil and grease from the food service industry. The majority of the yellow grease produced in Georgia is collected by renderers who process it by cleaning and refining it for further used such as in various chemicals, soaps, cosmetics, plastics, lubricants and livestock and poultry feed. There is also an export market for reprocessed yellow grease. One major yellow grease collector/processor operating in Georgia operates a biodiesel plant in Kentucky using the reprocessed product as a feed stock. Yellow grease is a favorite source of feed stock for the very small cottage industry type biodiesel producers. It is a potential source of feed stock but one that has yet to prove a reliable source of consistent quality that most biodiesel processors could exploit.

Each of these sources is currently finding markets for the fats and oils they produce as Georgia does not have supplies of unused products. New users, such as biodiesel producers will need to bid those supplies away from the current use. This will surely place some upward pressure on available feed stock prices.

Palm oil or palm olein is a feed stock source that may also be used in Georgia under the right location and price conditions. In early August, 2005 the IRS issued a guidance document that extended the virgin feedstock definition to palm oil. Industry sources indicate that at present no palm oil is produced in the U.S.; all sources are international, primarily from Indonesia, Malaysia, and Africa, with some additional sources in South America. With the Gulf Coast as one of the primary points of entry, palm oil could work its way into Georgia and other southern states biodiesel production. Palm oil is available in both crude and RBD (refined, bleached, deodorized) as well as palm olein (fractionally separated palm oil). Palm olein is the separated liquid fraction of palm oil.

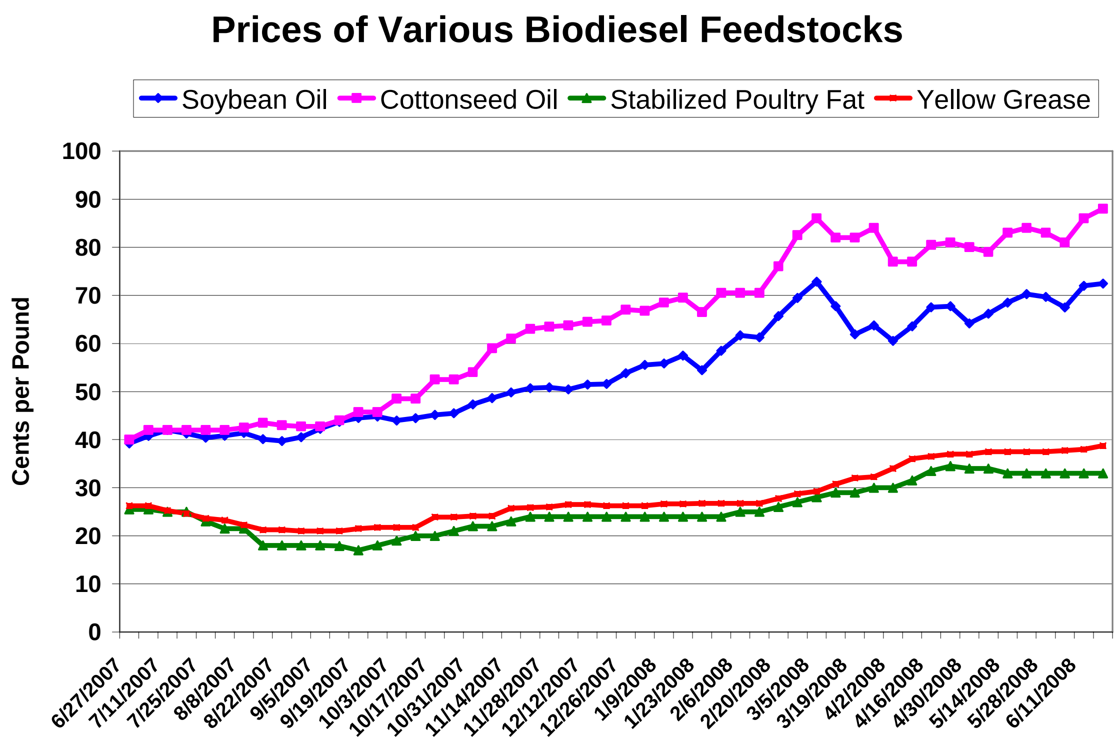
Oil Content of Various Oilseeds

Georgia has the capability of growing a variety of oilseeds that could be potential feedstocks for biodiesel production. The following table lists the more common oilseed crops with a history of production in Georgia and the estimated oil content of the seeds. It should be noted that the oil yield from those seeds will be near the listed oil content only if the oil is extracted using a solvent technology. Oil yields using expelling technology will be lower. Typical cold press yields will be about 70 to 75 percent of the total oil content. More advanced heated seed expeller yields may approach 90 percent.

Oilseed	Estimated Oil Content
Canola	42%
Cottonseed	18%
Peanuts	48%
Soybeans	19%
Sunflower	42%

Feed Stock Costs

The following chart illustrates the price relationship between some of the major oils and fats that may be available for biodiesel production in Georgia. As a general rule, the fats and oils markets are dominated by soybean oil, the most commonly available and dominant oil used in the United States. Being the dominant oil, the price of most other oils tends to move along with the price of soybean oil. The correlation is not a perfect one but very strong none-the-less.



Data Source: The Jacobsen Publishing Company

There are two points to be taken from the above chart of potential feedstock prices. One is the general overall upward trend in prices. Expansion in biodiesel production, i.e., demand for oils, has increased and that has placed upward pressure on feedstock prices. Also impacting prices during 2007 was a sharp reduction in soybean acres produced in the U.S. which translates into a reduced available supply of soybean oil. The combination of increased demand for feedstocks and reduced supply of the dominant oil caused prices to rise to record levels during 2007 and into the first half of 2008. While soybean acreage increased during 2008, we have yet to see any reduction in soybean oil prices.

The second main point to take from the above chart is the difference in price between the different potential feedstocks. Cottonseed oil is a premium oil and is very expensive. On the other hand, stabilized poultry fat and yellow grease are lower end products that traditionally have had lower values uses or were further processed before having higher valued uses. Thus their market prices have been well below other higher values oils.

The major large scale biodiesel producers have tended to prefer soybean oil as their feedstock of choice. The main reasons for this are availability, consistency of product and the ability to manage price risk through the futures market.

"Back of the Envelop" Biodiesel Economics

There are some fairly simple calculations one can do to determine the basic economics of biodiesel production. Generally, it takes about seven and one-half pounds of feedstock to produce one gallon of biodiesel. If we multiply the price of the feedstock by 7.5 we can determine the feedstock portion of our biodiesel production costs. The other biodiesel production costs beyond the feedstock typically average about $0.75 per gallon in large commercial operations while smaller operations are likely to be higher depending on several factors discussed later including the basic economies of scale.

Using the latest soybean price in the previous chart we can determine that our feedstock costs would be about $0.72 x 7.5 = $5.40. In other words, we would need to buy $5.40 of soybean oil to make a gallon of biodiesel. Total production costs using soybean oil are thus about $6.15 per gallon from a commercial sized operation. If we used yellow grease our feedstock cost would be about $0.39 x 7.5 = $2.93 and our total cost of production would be about $3.68 per gallon from a commercial operation. At the time of this writing, retail petro-diesel prices were about $4.65 per gallon. So, we can clearly see the importance of feedstock selection and price has a major impact on the total cost of producing biodiesel and its competitiveness in the market place.

Costs of Creating Your Own Oil Feedstock

One alternative to purchasing feedstock oil is to produce your own by expelling it from oil bearing crops. The most practical method of making oil for the small scale biodiesel producer is by using a cold press expeller. A cold press expeller is basically a screw press that uses mechanical force to press the oil from the seed. The expeller separates a portion of the oil from the seed resulting in crude oil and meal. The meal can be fed to livestock as a protein and energy source or sold to help off set the cost of the oilseed. This method of obtaining oil requires storage for the oil seeds, a tank and strainer system for the crude oil and storage for the meal product.

There are vendors that sell small motor driven expellers and sources can be found by performing a web search. Costs for the systems vary by source of the machinery, delivery terms and accessories provided. The capital costs used in the following analysis were taken from a study from Montana State University and are representative of systems ready for use.

The following assumptions were used in the analysis table demonstrating the economics of small scale oilseed expelling.

1. Two expellers complete with storage facilities and oil straining system were evaluated.
2. Name plate capacities are 5 and 10 tons per day of oilseeds when operated for 24 hours. Analyzed used capacity is an eight hour per day shift operating 250 days per year.
3. Labor costs are charged at $15.00 per hour and included benefits.

4. Repairs are charged at 5 percent of capital cost.
5. Depreciation was charged using the Straight Line method over five years.
6. An interest rate on the capital outlay of 8 percent of capital cost was charged.
7. The example used is soybeans with an assumed oil content of 18 percent. The expeller would provide a yield of 73 percent of the seed oil content.
8. The price of soybeans and soybean meal were at the date of writing.

Economics of Small Scale Oilseed Expelling

Capital Costs including storage		**5 ton per day**	**10 ton per day**
		$7,500.00	**$12,700.00**
Operating Costs based on 8 hours per day, 250 days per year			
Oilseed value or cost	**$14.70**	**$204,555**	**$407,884**
Labor @ $15 per hour	**$15.00**	**$30,000**	**$30,000**
Utilities		**$260**	**$310**
Repairs @ 5% of investment		**$375**	**$635**
Depreeciation @ SL 5 years		**$1,500**	**$2,540**
Interest @ 8% of investment		**$600**	**$1,016**
Total Operating Costs		**$237,290**	**$442,385**
Ton crushed per day		**1.7**	**3.3**
Ton crushed per year		**417.5**	**832.5**
Oil content of oilseeds	**18.0%**	**18.0%**	**18.0%**
Percent of oil content expelled		**73.0%**	**73.0%**
Tons of Oil Produced		**55**	**109**
Tons of Meal Produced		**363**	**723**
Gallons of Oil Produced		**14,629**	**29,171**
Price per Ton of Meal Produced	**$396.30**	**$396.30**	**$396.30**
Credit for Meal Produced & Sold		**$143,714**	**$286,568**
Operating Cost per Gallon		**$2.24**	**$1.18**
Net Cost of Oil Production		**$93,575**	**$155,817**
Cost per gallon of Oil Produced		**$6.40**	**$5.34**

The bottom line is that it is expensive to create your own oil by using the cold press expelling method. Costs per gallon of oil could be lowered by operating the equipment for more than one eight hour shift, but given the current price of oilseeds, it is costly to acquire oil either by creating your own or purchasing ready to use product.

Capital Costs of Small Scale Biodiesel Production Facilities

There is a tremendous ability to scale biodiesel production. It can be made one cupful at a time up to the largest commercial operations that may approach 60 million gallons per year or more. It is true that the larger the facility, the more it will cost to acquire or build. But it is also generally true that the capital cost and operating costs per gallon will decline as the size of the facility increases. The complexity and sophistication of the system will also impact cost per gallon of capacity.

As stated earlier, a good handyman can put together the components needed to make biodiesel on a small scale and can probably do it from used materials if enough time is spend hunting things needed. As an alternative, there are several vendors that sell kits for producing biodiesel. It is important to understand that the total actual cost of an operating facility will be higher than the quoted price for a kit package. Most kits are "bare bones" in nature in that they are usually just the basic equipment needed to actually produce biodiesel. They typically do not include the cost of shipping to your location, installation, any storage tanks, any needed wiring and plumbing; any needed space to place the facility and the associated tanks and testing equipment. These costs can, in some instances, increase the cost by a factor of 100 percent.

A cursory search of some vendors with Web sites turned up a wide range of kits and prices. At the small end of the size scale of 40 to 80 gallon per batch units, "bare-bones" kits ranged in price from a low of $3,000 to $17,900. The claims of the sellers indicated that a typical batch could be made between 24 and 60 hours with these units. The kits would also need to be shipped to the buyer, buyer installed and each vendor also had recommended add-ons that would make the process more user friendly. Of course all this would add to the actual purchase price. Estimated costs of the add-ons ranged from $1,000 to nearly $5,000 per unit. The add-ons included transfer pumps, valves, scales, heaters and tanks for material storage but the contents of add-on kits did vary. A recent Montana State University study estimated total capital costs of a 40 gallon facility of $3,455 and an 80 gallon unit at $5.950. Another study estimated the total capital cost of a 123 gallon per day unit at $7,435 and a 259 gallon per day unit at $12,675. These studies included some of the costs beyond the cost of the kit but did not include all the costs of wiring, plumbing, heaters, installation and housing for the units.

The search turned up one vendor that sells a 275 gallon per batch unit. It appeared much easier to use as it had many automated features unlike the smaller units that were indeed manually operated. The quoted price of this unit was $45,000 plus shipping and included suggested add-ons valued at another $13,600, for a total of $58,600.

One can increase production by purchasing more units and running them simultaneously. Thus moving from the very small scale into a bigger operation can be accomplished in a gradual manner.

As one seeks price quotes on larger more commercial sized units, prices are harder to come by over the Web. Vendors of larger scale facilities desire to become more involved in the process and are less likely to provide price estimates without the appearance of a commitment to purchase. They want more details from the potential purchaser about that actual business plans, feedstocks to be used, marketing plans, etc. That is entirely understandable. It seems that many of these intermediate sized operations tend to be modular units. They are typically sized to fit on a semi-tractor trailer for ease of movement. They can also be easily scaled to increase output by combining units to make a larger overall facility. Two vendors were willing to provide non-binding “ball park” quotes for a 2.5 million gallon per year plants. The two quotes were $2.6 and $3.4 million dollars for “turn key” plants ready to produce biodiesel.

Once we move up to the commercial sized operations of 10-15 million gallon per year capacity, they tend to be more of the “stick built” style where the major components may be built in a fabrication facility and shipped to the site but require a good deal of on-site construction, plumbing and erection. One major factor in the cost of the larger sized plants deals with the decision on whether or not to process of by-product glycerin. The choice is whether or not to refine the glycerin or just market at as crude product. Larger scale plants may be able to justify the added costs of refining glycerin to capture the higher market price for the finished product. Smaller plants generally cannot justify the added cost.

The following table is a summary of estimates of the capital cost of various sized small scale biodiesel plants. Note that the author increased the quotes from the previous narrative by 50 percent for some of the units to account for the added costs of getting the facilities operational and to provide a minimal amount of operating capital. One can get into the biodiesel production business for a fairly modest amount of money. Of course the larger the desired operation and the more automated it is, the more it is likely to cost.

Estimated Capital Costs of Various Sized Small Biodiesel Plants

Plant Size	**Capital Costs**	**Annual Production**	**Cost per Gallon**
40 Gallon per Day	**$5,183**	**10,000**	**$0.52**
80 Gallon per Day	**$8,925**	**20,000**	**$0.45**
123 Gallon per Day	**$11,153**	**30,750**	**$0.36**
259 Gallons per day	**$19,013**	**64,750**	**$0.29**
275 Gallons per Day	**$70,000**	**68,750**	**$1.02**

Note: Annual production based on 250 batches per year.

Operating Costs of Small Scale Biodiesel Facilities

The following table illustrates estimated costs per batch and per gallon of producing biodiesel in various small scale production facilities. The author made several assumptions in developing the estimates.

1. Cost of feedstock was 50 cents per gallon.
2. Cost of Methanol was $3.20 per gallon.
3. Cost of catalyst was $1.85 per gallon.
4. Labor requirements were 3 hours per batch for the three smaller units and 4 hours per batch for the 259 gallon per day unit and 2 and one-half hours for the more automated 275 gallon unit. Labor was charge at $10.00 per hour.
5. Fuel taxes were charged based on 24.4 cents Federal excise tax and 4 percent Georgia tax but does not include any local option taxes.
6. Depreciation is based on a 5 year straight line system.
7. Interest on investment was charged at 5 percent of total capital cost from the previous table.
8. Some of the other costs were based on estimates made in a Montana State University study of small scale biodiesel production and were taken for use in this study.

The key points to be taken from the following table are that small scale production of biodiesel is an expensive proposition if you total up all the costs associated with the operation. Total estimated production costs were well above the current rate of about $4.85 per gallon for retail biodiesel as of mid July, 2008.

A second key point is that feedstock cost represents about 62 percent of production costs when the purchase price was 50 cents per pound or $3.75 per gallon. This once again emphasizes the importance of securing low cost yet high quality feedstocks. It takes one gallon of feedstock to produce a gallon of biodiesel. Thus, with the mid July 2008 biodiesel price of $4.85 and per unit process costs of $2.31 for the 40 gallon per batch producer, one would need to acquire feedstocks at a price of $2.54 per gallon ($4.85 - $2.31) or less to make the biodiesel “profitably”. Finding feedstocks at that price will be a challenge given the current market environment.

ESTIMATED SMALL SCALE BIODIESEL PRODUCTION COSTS

	Batch Production Capacity				
	40	**80**	**123**	**259**	**275**
Feedstock Cost	$150	$300	$461	$971	$1,031
Processing Costs					
Chemicals	$26	$51	$79	$167	$177
Utilities	$3	$6	$9	$18	$19
Supplies	$1	$2	$2	$5	$6
Labor	$30	$30	$30	$40	$25
Repairs & Maintenance	$1	$2	$2	$4	$14
Insurance	$5	$5	$5	$5	$5
Fuel Taxes	$17	$34	$52	$110	$117
Quality Control	$5	$10	$15	$31	$33
Sub Total	$237	$439	$656	$1,351	$1,427
Fixed Costs					
Depreciation	$4	$7	$9	$15	$56
Interest on Investment	$1	$2	$3	$5	$17
Sub Total	$5	$9	$12	$20	$73
Total Cost per Batch	$243	$448	$667	$1,371	$1,499
Total Cost per Gallon	$6.06	$5.60	$5.42	$5.29	$5.45
Process Costs	$2.31	$1.85	$1.67	$1.54	$1.70
Feedstock Costs	$3.75	$3.75	$3.75	$3.75	$3.75

Note: based on 250 batches per year.

Sensitivity to Feedstock Cost

Feedstock costs represent a major element in biodiesel production. The above analysis was based on a cost of 50 cents per pound for feedstocks. Many smaller producers may be able to secure feedstock at a lower cost by using waste vegetable oil. The following table illustrates how cost of production varies with different feedstock prices.

SENSITIVITY OF TOTAL COST TO FEEDSTOCK COST

	Batch Production Capacity				
	40	80	123	259	275
Feedstock Cost	Total Cost of Production				
$0.10	$3.06	$2.60	$2.42	$2.29	$2.45
$0.15	$3.44	$2.98	$2.80	$2.67	$2.83
$0.20	$3.81	$3.35	$3.17	$3.04	$3.20
$0.25	$4.19	$3.73	$3.55	$3.42	$3.58
$0.30	$4.56	$4.10	$3.92	$3.79	$3.95
$0.35	$4.94	$4.48	$4.30	$4.17	$4.33
$0.40	$5.31	$4.85	$4.67	$4.54	$4.70
$0.45	$5.69	$5.23	$5.05	$4.92	$5.08
$0.50	$6.06	$5.60	$5.42	$5.29	$5.45

Feedstock Issues

Generally, the better the feedstock quality the higher the market price and the reverse is also generally true as well. High cost feedstocks make good biodiesel but the cost of the biodiesel is also high. Thus, many small scale biodiesel producers look for the lower valued used vegetable oils in an attempt to be successful from an economic point of view.

When attempting to use waste vegetable oil (WVO) one often encounters some problems due to the often high free fatty acid (FFA) content of the WVO. A FFA is one that has been separated from the glycerol molecule as a result of the oil breaking down due to use. The high FFAs, those over 2.5 percent, pose problems for the small scale biodiesel producer.

1. More catalyst is needed to create the trans-esterification process.
2. FFA salts or soap is formed during the process and separation is a problem.
3. Water is formed during the process and must be removed.
4. The FFA will not be converted into fuel and thus the yield of the feedstock will be reduced. This drives up the cost of the "used" feedstock.

There are ways of handling the high FFA WVO to make them suitable for the small scale biodiesel producer. One way is to dilute them with low FFA oils however that may mean extra storage tanks needed for differing types of oils and it may drive up the cost of the feedstock.

One can also pre-process the high FFA oil by adding catalyst and water to change the FFA to soap which can then be removed. This will reduce the volume of the feedstock by the amount of the FFA content. For example, if the oil has a FFA content of 10 percent, removing it will result in the added costs of removal and extra labor plus the loss of 10 percent of the purchased feedstock. Thus costs are increased.

Perhaps the most commonly used method is to add acid and large quantities of methanol to try to convert the FFA into fuel. This will run up the cost of production in increased chemical costs and added labor. In addition, an extra tank will be needed for this process. So, while WVO may be priced attractively, WVO does pose problems for the small scale producer.

Glycerin By-product

The primary by-product of the biodiesel process is glycerin or glycerol. Glycerin will be produced at the rate of about 12-13 percent of the volume of biodiesel produced. Thus, a 40 gallon batch of biodiesel will produce about 5 gallons of glycerin. Disposal of the glycerin is a problem for some producers. Perhaps the best way to dispose of it is to process it through a waste water treatment plant. Any hauler with a dumping permit such as septic tank cleaners should be able to handle the product.

Summary and Conclusions

Biodiesel can be made on a small scale using either home made or purchased kits. Total capital costs vary considerable depending upon the sophistication of the system. When purchasing kits, buyers should be aware that more than likely they will need additional parts, shipping to pay and installations costs that will added to the sticker price.

Feed stock costs are the most critical element in the total cost of producing biodiesel. While low cost feedstocks appear attractive, they usually need a degree of pre-processing before they are ready to make biodiesel. Waste vegetable oils usually have a high level of free fatty acids that should be removed prior to making biodiesel. Pre-processing results in increased costs and lower biodiesel yields from a given amount of feedstock.

Producers need to strive for a high quality product. High quality fuel is less likely to damage engines. It also helps protect the image of biodiesel as a viable alternative fuel. If the producer desires to sell the biodiesel into the market, it must meet strict ASTM market standards.

Sources:

Source for Georgia diesel fuel taxes. http://www.georgiagasprices.com/tax_info.aspx

Schumacher, Joel, “Small Scale Biodiesel Production: An Overview”, Ag Marketing Policy Paper No. 22, May 2007, Montana State University

“Feasibility Report Small Scale Biodiesel Production”, Waste Management and Research Center, University of Illinois, http://www.wmrc.uiuc.edu/main_sections/tech_assist/small-scale-biodiesel.pdf

The Center for Agribusiness & 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.

To find out more, visit our Web site at: http://www.caed.uga.edu

Or contact:

John McKissick, Director
Center for Agribusiness and Economic Development
Lumpkin House
The University of Georgia
Athens, Georgia 30602-7509
Phone (706)542-0760
caed@agecon.uga.edu

Report Number: CR-09-03 **August 2008**

Issued in furtherance of Cooperation Extension Acts of May 8 and June 30, 1914, the University of Georgia College of Agricultural and Environmental Sciences, and the U.S. Department of Agriculture cooperating.

J. Scott Angle, Dean and Director