MISSISSIPPI BIODIESEL FEASIBILITY STUDY

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and the

SOUTHEASTERN REGIONAL BIOMASS ENERGY PROGRAM
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MISSISSIPPI BIODIESEL FEASIBILITY STUDY REPORT

Commissioned by
Mississippi Development Authority-Energy Division
Mississippi Technology Alliance – Mississippi Alternative Energy Enterprise

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Biofuels such as biodiesel and ethanol are critical components to maintaining our national security and reducing our dependency on foreign oil. Biofuels also have a direct impact on the domestic farm economy and help create agricultural and non-agricultural jobs. Most importantly, biofuels offer significant environmental benefits in improving the air and water quality.

One of the newer biofuels is Biodiesel and it is rapidly gaining popularity in America and around the world. Biodiesel is a clean burning alternative fuel derived from domestic, renewable resources such as fats and oils like soybean oil, canola oil, corn oil, animal fats, and used restaurant greases. Biodiesel is made by a process called trans-esterification, which in simple terms is a conversion of vegetable oils or animal fats into biodiesel via a chemical reaction that uses an alcohol such as methanol and a catalyst such as sodium hydroxide.

The use of biodiesel as a fuel is an easy replacement for petroleum based diesel, and it offers several important benefits. Since biodiesel can be simply splash blended with petroleum based diesel in any concentration, it does not require any special handling or storage facilities. More importantly the use of biodiesel, even at a 100% level (B100), does not require any major modifications to conventional vehicle or stationary diesel engines, and offers improved lubricity for more efficient engine operation. The National Biodiesel Board has designated March 18 as the “National Biodiesel Day” to celebrate the birthday of Rudolf Diesel, inventor of the internal combustion engine that bears his name. Rudolf Diesel designed his engine in the early 1900’s originally to run on peanut oil.

Biodiesel offers significant environmental benefits. The greatest virtue of biodiesel is that it contains almost no sulfur. Furthermore, according to a report issued by the United States Environmental Protection Agency (USEPA) in October 2002, burning neat biodiesel (B100) reduces the emissions of particulate matter and carbon monoxide by almost 50% and unburned hydrocarbons by almost 70%. There is, however, a slight increase in the nitrogen oxides (NOx) emissions, but blending reduces NOx emissions to a negligible amount. Research is currently being conducted to lower these emissions. Biodiesel could possibly be the ideal additive to petroleum diesel for maintaining the fuel’s lubricity, especially by 2006 when the new lower sulfur emission standards for diesel fueled vehicles will be in place. The amount of sulfur allowed in emissions will be 15 parts per million (ppm) compared to the current level of 500 ppm. According to the National Biodiesel Board, biodiesel is the only alternative fuel to have fully completed the health effects testing requirements of the 1990 Federal Clean Air Act Amendments. Any product marketed as biodiesel must also meet the high standards set by the American Society for Testing and Materials (ASTM D6751-2).
The primary caveat for using biodiesel is its current higher cost than conventional petroleum diesel. The current average retail price of biodiesel around the country is about $1.70 per gallon, but that is expected to drop as the market for this fuel grows in size and new manufacturing technologies are developed. The United States consumes approximately 50 billion gallons of diesel fuel annually and a 2% blend with biodiesel would represent a market size of 1 billion gallons annually. Current US production of biodiesel is about 40 million gallons. Biodiesel is currently blended with petroleum diesel in concentrations ranging from 2% (B2) to 20% (B20). Some of the other issues with biodiesel that are being researched include its cold temperature flow properties and its long term oxidative and thermal stability during storage.

Biodiesel is rapidly emerging as an alternative product for soybean producers since the majority of this fuel in the United States is made from soybean oil. In Europe, especially Germany, where biodiesel has been in use for several years, most of the biodiesel production is derived from rapeseed or canola oil. Biodiesel presents an opportunity for Mississippi soybean producers to convert their lower value soybeans into higher value products including soybean meal and glycerin. This type of “value-added” processing operation would require the integration of a biodiesel facility with a soybean processing facility that would utilize the oil removed from the bean leaving behind soybean meal and hulls for other uses. Currently there is only one soybean processing and oil production facility in Mississippi.

There is a high level of interest in producing biodiesel in Mississippi. Presently there are three initiatives in the state at various stages of development that will have biodiesel production capabilities. The smallest one has been producing biodiesel for several months at an intermittent rate of about 300 gallons per day. A facility capable of producing about 15 million gallons of biodiesel per year is currently under construction in Nettleton, Mississippi while additional plants are under consideration in north-west Mississippi. The state of Mississippi consumes about 730 million gallons of petroleum diesel fuel annually for all applications including on-road, off-road, farm and railroad. Using a 20% blend of biodiesel (B20) across the board would create a demand for more than 146 million gallons per year. Legislators in Mississippi are also very interested in promoting the production and use of biodiesel in the state. House Bill 928 that was passed in 2003 included language to create an incentive for biodiesel production. The Mississippi Development Authority – Energy Division also provided a grant to the Lauderdale County School District to power nine school buses at an elementary school with a blend of B10 biodiesel. This is the first biodiesel school bus demonstration project in Mississippi.

The biodiesel industry could potentially see significant growth over the next few years and may top 500 million gallons by 2012. Several factors such as low sulfur regulations, both on the national scale and in California, will be a major driving force in increasing the consumption of biodiesel. The current Energy Bill being
debated in the Congress also has favorable provisions for biodiesel and its enactment would provide a boost to biodiesel. Technology will also play a major role in lowering the cost of biodiesel production and finding alternative, higher value uses for the primary process byproduct, glycerin. Legislative incentives may not be necessary if biodiesel is competitive with petroleum diesel on a cost basis alone. Increased used of biodiesel will also require a massive education effort to inform the public about the benefits of this relatively new renewable fuel.
EXECUTIVE SUMMARY

The objective of the comprehensive feasibility study was to determine the factors that would be involved in the successful implementation of a biodiesel industry in the state of Mississippi. Such factors include feedstock availability, cost of feedstocks, potential biodiesel demand, process and plant economics, consumer education, and legislative actions that will spur the production and/or consumption of biodiesel in Mississippi.

Feedstocks can account for more than seventy percent of the total cost of producing biodiesel; hence feedstock cost and availability are very important in determining the feasibility of a biodiesel industry. Table 1 shows the various feedstocks available in the state along with their average cost. Detailed information on feedstock availability is presented in Section 2 and 3 of the study. Mississippi is a net exporter of soybeans, the primary source of oil used for biodiesel production in the United States. Mississippi, however, is not an exporter of soybean oil and currently only one soybean processing facility exists in the state. A financial analysis by Frazier Barnes and Associates (Section 4) shows that an integrated facility with both soybean processing and biodiesel production could be well suited for Mississippi. Additionally an integrated facility also has a better payback than a standalone facility as shown in Table 2.

Table 1

<table>
<thead>
<tr>
<th>Feedstock</th>
<th>Availability (gallons)</th>
<th>Average Cost (per pound of feedstock)</th>
<th>Average Cost (per gallon of feedstock)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soybean Oil</td>
<td>38.6 million</td>
<td>$0.23/lb</td>
<td>$1.73/gallon</td>
</tr>
<tr>
<td>Cottonseed Oil</td>
<td>16.0 million</td>
<td>$0.25/lb</td>
<td>$1.875/gallon</td>
</tr>
<tr>
<td>Yellow Grease</td>
<td>6 million</td>
<td>$0.11/lb</td>
<td>$0.83/gallon</td>
</tr>
</tbody>
</table>

(Note: These feedstock prices were considerably higher at the time the study was released.)

Table 2

Biodiesel Facility Payback
(Simple Payback based on a 13 million gallons/year plant)

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Subsidy</th>
<th>Payback Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standalone*</td>
<td>Federal</td>
<td>7-8</td>
</tr>
<tr>
<td>Standalone*</td>
<td>None</td>
<td>10</td>
</tr>
<tr>
<td>Integrated**</td>
<td>Federal</td>
<td>4-5</td>
</tr>
<tr>
<td>Integrated**</td>
<td>None</td>
<td>7-8</td>
</tr>
</tbody>
</table>
*Stand-alone production facility: Biodiesel from virgin oils and recycled fats purchased on the open market.
**Integrated Facility: Process Mississippi grown soybeans into oil, biodiesel, and other co-products.

The biodiesel market is still in its infancy in the United States, based on both production and consumption. Biodiesel produced in any state would be marketed regionally and possibly supplied to areas of the country in greatest need of improving air quality. The total petroleum diesel consumption in Mississippi ranges from 700 million to 800 million gallons per year. This represents a potential demand for biodiesel in Mississippi as follows:

- 15 million gallons per year @ B2 (2% biodiesel blend)
- 150 million gallons per year @ B20 (20% biodiesel blend)

A significant amount of petroleum diesel in Mississippi is used in the agricultural sector. The potential on-farm use of biodiesel could be as much as 1.6 million gallons per year with a B2 blend.

Current production cost of biodiesel is about two dollars per gallon, but due to federal subsidies, companies such as West Central Soy in Ralston, Iowa are able to market B100 (100% biodiesel) for about $1.60 per gallon. Typically a biodiesel blend costs the end user one cent per gallon for each percent of biodiesel mixed in with petroleum diesel. For example, a B5 blend would be five cents more than the cost of petroleum diesel and B20 would be 20 cents above the cost of petroleum diesel.

There appears to be two distinct classes of commercial biodiesel plants – small ones in the range of 1 to 3 million gallons per year (mmgy) and those that can produce 13 million gallons or more per year of biodiesel. There are several “backyard” operations as well that are currently producing anywhere from a few hundred to a few thousand gallons per year of biodiesel. Smaller 3 mmgy units, such as the modular system offered by Santa Barbara-based Biodiesel Industries, and the backyard operations tend to utilize yellow grease as a feedstock. The larger plants, such as those offered by Lurgi PSI, rely primarily on vegetable oil feedstocks. A mid-sized plant in the range of 5 mmgy could be developed that has the flexibility of using either feedstock, but the capital cost of the plant increases due to the additional steps required for preconditioning the raw feedstocks in order to obtain a consistent feed to the reactors. A list of biodiesel technology providers along with some process economics information is provided in Section 1 of this study.
RECOMMENDATIONS

Biodiesel production, along with additional soybean processing capacity in Mississippi has the potential to provide a higher value revenue stream for the state’s agricultural sector. Generally speaking, the renewable fuels industry tends to increase the feedstock prices and create jobs in the local economy. Prices of soybeans, animal fats, and yellow grease would be positively impacted with the advent of a biodiesel industry in the state. However, due to the high production cost of biodiesel, near-term widespread utilization of biodiesel is not feasible without assistance from the federal and state governments.

Biodiesel will require legislative support in a manner similar to what has been provided for encouraging the use and production of fuel ethanol. Current ethanol production in the US now tops 2.5 billion gallons annually compared to 40 million gallons for biodiesel. Producer credits are available for new biodiesel production from the federal government through the Commodity Credit Corporation (CCC) under the U.S. Bioenergy Program. This program covers both ethanol and biodiesel, and most of the funds are being utilized for ethanol payments since new biodiesel production coming on-line is very small compared to that of ethanol. The U.S. Energy Bill proposed in 2003 also contained specific credits for biodiesel production and the Bill will be taken up again by the Congress in 2004.

Biodiesel represents a unique opportunity for the Mississippi Legislative body to promote a domestic agricultural product, while improving the air quality of Mississippi, lowering our dependence on foreign oil, and creating high quality jobs in the state. Incentives for biodiesel that is produced from either vegetable or animal fats can be provided in any number of the following ways, and can be either production oriented or market oriented:

- Provide producer payments similar to ethanol production.
- Provide blender credits to effectively negate the impact of an excise tax on sales of biodiesel.
- Direct investment in integrated soybean storage/processing and biodiesel production and distribution facilities.
- Provide tax credits on equipment used for biodiesel production, distribution or blending.
- Encourage and provide incentives for integrating biodiesel distribution with the conventional petroleum diesel distribution network, which will facilitate biodiesel availability and market adoption.
- Adopt the use of biodiesel blends in state fleets and other municipal fleets such as school buses.
- Special monetary incentives for on-farm biodiesel consumption.
- Encourage the use of biodiesel blends in private fleets by offering monetary incentives.
- Adopt use of biodiesel for stationary applications such as generators.
- Encourage use of biodiesel in the marine transportation sector.
• Invest in renewable energy education.
• Invest in research and development focused on lowering the production cost of biodiesel and finding additional uses for biodiesel and the byproduct glycerin.

Several states around the country from Maine to Washington have already initiated biodiesel promotion programs. Three examples are the programs in Minnesota, Arkansas, and Texas. The state of Minnesota has mandated the use of B2 (2% blend of biodiesel) in all petroleum diesel consumed in the state by the year 2005 subject to availability. Arkansas on the other hand is providing a $0.10 per gallon incentive for biodiesel production for the first 5 million gallons up to a period of 5 years. Texas now provides a net grant of 16.4 cents per gallon to producers of biodiesel for a period of 10 years, but the grant is capped at $3.6 million per plant.

In addition to clarifying the language in House Bill 928, a unique approach in Mississippi may be to fund an incentive to utilize a biodiesel blend such as B2 for all on-farm applications across the state. This approach will enable a value added agricultural product to be used directly to benefit the farmers and will establish Mississippi as the first state in the nation to do so. Creating a market for biodiesel in the state would benefit the biodiesel producers as well as the consumers.

Finally, the drivers for biodiesel demand in the future are likely to be as follows:
• Demand for cleaner air
• Federally mandated lowering of sulfur levels in automotive emission in the year 2006
• Emphasis on energy security
• Renewable Fuel Standard (Energy Bill)
• Adoption of biodiesel by government (Federal and State) fleets
• Niche applications such as auto racing that require high lubricity fuels.
• Increased cost of petroleum based diesel

These drivers, when encouraged by the appropriate legislative actions, consumer education about the benefits of renewable fuels and the advent of cheaper biodiesel production technology can have a significant impact on the creation of a sustainable market for biodiesel both regionally and throughout the United States.
ACKNOWLEDGEMENTS

The Mississippi Biomass Council (MBC) received a grant jointly from the Mississippi Development Authority – Energy Division (MDA-ED) and The Mississippi Technology Alliance – Mississippi Alternative Energy Enterprise (MTA-MAEE) to undertake this study. A portion of the funding for this study was derived through a grant from the Southern States Energy Board to MDA-ED. All of the funds from MAEE were made possible through a grant from the Mississippi Land, Water, and Timber Resources Board.

The purpose of this study was to develop a knowledge base in the state of Mississippi that would facilitate the creation and sustenance of a state biodiesel industry. Another significant goal of this study was to increase the awareness among the general public about biodiesel.

This report has been a truly collaborative effort, both in terms of providing the funding and performing the various tasks of the study. The Mississippi Biomass Council contracted with the following entities to complete the tasks as listed below:

- Mississippi State University Dave C. Swalm School of Chemical Engineering to review engineering and technology aspects of biodiesel production. (MDA-ED Funding)
- Mississippi State University GeoResources Institute to create a geographical information system (GIS) database of available feedstocks and necessary business infrastructure. (MDA-ED Funding)
- Alcorn State University Small Farms Development Center to catalog the animal waste and used grease available in the state that may be utilized to produce biodiesel. (MDA-ED Funding)
- Frazier Barnes and Associates to evaluate the current and future state of the national biodiesel industry and market, current and future renewable fuel legislation and incentives, and licensing and permitting requirements. In addition to these items, Frazier Barnes also gathered financial information and created a model that could be utilized for developing a biodiesel industry in Mississippi. (MTA-MAEE Funding)
- The Mississippi Department of Agriculture of Commerce (MDAC) and the United States Department of Agriculture (USDA) – Agricultural Statistics provided additional assistance for gathering information on crop based feedstock availability.

The efforts of individual entities involved in this project have been preserved in the final report as distinct sections. Although, this may inevitably lead to some duplication of information, it allows the independent works to stand on their own and validate the researchers’ findings. Results from the study will be jointly promoted by the MDA-ED, MAEE and the Biomass Council.
The Mississippi Biomass Council wishes to thank Mr. Wes Miller and Dr. Barbara Ousby, both formerly with the MDA-ED for recognizing the need for this study and for their work in helping make it a reality by assisting MBC in securing the funds for its completion. MBC also recognizes the foresight of Mr. Kenneth Calvin, Director of MDA-Energy Division and Mr. Tony Jeff, former Executive Director of MAEE for making the funds available for this study. Additional thanks are due to Patrick Sullivan and Jim Lipe with the Mississippi Department of Agriculture and Commerce, Bubba Weir, current Executive Director of MAEE, and Serial Kennerson, USDA-Agricultural Statistics.

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The Mississippi Biomass Council is a non-profit volunteer organization dedicated to promoting the use of bio-based products.
POINT OF CONTACT

Any general questions regarding this study may be directed to the following project coordinators. Individuals listed in the independent sections of this report may be contacted directly for specific questions related to those sections.

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