

# Fuel Alcohol in Louisiana May 1987

by  
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## **Preface**

This report was prepared to be a broad general report, which addresses the hundreds of inquiries of different types, which DNR receives in its function as the State energy office. The author wishes to especially thank Phyllis Ortego and Barbara Dunklin for their patient typing and patient revisions to this report.

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## **June 1989 Update** **Fuel Alcohol Laws in Louisiana** **Status**

The major law affecting alcohol fuels in Louisiana is the Agricultural Ethanol Production Law. Incentive payments to qualifying fuel alcohol producers were provided at \$1.40 per gallon of ethanol. The total amount of funds appropriated for fiscal year 1987-88 was \$50 million. The

money ran out in January 1988 and no more money has been provided for incentive payments since that time. The 1989 session of the Legislature repealed the act.

RS:3:3701 through 3709

<Agricultural Ethanol Production Law>

The current session of the Legislature has repealed this law except for the provisions of the Agricultural Industry Board. The Board is to remain in full effect until such time as there is no litigation pending against or involving that board.

RS:51:785.1

Provides for the labeling of gasohol pumps and containers. This law is also being amended by the 1989 Legislature. The labels are being changed from "Ten percent ethanol enriched" to read "Contains Ethanol" or "Contains Methanol." The methanol sign is to be three times larger than the ethanol sign and must be printed on a yellow background.

RS:36:629(m), 36:802.6

Establishes the Agricultural Industry Board within the Department of Agriculture and Forestry. The Board is to go out of existence when any litigation it is involved in is completed.

RS:30:1301 through 1304

<Louisiana Gasohol Act>

Enacted in 1979 this law provides that:

- A. All existing industrial incentives are to be applied to gasohol production facilities;
- B. All state-owned motor fuel supply stations shall supply gasohol for use by state vehicles whenever possible.

RS:47:305.28

Enacted in 1979, amended in 1985.

Exempts gasohol produced in Louisiana from state sales and use taxes.

The 1985 amendment specified that the alcohol in gasohol had to be produced and fermented as well as distilled in Louisiana.

RS:47:714.1

Repealed in 1986.

Exempted gasohol containing Louisiana alcohol from the gasoline tax. The Agricultural Ethanol Production Law replaced this law.

RS:47:802.1

Repealed in 1986.

Exempted gasohol from the special fuels tax. The Agricultural Ethanol Production Law replaced this law.

## Summary

When this report was begun in 1986 it was intended to be a review of the first years' experience (1985) with the ethanol tax exemption in Louisiana. When it became apparent to the author in April 1986 that the gasohol law would be profoundly changed by the 1986 Legislature the report was set aside and has been extensively revised since October 1986. Last September the gasohol tax exemption ended and the new gasohol direct subsidy began. The report has been updated to reflect how the Agricultural Industry Board which administers the subsidy, has interpreted the 1986 legislation. The wide variations in alcohol selling prices before and after October 1986 are correct for the year for which they are stated. Much of the analysis of the 1985 data was retained in the report because only one crop was consumed in Louisiana for fuel alcohol production that year, thereby greatly simplifying the cause and effect relationship between the fuel alcohol tax incentive and its impact on agriculture. This information was then supplemented with the developments of 1986.

The following is a set of significant observations and points covered in this report.

- The 1985 Louisiana gasohol exemption was 28 million dollars. The first full year of operation for the state's gasohol industry was 1985. Gasohol sales then represented approximately 8.8 percent of the gasoline market.
  - If all 10 of the gasohol plants operating or under construction in 1986 were able to sell their gasohol in Louisiana the gasohol tax subsidy would be 217 million dollars, at \$1.40 per gallon of alcohol. The gasohol industry's capacity would represent 75 to 80 percent of the state's gasoline market. The total gasohol payments are currently capped at \$52 million, however.
  - The primary benefit to farmers in 1985 was an increase of 5.3 million dollars in the total price of the sugarcane molasses crop. Molasses was the only agricultural crop used for a fuel alcohol feedstock until 1986.
  - There were 178 new jobs created in the gasohol industry in 1985.
  - Corn and milo will be the chief new agricultural feedstock from 1987 onward. The molasses supply was already almost completely dedicated to alcohol in 1986. In September, 1986, the home grown requirement went to 100 percent, plus ethanol capacity was sharply increasing. Additional molasses in large amounts would require new sugar mills, which are prohibitively expensive.
  - Louisiana's gasohol tax exemption is the largest in the nation both in total dollar amount and in amount per gallon.
  - There must continue to be a significant home grown feedstock requirement of some sort to insure a tangible benefit to farmers.
  - Without the subsidy, it is presently uneconomical to produce ethanol for fuel.
- Additionally the report contains information on the various Louisiana crops viable for fuel alcohol feedstock and a detailed summary of the process economics of alcohol production.

Other developments, not addressed, in this report, were not insignificant in their effect on the ethanol market. Texaco, Tenneco, Time Saver, and Southland Corporation (7-Eleven) have all been reported to cease their gasohol marketing operations.

## Introduction

The purpose of this report is to answer the many types of questions, which the Department of Natural Resources receives regarding fuel ethanol. The report contains sections on benefits to agriculture, the gasohol tax exemption, basic ethanol production, appendices on Louisiana ethanol plants, Department of Commerce tax packages, Department of Revenue materials, federal alcohol fuel requirements, a bibliography, and a glossary. Gasohol is a blend of 10 percent anhydrous ethanol and 90 percent gasoline and is completely exempt from 14 cents of Louisiana's 16-cent motor fuel tax and 6 cents of the 9-cent federal tax.

The first full year of gasohol operation in Louisiana (1985) is examined in detail. A great deal can be learned from the state's viewpoint from 1985 when only one crop, sugarcane molasses, was being used for fuel alcohol production. While additional Louisiana molasses is strictly limited by sugar factory capacity, grain crops will not be so limited. Corn and grain sorghum production has greatly expanded in 1984 and 1985 (Table III "Benefits to Agriculture" section) without any influence from alcohol production.

## Background

The spontaneous fermentation of fruits probably led to the discovery of alcohol. The earliest written records contain reference to intoxicating spirits, so it is reasonable to assume that their accidental discovery probably predates writing by many years. Ethanol production flourished as an "art" or "craft" until 1810 when the chemist, Gay-Lussac, demonstrated that glucose was the basic starting block for ethanol fermentation.

The essential role of yeast in the fermentation process was not clearly established until 1837. The French microbiologist, Pasteur, discovered that not only does the process require no air, but the alcohol yield is reduced by its presence. To distinguish this reaction from those that require oxygen, he dubbed this process fermentation.

In 1897, Buchner discovered he could accomplish fermentation without living yeast cells by using extracts from the cell. This amounted to the discovery of the enzymes that yeast produces which cause the conversion of glucose to ethanol to take place. During the next 40 years, such yeast extracts were used by distinguished biochemists to piece together the pathway by which fermentation occurs.

Distillation, the separation of alcohol and water by successive evaporation and condensation, also made a gradual transition from art to science. The first text on the subject, *Das Kliene Distillierbuch*, was published in Strasbourg in the 1500s. The first known continuously operating still was built in France in the late 1800s.

Otto, the man generally credited with invention of the spark-ignited internal combustion engine, ran his first engine on ethanol. Almost all subsequent early experimentation in self-propelled vehicles used engines fueled with ethanol. Henry Ford originally presumed

it would be the fuel for all of his vehicles and continued experimentation with it well into the 1930s.

The U.S. Department of Agriculture published a report called "Use of Alcohol and Gasoline in Farm Engines" in 1907. The U.S. Department of Agriculture again published on the subject in 1936 with a booklet called "Motor Fuel from Farm Products". Also in 1936, a man named Named Bridgeman published a treatise titled "Utilization of Ethanol Gasoline Gasoline Blends" (\*Source: "Alcohol Fuels: Use, Production Principles, and Economics", Solar Energy Research Institute).

Louisiana defines gasohol to mean a fuel that contains not more than ninety percent gasoline and at least ten percent ethanol. Ethanol is ethyl alcohol. For a Louisiana fuel ethanol producer to be eligible for the \$1.40 per gallon state ethanol subsidy the ethanol must be fermented from agricultural products. The law has been interpreted to mean that 100 percent of the feedstocks must be from Louisiana farmers.

Ethanol is one of a series of chemicals called oxygenates which have begun to be added to gasoline as octane enhancers as lead has been phased out. These chemicals are called oxygenates because they have oxygen in their molecular makeup. Ethanol is the only one made from agricultural products such as grain or sugarcane molasses. Only ethanol fermented from agricultural products receives a subsidy from Louisiana or the federal government. Other oxygenates include methyl alcohol (methanol) and ethers such as methyl tertiary butyl ether (MTBE). MTBE is in widespread use throughout the U.S. and Europe as an octane enhancer in gasoline.

Methanol has received a lot of attention because it is cheap. However, methanol is corrosive and will attack plastic fuel system components if the system is not specifically designed to handle methanol. Methanol has long been a preferred fuel for racing engines because of the higher compression ratios at which methanol may be burned relative to gasolines. Refiners have added methanol to aircraft fuels in small amounts as an anti icing or an anti stalling agent. Methanol has been produced by the destructive distillation of wood but is largely obtained from synthesis gas produced by the partial oxidation of natural gas. Synthesis gas may also be produced by the gasification of coal or virtually any carbonaceous fuel.

### **Fuel Alcohol in Louisiana**

During the 1986 Regular Session of the Louisiana Legislature House Bill 550 passed and was subsequently signed by the Governor. This act repealed the gasohol tax exemption 60 days after it was signed and went into effect on or about October 1, 1986.

During the 1985 Regular Session Act 917, the Agricultural Ethanol Production Law, was passed and had been signed into law. For all intents and purposes this law lay dormant until triggered by Act 550, mentioned above.

In other legislation during the 1986 Regular Session and the Special Session the actual gasohol subsidy was addressed again. The direct subsidy to be paid was reduced from

\$1.60 to \$1.40 per gallon of ethanol. The total subsidy to be paid from the Agricultural Industry Incentive Fund directly to the ethanol producers was limited to \$52 million dollars per year.

Act 917, mentioned above, created the Agricultural Industry Board to administer the Fund, also mentioned above, and in general, to administer the gasohol program in Louisiana. Its make up, duties, and the rules it had promulgated are covered in detail in Appendix I.

Gasohol is an important new industry in Louisiana's economy, with an especially important impact on the state's distressed farm economy. It is hoped that this report and the data collected and published here proves to be of service to those trying to understand and deal with the fuel alcohol issue in Louisiana. The first full year that fuel ethanol plants have operated in Louisiana was 1985. The following report is an analysis of the benefits, primarily to agriculture, and the costs of the state gasohol tax exemption. One is able to determine with a good deal of certainty the direct benefits to farmers as the only feedstock used in 1985 was sugarcane molasses. The cost side, the amount of the gasohol tax exemption, is available from the Department of Revenue and Taxation. The major findings were:

- The primary benefit to farmers was an increase of 5.3 million dollars in the total price of the 1985 sugarcane molasses crop.
- The gasohol tax exemption during the same time period was 28 million dollars.
- Louisiana's exemption was the largest in the nation.
- There were 178 new jobs created in the gasohol industry in 1985.
- There must be a state home grown feedstock requirement of some sort to ensure a tangible benefit to farmers.

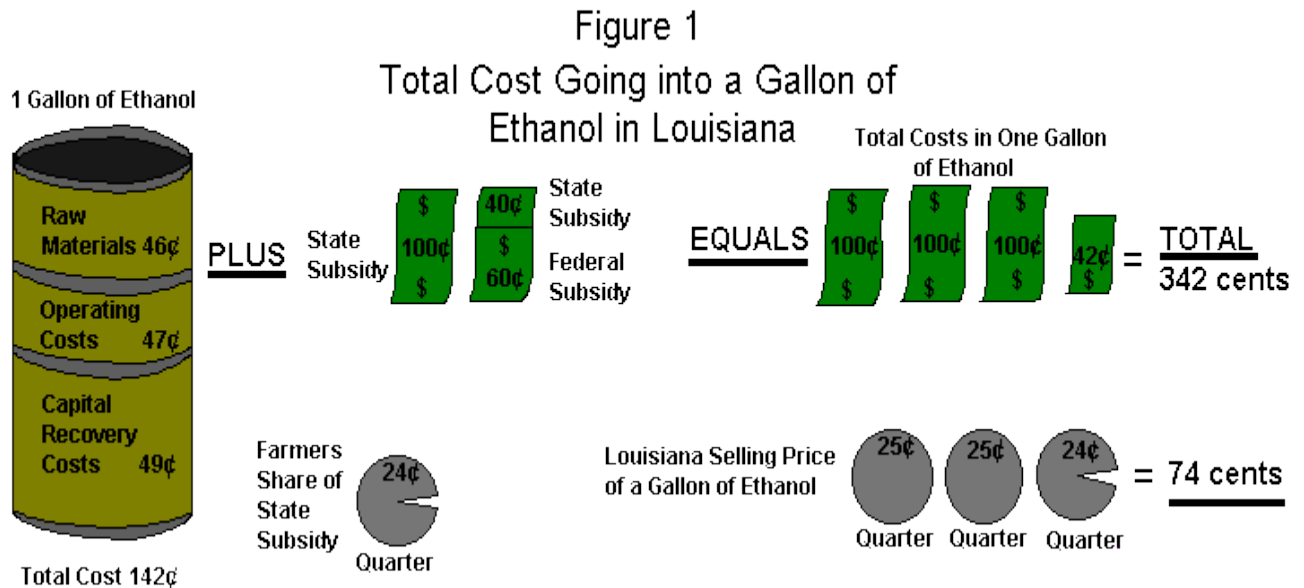
Looking at 1986 and 1987, at ethanol plants that were in operation or under construction in 1986 and planned for construction in 1987, and assuming that the current legislation does not change, one finds:

- The gasohol tax exemption cost rises to 54 to 64 million dollars a year when all of the existing plants at the beginning of 1986 reach their full capacity.
- Two very large plants are currently under construction that will put the gasohol industry's capacity at 75 or 80 percent of the Louisiana gasoline market.
- If all 10 of the gasohol plants operating or under construction in 1986 are able to sell their gasohol in Louisiana the gasohol tax exemption will be 217 million dollars at \$1.40 per gallon of alcohol. (Note, the total payments are capped at \$52 million by law.)
- The October 1986 to May 1987 Louisiana selling price of ethanol is reported to be in the \$0.62 to \$0.78 per gallon range. This price is for the 95 percent or so, 5 percent denaturant blend as delivered from the plant; not on a 100 percent ethanol basis. Prices vary widely from state to state, due to the size of the state subsidy and perhaps special competitive situations. The price used in Figure 1 is a published January price, when all the confidential business plans were approved for 1987 by the Agricultural Industry Board (AIB). The current combined Louisiana and federal tax subsidies are \$2.00 per gallon of ethanol.

- In October, 1986, the state's home grown requirements for molasses as well as other feedstocks went to 100 percent for a manufacturer to qualify for the State subsidy. Year in and year out the Louisiana sugar industry has produced enough molasses for 14.4 million gallons per year of ethanol. The demand for molasses feedstock has historically exceeded this amount and if current construction plans are met the molasses available from Louisiana will not be sufficient to meet a 100 percent home grown feedstock requirement.
- Sweet sorghum has been investigated by LSU and others as a source of molasses for alcohol plants. Thus far sweet sorghum has been found to be far too expensive as a feedstock. In addition there are tillage and severe milling problems associated with sweet sorghum.
- The state's largest ethanol producing user of molasses is planning to be able to use grain also by mid-1987.
- The price of ethanol is directly related to the wholesale price of gasoline. Gasohol and gasoline prices have dropped sharply as the price of crude oil has dropped. Finally, using the data collected in the report there are many ways to change the current or future effects of Louisiana's gasohol tax exemption. It is hoped that this report will provide a common basis for analyzing such changes. Some are presented below.
- In 1985 the benefits of the \$1.60 per gallon Louisiana ethanol tax exemption was split between agriculture and gasohol interests in the following fashion; \$0.30 went to agriculture and the remaining \$1.30 went to gasohol producers.
- The U.S. average state tax exemption in 1985 was \$0.47 per gallon of ethanol or \$0.047 per gallon of gasohol.
- If the state exemption or subsidy were eliminated altogether under current market conditions, the molasses based ethanol business could not survive in Louisiana. If it received the same price as in other states with no exemption and paying the 1985 price of molasses (\$70 per ton), costs would exceed income.
- On September 1, 1986, the gasohol tax exemption ceased and certified alcohol producers began receiving a direct subsidy of \$1.40 per gallon of alcohol from the Louisiana Agricultural Industry Fund. Farmers are to be paid \$2.25 per bushel of corn for alcohol versus a selling price of Louisiana corn sold for other purposes of \$1.65 per bushel. Based on these figures the farmer receives 17 percent or \$0.24 of the \$1.40 per gallon state subsidy as a premium on his corn.\*
- The current total state subsidy expressed in bushels of corn is \$1.40 per gallon of ethanol times 2.57 gallons ethanol per bushel or \$3.60 per bushel.
- \* The above figures were early January 1987 figures. The May 1987 Louisiana figures are for "A contract" corn at \$2.65 per bushel. The author's understanding is that "B contract" corn (corn sold after July 1, 1987,) currently is Chicago Board of Trade (CBT) price with no premium. This may change during the current session of the Legislature. The May 15, 1987, actual selling price for Louisiana corn from the Louisiana Farm Bureau (CBT price plus basis point) statewide averaged \$2.02 per bushel. The range of Louisiana corn for April and May 1987 has ranged from \$1.87 to \$2.07 per bushel (CBT plus basis points).

Based on \$2.65 "A contract" corn and a \$2.02 Louisiana selling price, the premium to

farmers would be \$0.245 per bushel, virtually the same as the farmer's share used in Figure I.



**Notes on Figure I:**

The net raw material cost used was that for grain sorghum, the only Louisiana grain crop actually being used at the time the graphic was prepared. The farmer's share in the figure was based on information furnished by the Louisiana Department of Agriculture as to what the projected premium price the Louisiana Agricultural Industrial Board (AIB) was requiring over the Chicago Board of Trade (CBT) corn price at that time. At the current writing the farmer's premium share is quite a bit less, as the CBT corn price has moved much closer to the floor price set by the AIB for a farmer to be able to "cash flow". "Cash flow" as used in the agricultural community defines the conditions, particularly the selling price, a farmer must have to pay all of his bills and make a profit. Corn should become the predominant fuel alcohol feedstock as 1987 progresses. The net raw material cost for sugarcane molasses could also have been used, as most of the ethanol produced to date under the Louisiana gasohol program has been made from molasses. The Louisiana selling price of ethanol was a published price from the January 1987 time frame.

Fuel ethanol producers are not receiving the value they should be receiving at current selling prices as can be seen by examining Figure I. If ethanol were priced as other goods normally are, its wholesale price would be at least \$3.42 per gallon rather than the \$0.74 it was selling for in January 1987. On September 1, 1986, the State of Louisiana switched from a \$1.60 per gallon of ethanol tax exemption to a \$1.40 per gallon direct subsidy to the producer. The wholesale price to the gasohol blender promptly dropped from the \$2.10 per gallon range to the \$0.70 to \$0.78 per gallon range in response. This is because the producer began receiving his subsidy directly rather than indirectly from the actual blender, who was the party receiving the tax exemption. *Chemical Week* in discussing the same problem as it occurs around the country says ethanol producers could improve their margins if they "have enough nerve" to price it as if it were an octane improver and assign it a fuel value. Other industrial analysts say that with the prices of competing octane boosters slipping as gasoline prices go down that there is little likelihood of the



marketplace supporting such a move. There are signs that both the wholesale price of gasoline and of ethanol are beginning to recover from their low points of early April 1986.

**Tax Exemption:  
The Cost Side of Fuel Ethanol**

In 1985 Louisiana's actual gasohol tax exemption amounted to \$28 million based on the production of 176 million gallons of gasohol. This made the state's exemption the largest in the nation in 1985. If all of the alcohol plants that have been certified by the Louisiana Agriculture Industrial Board as of this writing were able to produce at capacity (155 million gallons per year of ethanol) and sell their output in Louisiana, gasohol would command between 75 and 80 percent of the State's gasoline market. The resulting gasoline subsidy (at \$1.40 per gallon) would be \$217 million dollars a year. The Legislature however, has only appropriated 52 million dollars in 1986 - 1987 for gasohol subsidies. It is the Author's understanding that the preceding figure cannot be exceeded.

<b>Highway fund losses due to gasohol motor fuel tax exemptions</b>			
	<b>Current exemption (¢/gal)</b>	<b>Projected 1985 sales (Million gal)</b>	<b>Projected 1985 state highway revenue loss (Million \$/year)</b>
Alabama	3.0	250	7.5
Colorado*	5.0	270	13.5
Florida	<sup>2</sup> 2.0	640	19.2
Idaho*	4.0	13	0.5
Iowa	<sup>3</sup> 1.0	450	6.8
Kansas	<sup>4</sup> 4.0	267	12.0
Kentucky*	3.5	465	16.3
Louisiana*	16.0	60	9.6
Michigan*	1.0	525	5.2
Minnesota	<sup>5</sup> 4.0	50	2.0
Montana* <sup>1</sup>	5.0	12	0.6
Nebraska	<sup>6</sup> 3.0	234	9.4
New Mexico*	11.0	78	8.6
North Dakota*	<sup>7</sup> 8.0	11	0.8

Ohio	2.5	680	17.0
South Dakota	* 3.0	40	1.4
Tennessee	4.0	250	10.8
Texas*	5.0	460	10.9
Virginia	8.0	263	21.0
Washington	1.8	9	0.2
<b>Total sales</b>			
<b>Exemption states</b>		<b>5,027</b>	<b>173.3</b>
<b>Other states</b>		<b>1,436</b>	<b>---</b>
Federal exemption	6.0	6,463	388.0
<b>Total state and federal highway revenue loss</b>			<b>561.3</b>
<p>*-Exemption limited, usually in-state alcohol.  1-50¢/gal producer credit  2-Midyear decrease to 2¢ from 4¢  3-Midyear decrease to 1¢ from 2¢  4-Midyear decrease to 4¢ from 5¢  5-Midyear increase to 4¢ from 2¢  6-Midyear decrease to 3¢ from 5¢  7-Midyear increase to 8¢ from 6¢  8-Midyear decrease to 3¢ from 4¢</p> <p>Source: <i>Highway Users Federation</i></p>			

The above table was compiled from the following source:  
"Oil and Gas Journal", January 20, 1986 p.32

**TABLE I**  
**Fuel Alcohol Capacity and Exemption**  
**in Louisiana**

	<b>Alcohol Production (gallons)</b>	<b>Exemption (dollars)</b>
1985 Actual	17.6 million	\$ 28 million <sup>1</sup>
1986 Capacity	47 million	\$ 66 million <sup>2</sup>
1986 Capacity plus under construction	155 million	\$ 217 million <sup>3</sup>

<sup>1</sup> This amount was the actual value of the gasohol tax exemption at \$1.60 per gallon of ethanol in calendar year 1985 as supplied by the Department of Revenue and Taxation.

<sup>2</sup> The potential direct tax subsidy at \$1.40 per gallon of ethanol for all the plants in operation in January 1986 without a \$52 million dollar cap is represented by this figure.

<sup>3</sup> The potential direct subsidy for all plants completed and actually under construction at \$1.40 per gallon is represented by this figure. It is highly unlikely that gasohol would have ever been able to capture close to 80 percent of the Louisiana gasoline market. Several plants began operation late in 1985 and as they establish and develop their operations, the total gasohol tax exemption would have risen to 66 million dollars a year in 1986 if the Legislature had not changed the exemption to a subsidy with a \$52 million cap for 1986. At current capacity the ratio of tax exemption to jobs created is between 300,000 and 350,000 dollars a year per job. There are two very large plants currently under construction which when completed will triple the industry's current capacity. The amount Louisiana agriculture received in 1985 due to increased demand for alcohol feedstocks was calculated as 5.3 million dollars (see section on sugarcane). It is not known how much of this increase actually reached the farmer as it was split with those who buy and store the molasses and then resell it to the ethanol plants. The cost to the state for the same time period was 28 million dollars in foregone revenue.

## Fuel Alcohol Benefits to Agriculture in Louisiana

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The largest single cost to the alcohol producer is his raw material.

**TABLE II**  
**Louisiana**  
**Fuel Alcohol**  
**Net Raw Material Cost - \$/gal.**

Crop	Feedstock	- Byproduct Credit	= Net Raw Material Cost
Sugarcane Molasses	\$ 1.02	0	\$ 1.02
Corn	\$ 0.99	\$ 0.36	\$ 0.63
Grain Sorghum	\$ 0.79	\$ 0.36	\$ 0.43
Sweet Sorghum	\$ 1.95	0	\$ 1.95
Rice*	\$ 2.05	\$ 0.36	\$ 1.69
Wheat	\$ 1.24	\$ 0.44	\$ 0.80

\*1984 price

Data Source:

"Louisiana Farm Reporter," Annual Crop Summary - 1985, Louisiana Crop and Livestock Reporting Service, Box 5524, Alexandria, LA 71307-5524.

The primary benefit of ethanol is its impact on the state's agriculture. Louisiana's major crops are shown in Table III. The crops that may be used to produce ethyl alcohol are sugarcane molasses, corn, grain sorghum (milo) and wheat. Rice, which is also used to produce beverage alcohol, is the state's most expensive feedstock for fuel alcohol. There is an interest in molasses from sweet sorghum as a feedstock although this is not being grown commercially in Louisiana. What is known about sweet sorghum is presented in a section of this report on that crop.

**TABLE III**  
**Major Louisiana Crops**

Crop	Acreage Harvested 1,000s		Yield per acre		Production 1,000s		Value of Production 1,000,000s	
	1984	1985	1984	1985	1984	1985	1984	1985
Cotton (bale)	645	630	786	571	1,056	750	\$275	\$195
Corn (bu)	82	205	115	114	9,430	23,370	\$32	\$61
Rice (cwt)	528	463	4150	4370	21,932	20,256	\$180	N/A
Sugarcane (ton)	230	250	22.0	24.3	5,060	6,075	\$121	N/A
Grain Sorghum or Milo (bu)	269	410	65	68	17,485	27,880	\$47	\$58
Soybeans (bu)	2,430	2,100	27.5	21.0	66,825	44,100	\$401	\$223
Wheat (bu)	320	210	41	34	13,120	7,140	\$46	\$23
Hay (ton)	340	320	2.40	2.32	816	741	44	\$39
<b>Total acreage (Louisiana)</b>	<b>4,895</b>	<b>4,629</b>						

Source:

"Louisiana Farm Reporter," Louisiana Crop and Livestock Reporting Service, Box 5524, Alexandria, LA 71307-5524

Molasses from sugarcane has been the predominant feedstock in Louisiana for fuel alcohol as of this writing. One of the primary intents in exempting gasohol from the

motor fuels tax in 1979 as expressed in Act 793 was "...to assist in maintaining Louisiana's sugarcane industry as a viable producer of sugar; to encourage the utilization of sugarcane and other commodities for energy purposes." In this the Legislature succeeded. In 1984 Louisiana sugar farmers produced enough molasses for 12.1 million gallons of ethanol and in 1985 enough for 14.6 million gallons of ethanol. This was sufficient to meet the home grown feedstock requirements for the Louisiana tax exemption in 1985 (10 percent) and is just barely sufficient to meet the 1986 home grown requirement of 35 percent. In fact, if the molasses based plants operate at capacity in 1986 they will have required 82 percent of the previous year's harvest if they are to meet the legal requirements to qualify for the gasohol tax exemption. This has resulted in the domestic (Louisiana) price for molasses being bid up from \$45 a ton to \$70 a ton or a 56 percent increase in the past year. This price increase was attributed to one alcohol plant alone and the reason given for raising the price to this level was to preserve Louisiana molasses for ethanol production. Feed lot operators, the principal competing users of molasses, can get their carbohydrate from other sources it was said; the ethanol plants cannot.

Louisiana molasses based ethanol producers have been the first domestic producers to consume large amounts of molasses. They are also important consumers of molasses worldwide. They now are being joined by virtually all sugar producing Caribbean Basin countries in producing fuel alcohol from molasses for the American market. This alcohol will be allowed to enter the U.S. under very favorable terms under the Caribbean Basin Initiative, although there is opposition in Congress. This is causing molasses prices to rise worldwide to Louisiana levels. A study released by IOP Associates in April, 1986, to the U.S. House Ways and Means Subcommittee on Trade says that the rising value of molasses is likely to significantly crimp supplies of hydrous ethanol in the Caribbean Basin, both in the short-run and in the next five years. The price of molasses is expected to average 69 dollars per ton through 1992.

Another interesting fact is the effect that Louisiana ethanol production has had on the domestic sugar price. The U.S. sugar price is set by federal farm policy. One large producer in the state recently bid on a very large quantity of surplus sugar to produce ethanol. When the bid was awarded, the U.S. price of sugar went up 15 percent, at least for a short while. *Alcohol Week* confirms this in part; they report that the price of sugar rose a cent a pound when USDA announced it was accepting bids to take forfeited sugar off the human consumption market.

The question which is often asked is, "How much have Louisiana farmers benefitted from fuel alcohol production in Louisiana?" The 1985 crop is the first one to benefit from the 25 dollar per ton run up in the price of molasses. The sugar prices are being set by USDA activities. The only grain based plant in Louisiana had just come into production in 1985 and had not had time to be a factor. Several grain based feedstocks will also be considered later in this report. Another benefit to be considered is the 178 permanent jobs generated at the gasohol plants which were in production in 1985.

What does the future hold for molasses feedstocks? There is just about the right amount of molasses from the 1985 crop to meet Louisiana's 35 percent home grown requirement in 1986. There will not be enough molasses grown in Louisiana in 1986 to meet the 100 percent home grown requirement on the books for 1987 unless some current molasses users switch to grain. One large producer has plans to be able to use grain by mid 1987. There are a number of choices available to the state's fuel alcohol producers. They can equip their plants to use corn, grain sorghum (milo) or perhaps wheat. The raw material costs are currently less than those for molasses (Table II above). Feeding grain as well as molasses at existing facilities would be very beneficial as it creates a demand for grain from the same tax incentive. The raw material cost of the various crops are summarized and compared in Table V. There has been real interest in having sweet sorghum grown for molasses feedstock. This is an "if" proposition as one has to convince hard pressed farmers they should quit what they are currently growing and plant a crop that is not in commercial production in the region. Hundreds of thousands of acres would be required to meet current and prospective 1987 demands for the 100% home grown requirement. An ethanol producer could greatly expand the amount of molasses available in 1986 and later by contracting for high test molasses ahead of time from sugarcane harvest, but this is prohibitively expensive. High test molasses is basically molasses with no sugar taken out. Or a manufacturer could contract for overseas molasses for his needs and forgo the state tax exemption. Using grain for additional feedstocks would seem to be the most economic choice.

**TABLE V**  
**LOUISIANA: SEASON AVERAGE PRICE AND VALUE OF PRODUCTION**

		<b>PRICE</b>	
<b>CROP</b>	<b>UNIT</b>	<b>1984</b>	<b>1985</b>
Cotton Lint, All	Lb.	0.543	0.542
Cottonseed	Ton	79.00	49.50
Corn, Grain	Bu.	3.35	2.60
Wheat, Winter	Bu.	3.50	3.25
Rice, All	Cwt.	8.20	-
Sugarcane, All	Ton	23.90	-
Sorghum, Grain	Bu.	2.69	2.07

Potatoes, Irish	Cwt.	11.20	14.00
Sweet Potatoes	Cwt.	7.90	5.30
Soybeans, Beans	Bu.	6.00	5.05
Hay, All (baled)	Ton	54.00	53.00
Strawberries, All	Cwt.	54.00	53.00
Peaches	Lb.	0.35	0.33
Pecans, All	Lb.	0.540	0.461
Pecans, Improved	Lb.	0.750	0.700
Pecans, Native	Lb.	0.450	0.410

Source:

*Louisiana Farm Reporter* (1985 is the latest year currently available)

## Sugarcane Acreage

A sample calculation showing the acreage needed to produce 100 million gallons of ethanol, or roughly 50 percent of the state's gasoline market being supplied by gasohol is shown for each of the state's crops except for sugarcane, sugarcane is a special case. An additional sugar mill is required along with additional acreage, and such a mill is an expensive long term investment. The history of the sugar industry in Louisiana in the past ten years or so has been to shut down sugar factories and cannibalize them to keep the rest in operation. The number of mills currently operating in Louisiana is roughly one half what it was ten years ago.

Louisiana's 1985 sugarcane crop was 250,000 acres. The 1985 molasses production was 36.5 million gallons at 6 gallons per ton of cane or enough molasses to produce 14.4 million gallons of anhydrous ethanol. Average molasses production year in and year out has been roughly 36 million gallons.

**TABLE IV**  
**Acreage/Ethanol Calculation for sugarcane**

<p>Acres = 275,000 (limited by the number of sugar mills)  Harvest = 6.5 million tons of cane (1986 December estimate)  Molasses = 6.5 million tons x 6 gal/ton = 39 million gallons  Ethanol = 39 million gallons x 1 gallon ethanol/2.5 gallons molasses  = <b>15.6 million gallons of ethanol</b></p>
--

## Grain Sorghum (Milo)

The second feedstock to actually be used for fuel alcohol in Louisiana is milo. The *Louisiana Farm Reporter* relates that 1985 grain sorghum production was a new record, breaking the 1984 production record. (The actual acreages, yields, and production may be found in Table III where they may be compared to the other major Louisiana crops.) The point that both 1984 and 1985 milo harvests were record crops is noteworthy, indicating a shift to milo similar to that for corn. This shift is independent of gasohol plants up to this point as the milo-to-ethanol plant produced only token amounts of ethanol in 1985. In fact no fuel alcohol sales were reported to the Department of Revenue and Taxation from this plant in 1985. The 1985 U.S. milo crop was up 28 percent from the 1984 crop and was a record high. The Louisiana seasonal average price for milo declined by 23 percent which was bad for the farmer but has made it the state's best bargain as an alcohol feedstock. The net raw material cost for ethanol from grain sorghum in 1985 was \$0.43 per gallon. This compared to a net raw material cost for ethanol from molasses of \$1.02 per gallon, which was good for the sugar farmer but not so good for the ethanol producer. In 1985, 17.6 million gallons of fuel ethanol was produced, virtually all from molasses. If it had been produced from milo instead, the state's gasohol industry would have been able to save itself \$10.4 million dollars on feedstock, based on the preceding figures. Louisiana's largest users of molasses plan to be able to use grain by mid 1987. This will ease the one-feedstock strain greatly.

Currently a strong imbalance exists in the crops being used as alcohol feedstocks. Only one type of farmer was able to derive any benefit from the gasohol tax exemption in 1985. The state's sugarcane molasses crop was almost oversold in 1986 and will certainly be so when the home grown requirement is raised to 100 percent. This imbalance should improve some in early 1986 when production begins in the state's first grain based plant and improve substantially in late 1986 when the second such plant is completed. In late 1986 Shepherd Oil should be able to use grain or molasses as feedstock which should balance out the benefits of the gasohol tax exemption to all the various types of farmers who can produce ethanol feedstocks.

Two acreage levels are calculated for each of the Louisiana's grain crops. The higher level, enough acreage to produce 100 million gallons of ethanol, represents the case where roughly 50 percent of the state's gasoline market is being supplied by gasohol. When the plants that are currently under construction are completed in 1987, the alcohol capacity to supply 75 to 80 percent of Louisiana's gasoline demand will be in place. The lowest figure, enough acreage to produce 40 million gallons of ethanol, is roughly the total capacity of the state's fuel alcohol industry at the beginning of 1986. Milo is the first grain crop to be used as feedstock beginning in 1985 in Louisiana. At this writing it is also the state's best bargain price-wise of all the crops that could be used for such a purpose. Exactly how grain sorghum's price behaves remains to be seen, but gasohol's impact will be small until some of the molasses-based plants develop the ability to use milo and other grains in mid 1987. The state's largest plant is scheduled to come



on-line in the fall of 1986. It is designed to use corn, although it could use grain sorghum as well.

**TABLE VI**  
**Acreage Calculation - Milo**

<p><b>For 100 million gallons of ethanol per year</b> Acres = <math>100 \times 10^6 \text{ gal. ethanol} \times 0.38 \text{ bu/gal.} \times \text{acre}/68 \text{ bu}</math> = <b>560,000 acres of milo</b></p> <p><b>For 40 million gallons of ethanol per year</b> Acres = <math>560,000 \times 0.4</math> = <b>224,000 acres of milo</b></p>
---

## **Corn**

In the past two crop years corn production has gone from almost nothing to a 205,000-acre crop for Louisiana with yields essentially as good as those for rest of the nation. While corn is the most widely used ethanol feedstock in the U.S., none is currently used in Louisiana for this purpose. There is a large plant under construction on the Mississippi below New Orleans which will use corn. It is scheduled for completion in late 1986. In addition, in 1986 when the Louisiana home grown feedstock requirements go to 100 percent, at least one plant which uses molasses exclusively plans to be able to use some grain as well. Farmers in the state have shown a big interest in corn without any influence from alcohol; therefore, it seems highly likely that they will be willing and able to accommodate almost any new demand gasohol plants might produce.

**TABLE VII**  
**Acreage Calculation - Corn**

<p><b>For 100 million gallons of ethanol per year</b> Acres = <math>100 \times 10^6 \text{ gal. ethanol} \times 0.38 \text{ bu/gal.} \times \text{acre}/114 \text{ bu}</math> = <b>333,000 acres of corn</b></p> <p><b>For 56 million gallons of ethanol per year</b> Acres = <math>333,000 \times 0.56</math> = <b>186,000 acres of corn</b></p>
---

## **Distillers Dried Grains (DDG)**

In calculating the feedstock cost of grain there are some valuable by-products which must be taken into account. The most valuable are a family of very nutritious animal feed supplements generally referred to as distillers dried (or sometimes wet) grains (DDG).

The stillage (the solids left behind after the alcohol is distilled off) from fermentation contains fibrous carbohydrate material, protein from the original feedstock, high-protein yeast produced in fermentation and solubles which include various minerals and other nutrients. DDG is generally marketed at 10 percent moisture and has a protein content on the order of 25 to 28 percent dry basis. This is lower than soybean meal which is about 45 percent protein, but significantly higher than corn which is about 9 percent. DDG is a widely traded commodity worth \$110 per ton compared to corn at \$85 per ton at this writing. One ton of corn fed to an ethanol plant produces 0.3 tons of DDG.

The net raw material cost for ethanol from corn is \$0.63 per gallon based on \$2.60 per bushel corn and \$110 per ton DDG. The average selling price of the 1985 Louisiana corn crop was \$2.60 per bushel. The \$0.63-per-gallon net material cost for corn indicates that it would have been more economic to have used corn in 1985 than molasses which had a net raw material cost of \$1.02 per gallon. In fact it cost the ethanol producers who used molasses 62 percent more than corn would have cost. This was not the case in the previous year when corn was considerably more expensive and molasses was cheaper. This situation demonstrated however, the considerable advantage of being able to use grain as well as molasses as a feedstock.

The question arises then why have these producers not moved towards a cheaper and more plentiful feedstock? The answers, at least in part, are as follows: (1) significant additional capital investment is required to install grain handling and solid fermentation equipment to what is currently an all liquid process plant; (2) In 1985 all of the plants were still in the startup phase of their operation. The fuel alcohol industry across the U.S. has been especially prone to initial startup problems. The rule of thumb is that it takes two years to work all of the bugs out of a new operation. Also, cash flow is normally still negative during the initial phase of operation, making it very difficult to raise additional capital for a major process modification. Finally with grain there is a very valuable byproduct, DDG, which the alcohol producer also has to market. In fact, producers in states where the tax exemption is not so large may make more money off of their DDG than they do from their alcohol operation. But in Louisiana the local market for DDG is thin and would have to be developed or the DDG shipped to market in other localities. The economics at the time of this writing present an even more compelling economic case for these producers to develop the ability to use Louisiana corn in addition to the fact that there simply will not be enough molasses to go around in 1987 and later years. Most of the molasses based producers plan to be able to use grain in 1987.

Two acreage levels are calculated for each of Louisiana's crops. The higher level, enough acreage to produce 100 million gallons of ethanol, represents the case where roughly 50 percent of the state's gasoline market would be supplied by gasohol. When the plants that are currently under construction are completed in 1987, the alcohol capacity to supply 75 to 80 percent of Louisiana's gasoline demand will be in place. The lower figure, enough acreage to produce 56 million gallons of ethanol, is roughly the total capacity of the corn based fuel alcohol plant under construction at Myrtle Grove.

## Rice

Rice was Louisiana's largest grain crop in terms of acreage in 1985. Acres harvested were down 12 percent from the previous year while posting a record yield. The 1985 season average price is not available yet. The normal wait for rice and sugarcane figures is one calendar year. The net raw material cost for ethanol produced from rice is \$1.69 per gallon based on 1984 prices. Rice therefore is the most expensive fuel alcohol feedstock among the major crops grown in Louisiana.

Two acreage levels are calculated for each of Louisiana's grain crops. The higher level, enough acreage to produce 100 million gallons of ethanol represents the case where roughly 50 percent of the state's gasoline market would be supplied by gasohol. When the plants that are currently under construction are completed in 1987, the alcohol capacity to supply 75 to 80 percent of Louisiana's gasoline demand will be in place. The lower figure, enough acreage to produce 40 million gallons of ethanol, is roughly the total capacity of the state's fuel alcohol industry at the beginning of 1986.

**TABLE VIII**  
**Acreage Calculation - Rice**

<p><b>Acres for 100 million gallons of ethanol per year</b> Acres = <math>100 \times 10^6 \text{ gal ethanol} \times \text{ton}/80 \text{ gal.} \times 20 \text{ cwt/ton} \times \text{acre}/43.70 \text{ cwt}</math> = <b>570,000 acres of rice</b></p> <p><b>Acres for 40 million gallons of ethanol per year</b> Acres = <math>570,000 \times 0.4</math> = <b>250,000 acres of rice</b></p>
--

## Wheat

Wheat is a substantial grain crop in Louisiana with an acreage virtually equal to that of corn in 1985. The price of wheat is higher than for corn or milo and the yield per acre much lower, as can be seen in Table III. Wheat production in 1985 was down 46 percent from the 1984 level. The acreage harvested was down 34 percent and the yield 17 percent for the same period. The 1985 net raw material cost for ethanol produced from wheat was \$0.80 which is higher than that for milo or corn but lower than that for sugarcane molasses.

Two acreage levels are calculated for each of Louisiana's grain crops. The higher level, enough acreage to produce 100 million gallons of ethanol, represents the case where roughly 50 percent of the state's gasoline market would be supplied by gasohol. When the plants that are currently under construction are completed in 1987, the alcohol capacity to supply 75 to 80 percent of Louisiana's gasoline demand will be in place. The lower figure, enough acreage to produce 40 million gallons of ethanol, is roughly the total capacity of the state's fuel alcohol industry at the beginning of 1986.

**TABLE IX**  
**Acres Calculation - Wheat**

**For 100 million gallons of ethanol per year**  
Acres =  $100 \times 10^6$  gal ethanol/gal.  $\times$  0.38 bu  $\times$  acre/41 bu wheat  
= **930,000 acres of wheat**

**For 40 million gallons of ethanol per year**  
Acres = 930,000  $\times$  0.4  
= **370,000 acres of wheat**

### **Sweet Sorghum**

For years there has been a great deal of interest in the prospects of growing sweet sorghum for fuel alcohol. This is especially the case now as the sugarcane molasses crop was essentially sold out in 1986 and will be oversold when the home grown exemption requirement rises to 100 percent unless enough molasses based plants install grain fermentation equipment to alleviate the situation. Year in and year out Louisiana produces enough molasses to make roughly 14.4 million gallons of anhydrous alcohol. The molasses-based plants in operation at the beginning of 1986 had a combined capacity of 34 to 36 million gallons of ethanol. The state's home grown requirement in early 1986 was 35 percent which works out to require 11.9 to 12.6 million gallons of ethanol be produced from Louisiana molasses if all of the capacity is to be eligible for the state's tax exemption. In late 1986 the home grown requirement rises to 100 percent while the sugarcane molasses supply remains the same. If the current molasses based plants wish to be eligible for the tax exemption in 1986, they must find an additional source of feedstock such as sorghum syrup, or they must install the equipment necessary to use grain such as corn or milo. This is one of the reasons there has been so much work going on to evaluate sorghum. In addition, there is under construction in New Iberia a molasses-to-ethanol plant which will produce 35 million gallons per year of ethanol. At least one large plant currently in production is planning to install grain handling facilities by the middle of 1986 which will ease the supply situation somewhat. But there still will not be enough Louisiana sugarcane molasses for all those who wish to use it, thus the interest in sorghum.

Another consideration is that virtually all sugar producing Caribbean Basin countries are joining Louisiana producers in producing ethanol for the U.S. market through the Caribbean Basin Initiative. This is further restricting molasses supplies and bidding its price up.

Sweet sorghum is grown on a small scale for syrup and silage. Research with sweet sorghum for sugar production which would be processed in August and September prior to the maturing of sugarcane has been conducted in Louisiana for over 100 years. Production of sugar has never been successful for several reasons. The high starch and

aconitic acid content in the juice prevent the sugar from crystallizing out. This should not present a problem in fuel alcohol processing as the sugars would be fermented directly from the juice or molasses. In fact, the amount of molasses produced per acre would be several times greater for sorghum than for sugarcane as no sugar is removed in the sorghum case.

In 1983, 250 acres of sweet sorghum was planted in Breaux Bridge, Louisiana to establish the feasibility of using this crop to produce ethanol. Much was learned from this large scale field trial as well as other smaller ones conducted by LSU since 1979. This work has been aimed directly at establishing the feasibility of producing alcohol from sorghum molasses. Unfortunately, the most recent analysis (**1986 Budget**) prepared by Drs. Heagler and Fontenot indicate that sorghum molasses feedstock under the yields that can be expected will be too expensive for fuel alcohol production. At Breaux Bridge the growers and processors experienced numerous problems in growing, harvesting, and processing of the sorghum. Both the agricultural and processing problems for this crop, especially those for which no simple solution seems forthcoming, are discussed below from a paper by Dr. Giamalva of the LSU Sugar Station.

The price arrived at by Drs. Heagler and Fontenot in their **1986 Budget** for farmers to make a profit at the yields that may be expected was 15 cents per pound of fermentable sugar. Dr. Ray Ricaud of the LSU Agricultural Experiment Station arrived at the same figure elsewhere. This translates to a raw material cost alone for ethanol of \$1.95 a gallon or more. The 1986 selling price for fuel alcohol was \$0.74 per gallon.

Sugar mills in Louisiana process sugarcane into raw sugar and molasses beginning in October each year continuing into December. In the Louisiana sugar belt, sweet sorghum matures in late August through September. The sugarcane factories are very interested in having an additional crop during the 9 to 10 months they normally remain idle. Farmers of the sugarcane growing area of Louisiana are looking for additional alternative crops to be grown in their area. Interest has been shown as far north as Meeker in replacing some soybean acreage or using sorghum as a companion crop to sugarcane, in some fallow land, or cropping on land not committed to sugarcane. A regular grain drill was used at Breaux Bridge for planting using grain sorghum plates. This resulted in over planting which reduces stalk size and juice quality. The problem was corrected at LSU by hand thinning but the cost in commercial situations would be prohibitive.

Difficulties in harvesting were encountered when using the conventional soldier type of Louisiana sugarcane harvester. This type harvester removed most of the tops and none of the leaves. The newer, two row Louisiana harvester was the most efficient machine, especially when lodging occurred. When cut at the maximum height (8 feet) with either type machine, the difficulty was in loading. The tractor, drawing the wagon being loaded, rolled over the tops or bottoms of the cane stalk resulting in too many whole stalks being left in the field. Some sorghum was cut with a combine type harvester, which cut the stalks into 11 inch pieces. With this type of machine, special wagons fabricated from expanded steel are required and losses were too high in the mill yard because existing

equipment failed to pick up many pieces. Harvesting with the combine harvester was much slower than with the soldier type machine.

Because of the leaves left on the canes, washing did not remove the sand and silt on the cane. This resulted in excessive wear on the rollers. These leaves also decreased the bulk density of the material being ground so that choking occurred by flooding the rolls with shredded material. To rectify this problem, preparation of the cane prior to entering the mill train was reduced, grinding speed was reduced and pressure on the mill rows reduced. Most cane was harvested and processed immediately. Some as left on the ground in heaps for as long as 52 hours was burned. At this time a mill breakdown occurred, resulting in another 24 hour delay. For this cane only 20 gal. of molasses was produced from each ton of cane.

**TABLE X**  
**Acreage Calculation - Sweet Sorghum**

Assume 20 tons of sorghum per acre ( a very good yield)  
Fermentable sugars = 134.46 lbs per ton of cane (Breaux Bridge field test)  
1 gal. ethanol = 13 lbs. sugar

**For 100 million gallons of ethanol per year**

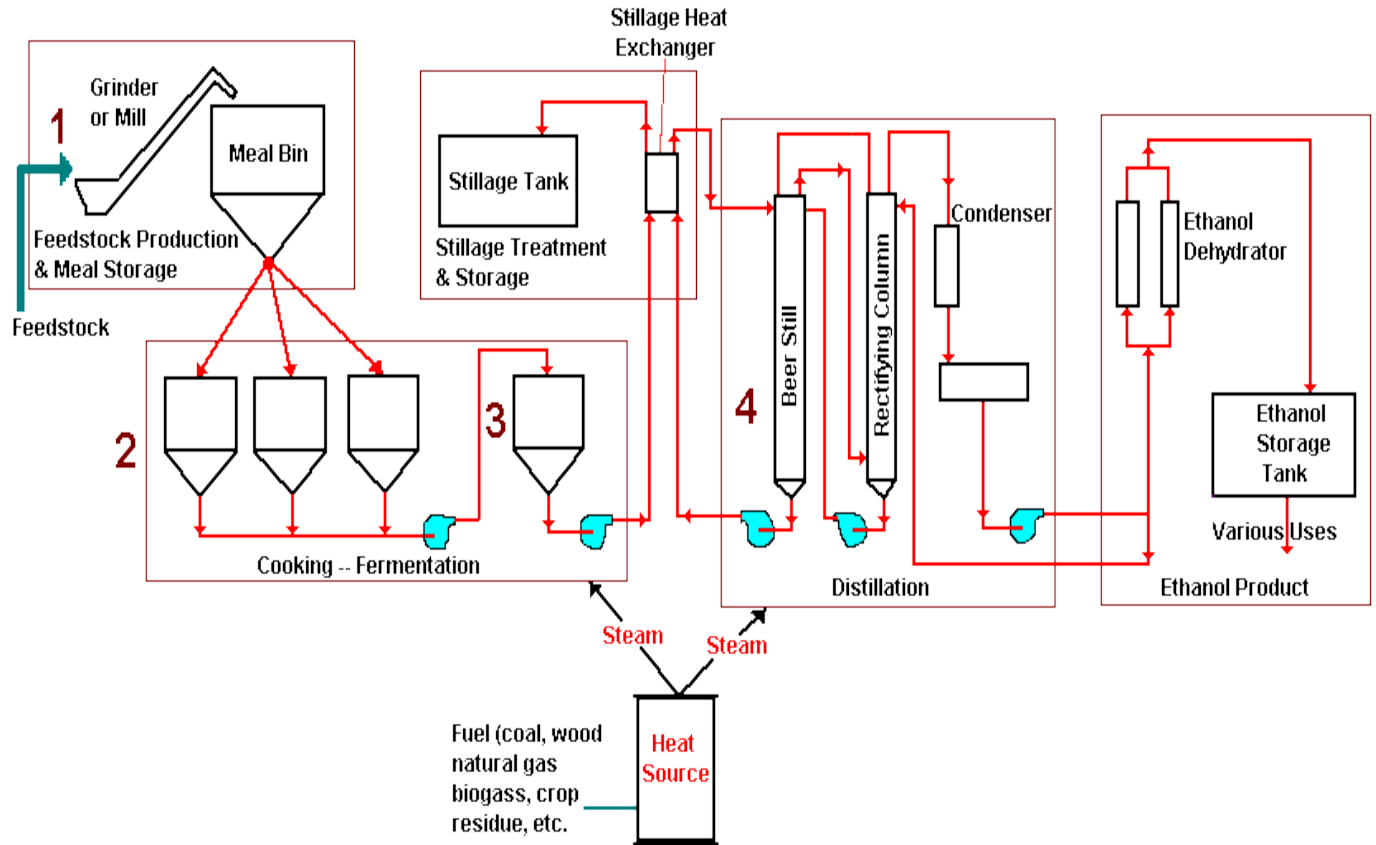
Acres =  $100 \times 10^6 \text{ gal ethanol} \times 13 \text{ lb. sugar/gal ethanol} \times \text{ton of cane}/134.46 \text{ lb. sugar} \times \text{acre}/20$   
tons of cane  
= **483,000 acres**

**For 35 million gallon of ethanol per year**

Acres = 483,000 acres x 0.35  
= **169,000 acres**

**Basic Ethanol Production**

The following quick review of the chemical manufacturing processes involved in alcohol production is excerpted from Chapter 3 of *Fuel from Farms*, which is available from the National Technical Information Service. Corn is used as the feedstock example. While molasses is currently the predominate ethanol feedstock in Louisiana, corn and milo are expected to dominate any expansion.



Basically, fermentation is a process in which microorganisms such as yeasts convert simple sugars to ethanol and carbon dioxide. Some plants directly yield simple sugars; others produce starch or cellulose that must be converted to sugar. The sugar obtained must be fermented, and the resulting "beer" must then be distilled to obtain fuel grade ethanol.

### 1. Feedstock preparation

Feedstocks can be selected from among many plants that either produce simple sugars directly (sugarcane, sweet sorghum) or produce starch (corn, grain sorghum). Feedstock preparation will vary with the feedstock, but some features are universal:

- sugarcane or sorghum must be crushed to extract their simple sugars.
- Starchy and cellulosic materials must be physically broken down by milling or grinding to break starch walls so that the material is available to water. Later steps break down the individual cell walls of the starch.
- Cooking

Starches are converted to sugars in two stages, liquefaction and saccharification, by adding water, enzymes, and heat (enzymatic hydrolysis). The choice of enzymes will determine the supervision the cooking stage will require. (Detailed information on suitable temperature, pressure, and pH for a particular enzyme appears on the manufacture's label.)

**Liquefaction**, or the breakdown of starch to complex sugars, requires:

- thoroughly mixing prepared feedstock with water;
- adjusting pH of the mixture to a level suitable for the enzyme being used;
- thoroughly mixing in the appropriate proportions of liquefaction enzyme (alpha-amylase) for the quantity of starch to be converted; and
- heating the grain mash. This breaks the cell walls of the starch. The free starch will gelatinize as the temperature increases, forming a thick mash. As the mash reaches the enzyme's optimum temperature, the enzyme chemically breaks down the starch to complex sugars (dextrins). When this liquefaction stage is complete, the mash appears soupy, as it did before gelatinization.

**Saccharification**, or the breakdown of complex sugars to simple sugars involves:

- cooling the mash to the optimum temperature for the saccharifying enzyme;
- adjusting the pH of the mash to the level required by the enzyme;
- mixing the appropriate proportions of saccharifying enzyme (glucoamylase) needed to convert the available sugar; and
- holding the pH and temperature (122 - 140°F) in the optimum range and stirring constantly until saccharification is complete, which is determined by testing for sugar content.

## 2. Fermentation

At this point the starch has been broken down to the simple sugar glucose and is now in a form which microorganisms called yeasts can feed on. Yeasts, in metabolizing glucose, produce ethanol and carbon dioxide. As with the enzymes, yeasts have an optimum temperature range.

- The mash is transferred to the fermentation tank and cooled to the optimum temperature (around 80 - 90°F). Care has to be taken to assure that no infection (other organisms that compete with the yeast for the glucose) occurs.
- The appropriate proportion of yeast is added.
- The yeast will begin producing alcohol and should turn the mash into a "beer of 8-12 percent alcohol and then become inactive as the alcohol content becomes too high". The mash is now ready for distillation. Separating the liquid beer from the solids of the mash stillage at this stage will help prevent possible clogging problems during distillation.

## 3. Distillation

Distillation separates the ethanol from the beer, which is mostly water and ethanol. (in some alcohol plants, distillation takes place in one, very tall column; the process



diagrammed above uses two separate columns, a stripper column and a rectifying column).

Ethanol boils at 172°F ( at sea level), while water boils at 212°F. By heating the beer to 172°F, the ethanol can be boiled off and the vapor captured and condensed to produce 192-proof (96 percent) ethanol concentration producible by conventional distillation. 200-proof (anhydrous) alcohol (which is required for blending gasohol) can be obtained through additional dehydration steps. Lower-grade ethanol (170-190 proof) can be used by itself in vehicles modified for alcohol use.

Source:

*Fuel from Farms - A Guide to Small Scale Ethanol Production*, Solar Energy Research Institute (SERI), 1617 Cole Boulevard, Golden, CO 80401.

**TABLE XI  
BRIEF ENERGY BALANCE FOR TYPICAL  
GRAIN FUEL ALCOHOL PLANT**

<b>PROCESS STEAM AND ELECTRICAL POWER BREAKDOWN</b>		
<b>IDENTIFICATION</b>	<b>PROCESS STEAM</b>	<b>ELECTRICAL</b>
* Receiving, Storage, & Milling	0.0%	6.1%
* Mash Cooking & Saccharification	30.5%	2.6%
* Fungal Amylase Production	0.7%	20.4%
* Fermentation	0.2%	4.0%
* Distillation	58.5%	1.6%
* DDG Recovery	6.4%	27.1%
* Storage & Denaturing	0.0%	0.7%
* Utilities	2.7%	27.0%
* Buildings	1.0%	0.5%
<b>Totals</b>	<b>100%</b>	<b>100%</b>

Total fuel requirements = 41,700 BTU/gallon of 200 proof ethanol

Total electrical energy requirements = 1.32 KWH/gallon of 200 proof alcohol

Source:

## **Fuel Alcohol Plant Cost Study Cases Grain Based Feedstocks 1986 Dollars**

This chapter presents a summary of a number of fuel ethanol from grain engineering and economic assessments. The cases come from a number of public sources and check with each other surprisingly well for such a wide variety of locations and economic situations. The results are summarized in graphical form in Figure II and in tabular form in Table XIV. These cost analyses have all been updated using 1986 Louisiana corn prices and 1986 distiller's dried grain (DDG) prices. The costs associated with the alcohol plants have been updated to 1986 dollars using the detailed CE plant cost indices published in *Chemical Engineering* magazine. No actual, confidential, or private data are used. The largest number of points are from an August, 1986, U.S. Department of Agriculture (USDA) report *Fuel Ethanol and Agriculture: An Economic Assessment* with actual 1986 corn and DDG prices substituted for 1985 prices. The cost in the USDA report are for corn dry milling plants with ethanol assumed to be the principal product (see the section on corn milling / alcohol plants). The results of two very detailed engineering analyses for large ethanol only plants are also included. Louisiana has two plants of similar size currently under construction.

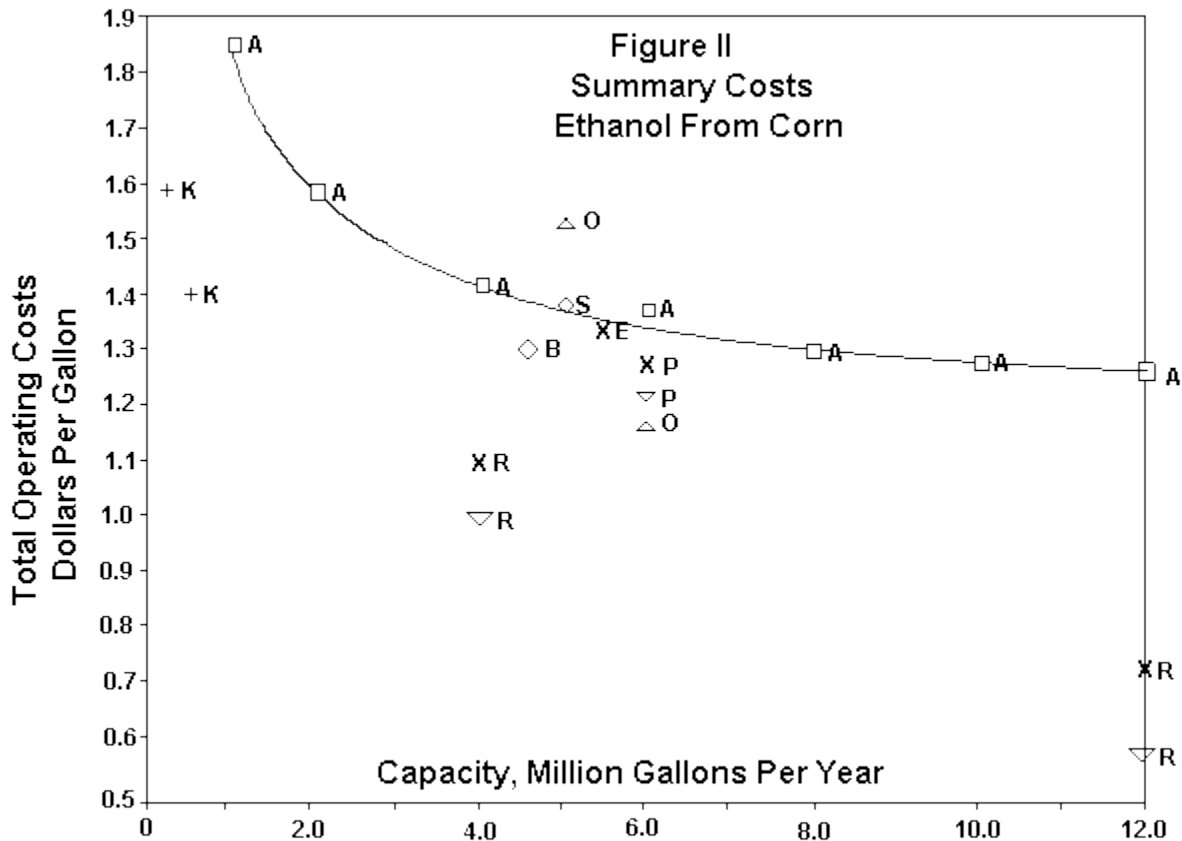
The following are detailed design cases which were carefully updated were a 46-million-gallon-per-year case prepared for Battelle Columbus Laboratories by F.C. Schaffer of Baton Rouge. The 46-and 50-million-gallon per-year plants show alcohol costs which are 6 to 7 percent lower than the USDA plants. This is remarkably close agreement when the variables involved and the different approaches and source of the analyses are considered. The author would expect the alcohol only from corn plants to be somewhat less expensive than a dry-milling alcohol plant. A dry-milling corn processing plant is capable of doing quite a bit more with its feedstock than a plant built only to produce beverage or fuel alcohol from corn (see the section on corn processing from the *McGraw-Hill Encyclopedia of Science and Technology*).

The early fuel alcohol plants in Louisiana were sugarcane molasses-based plants. These are the least expensive fuel alcohol plants of all to build but they operate on a severely limited feedstock. Molasses-based fuel alcohol plants are virtually exclusive to the state of Louisiana in the U.S. and public domain analyses of this type of plant are extremely difficult to find. Historically the Louisiana sugarcane industry has year in and year out produced enough molasses to make 14.4 million gallons of anhydrous ethanol. This has made Louisiana molasses very expensive at times and forced many of the early alcohol plants to install grain-based equipment as there simply was not enough molasses to go around as the percent Louisiana feedstock requirements rose in steps to 100 percent. Most

of the new alcohol capacity and modifications coming on line in the future are grain based, so grain-based plants are what are analyzed in this chapter.

**Figure II**  
**Table XII**  
**Table XIII**  
**U.S. Department of Agriculture**  
**Corn Dry-Milling Plants**  
**Plant Operating Costs**

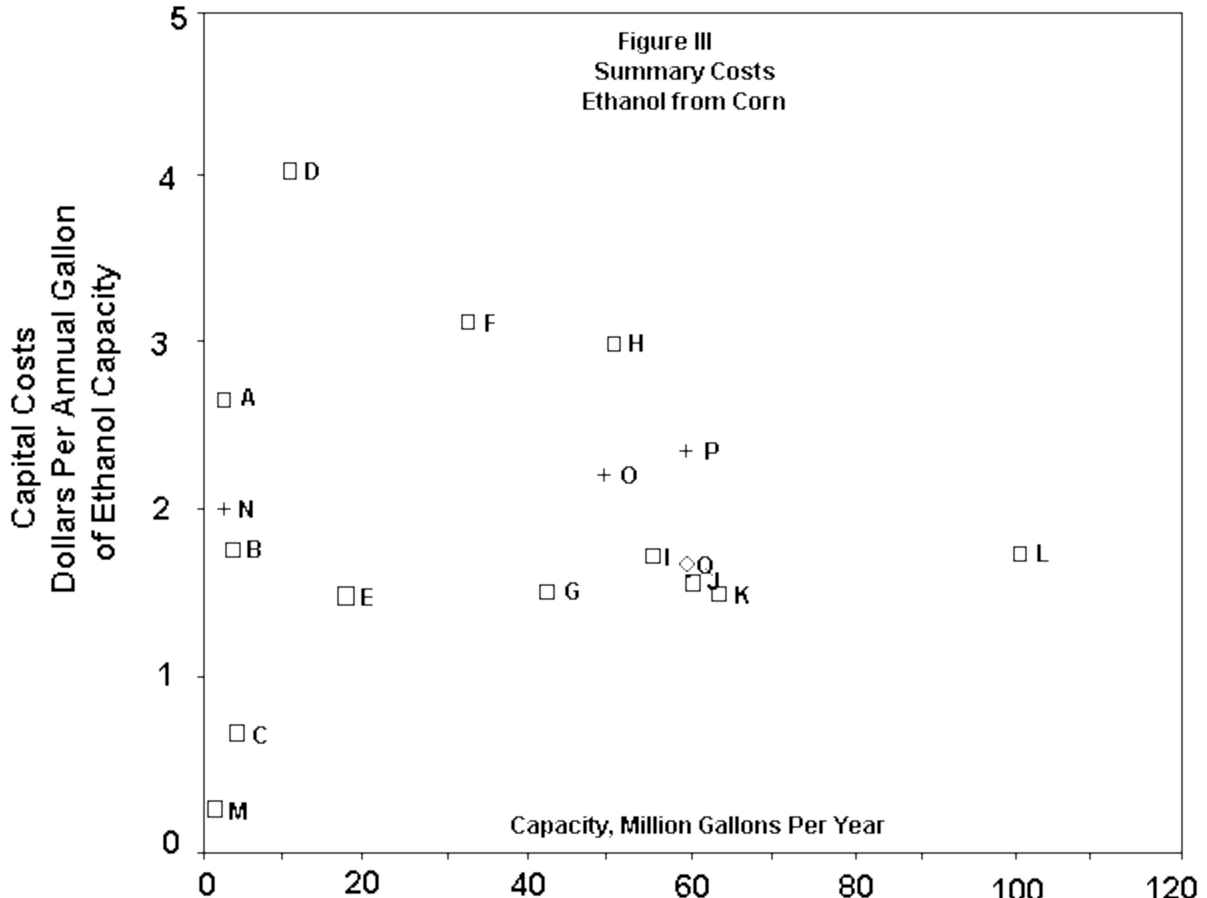
These cases were taken from *Fuel Ethanol and Agriculture: An Economic Assessment* by the U.S. Department of Agriculture (USDA). Table XII is Table 9 from the report and Table XIII substitutes the 1986 Louisiana corn feedstock prices and 1986 distillers dried grain (DDG) prices. Table XIII values are those plotted in Figure II to give consistent 1986 Louisiana based values. The USDA figures are for actual dry-milling grain plants operating mostly in the midwestern corn belt. The ROI used by USDA is 15%. These 1985 analyses are the most up to date of all the analyses available and are used in this report.



□ A	U.S. Department of Agriculture Costs with 1986 Grain Prices Table XII, Dry Milling
X E	U.S. Department of Energy, South Point Ethanol 60-Million Gallon Per Year Fuel

	<i>Ethanol Plant, Operator's Analysis of An Actual Operating Plant, Septmeber, 1986</i>
◇ B	Batelle Labs/F.C. Schafer, Table XIV, Dry Milling
○ S	- Solar Energy Research Institute/U.S. Department of Energy, Table XVI, Dry Milling
+ K	Kansas Energy Office, Table XVIII, Dry Milling
X P	- <i>Pace Petrochemical Service - 1986 Annual Issue</i> , Dry Milling
▽ P	Ibid., Wet Milling
△ O	<i>Octane Week</i> , July 21, 1986 "Pro Forma Costs," "current corn prices", Dry Milling
△ O	Ibid., "higher (capital) costs ... which plant at a serious competitive disadvantage" <i>Octane Week</i>
X R	Renewable Fuels Association (RFA) <i>Analysis of the USDA Fuel Ethanol Report</i> , Dry Milling
X R	Ibid., Dry Milling
▽ R	Ibid., Wet Milling
▽ R	Ibid., Wet Milling

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□ E	Shepard Oil (initial actual)
□ F	Agrifuels
□ A	Biomass Processors
□ G	Mississippi River Alcohol
□ C	Shreveport Ethanol
□ M	Smithfield Fuels
+ N	St. Joseph Ethanol
□ K	South Point Ethanol (Name plate)
□ I	South Point Ethanol (87% steam factor)
□ J	<i>Pace</i> (Dry Milling)
+ P	<i>Pace</i> (Wet Milling)

◇ Q	<i>Octane Week (Average Cost)</i>
□ H	<i>Octane Week (High Cost)</i>
□ D	<i>Bioenergy Directory (Wet Milling)</i>
+ O	<i>Bioenergy Directory (Wet Milling)</i>
□ L	<i>Bioenergy Directory (Wet Milling)</i>

**TABLE XII**  
**Cost per Gallon of Ethanol, Corn Dry-Milling Plants, 1985**

Cost	Ethanol plant size (million gallons per year)						
	10	20	40	60	80	100	120
	1985 Dollars per gallon						
Energy	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Other Direct	.17	.11	.08	.08	.06	.06	.06
Indirect	.25	.18	.13	.13	.11	.11	.11
Capital Recovery	.71	.58	.49	.45	.42	.40	.38
Feedstock <sup>1</sup>	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Byproduct Credit <sup>2</sup>	-.31	-.31	-.31	-.31	-.31	-.31	-.31
<b>Total</b>	<b>\$2.10</b>	<b>\$1.84</b>	<b>\$1.67</b>	<b>\$1.63</b>	<b>\$1.56</b>	<b>\$1.54</b>	<b>\$1.52</b>

<sup>1</sup>Assumes a corn price of \$2.35 per bushel plus \$0.20 transportation costs and a yield of 2.5 gallons of ethanol per bushel.

<sup>2</sup>Assumes distillers dried grain price of \$92 per ton and 16.8 pounds of distillers dried grain per bushel of corn.

Source:

***FUEL ETHANOL AND AGRICULTURE: AN ECONOMIC ASSESSMENT***, U.S.  
Department of Agriculture

**TABLE XIII**  
**Cost per Gallon of Ethanol, Corn Dry-Milling Plants**  
**Using 1986 Corn and Distiller's Dried Grain Prices**

Cost	Ethanol plant size (million gallons per year)						
	10	20	40	60	80	100	120
	1986 Dollars per gallon						
Energy	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Other Direct	0.17	0.11	0.08	0.08	0.06	0.06	0.06
Indirect	0.25	0.18	0.13	0.13	0.11	0.11	0.11
Capital Recovery	0.71	0.58	0.49	0.45	0.42	0.40	0.38
Feedstock @ \$2.25 Per Bushel	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Byproduct Credit \$132/Ton of DDG	-0.44	-0.44	-0.44	-0.44	-0.44	-0.44	-0.44
<b>Total</b>	<b>\$1.85</b>	<b>\$1.59</b>	<b>\$1.42</b>	<b>\$1.38</b>	<b>\$1.31</b>	<b>\$1.29</b>	<b>\$1.27</b>

**TABLE XIII - A (Addendum)**  
**Capacity, Capital Cost, and Dollars per Annual**  
**Gallon of Fuel Alcohol Plants in Louisiana**

CURRENT PLANTS (06/03/85)	FEEDSTOCK	CAPACITY gal Ethanol/ Year MM=Million	CAPITAL COSTS M=Thousand MM=Million	DOLLARS/ GALLON of Annual Capacity
Shepard Oil (Jennings)	Molasses	17.0 MM	\$25 MM	\$1.47
Ethanol Producers (Patoutville)	Molasses	3.0 MM	\$350 M (sic)	-
{ Authors note: A total of twelve plants built; none have been started up }	Molasses	{ 1 MM x 12 plants }	{ \$1.75 MM each }	{ \$1 75 }
<b>PLANNED</b>				

<b>PLANTS*</b>				
Agrifuels (New Iberia)	Molasses	32.0 MM	\$100 MM	\$ 3.13
Biomass Processors	Grain	2.0 MM	\$5.3 MM	\$ 2.65
Miss. River Alcohol Company (Myrtle Grove)	Grain	42.0 MM	\$ 64 MM	\$ 1.52
Shreveport Ethanol (Robson)	Grain	4.5 MM {2.0 MM Actual}	\$ 3 MM	\$ 0.67
Smithfield Fuels (Port Allen)	Molasses	1.5 MM	\$300 M**	\$ 0.20**
St. Joseph Ethanol (St. Joseph)	Grain	3.0 MM	\$6.0 MM	\$ 2.00
** This plant was proposed to be mostly used equipment from Colorado as per Mr. Tony Ball 4/18/85 in testimony to the Legislature. They were also in the market for used equipment from old Louisiana sugar mills.				

\* "Known plants with capacity production ability in 1987."

Source:

Louisiana Legislative Fiscal Office Report, **Gasohol and the Louisiana Economy**,  
06/03/85

**TABLE XIII - B (Addendum)**  
**Capacity, Capital Cost, and Dollars per Annual**  
**Gallon of Fuel Alcohol Plants in the United States**

<b>U.S. PLANTS</b>	<b>FEEDSTOCK (\$2.50/bu on average)</b>	<b>CAPACITY gal Ethanol/Year MM=Million</b>	<b>CAPITAL COSTS MM=Million</b>	<b>DOLLARS/ GALLON of Annual Capacity</b>	<b>COMMENTS</b>
South Point Ethanol South Point, Ohio	Corn	63 MM (Nameplate)  55 MM (87% Stream Factor)	\$ 95.2 MM	\$1.51/gal  \$1.73/gal	Operating analysis of an actual operating plant for DOE September



					1986.
<i>Pace Petrochemical Service - 1986 Annual Issue</i>	Corn	60 MM	\$ 94.0 MM* (Dry Milling)	\$1.57/gal*	August 1986 Analysis
			\$142.0 MM* (Wet Milling)	\$2.37/gal*	
<i>Octane Week, 6/21/86, p.10</i>	Corn	60 MM	\$ 100 MM	\$1.67/gal	
<i>Octane Week, ibid.</i>	Corn	50 MM	\$ 150 MM	\$3.00/gal	"higher cost...which puts plant at a serious competitive disadvantage". <i>Octane Week</i>
<i>International Bio-Energy Directory And Handbook – 1984</i>	Corn	10 MM	\$ 40.4 MM	\$4.04/gal	Wet Milling
	Corn	50 MM	\$111.0 MM	\$2.22/gal	Wet Milling
1982 dollars adjusted to 1986 dollars using "CE Plant Cost Index"; a 0.96% increase.	Corn	100 MM	\$176.7 MM	\$1.77/gal	Wet Milling

\*Note:

The manufacturing cost for the more expensive wet milling plant is actually less than for the dry milling plant. See Figure II.

## APPENDIX I

### SUMMARY OF CURRENT LOUISIANA GASOHOL LEGISLATION AND

# **AGRICULTURAL ETHANOL PRODUCTION LAW RULES AND REGULATIONS**

## **Summary of H.B. 550 1986 Regular Session**

This bill repeals the exemption from the gasoline tax and from the special fuels tax for gasohol.

This repeal took effect on or about August 26, 1986, at which taxes on gasohol begin to be collected and are transferred to the Agricultural Industrial Incentive Fund.

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## **Summary of Act 917 1985**

### **Agricultural Ethanol Production Law**

This act establishes an incentive program for certain producers of ethanol, to create the Agricultural Industry Board and provides for the appointment for the members, their terms of office, and their duties and authority, and provides for the creation of the Agricultural Incentive Fund. The purpose of this act is to:

- (1) Encourage participation of the private sector in the development of a production system for alcohol fuels within the state of Louisiana.
- (2) Promote the use of renewable energy in the state of Louisiana and the United States.
- (3) Provide a clean, efficient, and renewable source of energy.
- (4) Continue Louisiana's role as a major producer of energy for the nation.
- (5) Encourage the utilization of sugarcane, sorghum, milo, corn, and other agricultural products and byproducts for energy purposes and thereby encourage the establishment of a substantial market for agricultural products in Louisiana.
- (6) Attract new industry into Louisiana and thereby encourage the investment of capital in Louisiana.
- (7) Create a significant number of new jobs in the state of Louisiana.
- (8) Reduce the independence of the United States and the state of Louisiana on imported petroleum and imported natural gas by all economically and environmentally feasible means through the use of biomass and/or alternate energy sources in furtherance of the goals of the United States Biomass Energy and Alcohol Fuels Act of 1980.

The Agricultural Industry Board is created within the Department of Agricultural, composed of the Commissioner of Agriculture; six members to be appointed by the Governor, as follows: one member appointed from a list of three persons nominated by the Commissioner of Agriculture, two members appointed from a list of six persons nominated by the Louisiana Farm Bureau Federation, and three members appointed from the state at large, one of whom shall be actively engaged in farming; one member of the Senate appointed by the President of the Senate; and one member of the House of Representatives appointed by the Speaker of the House of Representatives.

The Agricultural Industrial Incentive Fund is established to receive taxes collected on gasohol and to make incentive payments to certified market participants (manufacturers of ethyl alcohol from Louisiana farm commodities). The amount of the incentive shall be an amount equal to the number of gallons of ethanol sold for use in gasohol during the previous month by the certified market participant, multiplied by an amount derived as follows:

- (1) For fiscal years 1985 and 1986, the product of sixteen cents times the gasohol multiplier.
- (2) For fiscal years 1987 and 1988, the product of fourteen cents times the gasohol multiplier.
- (3) For the calendar year beginning January 1, 1989 and thereafter, the product of twelve cents times the gasohol multiplier.

The Board shall adopt rules and regulations necessary to implement the provisions of the this law. All rules and regulations shall be adopted in accordance with the Administrative Procedure Act. Such rules shall include the form of any written agreements to be entered into between the certified market participant and the state of Louisiana through the Board.

In approving certified market participants, the Board shall apply the following criteria in considering the application:

- (1) The facility to produce ethanol shall be located in the state of Louisiana.
- (2) The facility shall be owned or leased and shall be constructed or converted and operated for the purpose of producing ethanol as its primary product from agricultural products.
- (3) The entire production, fermentation, and distillation process shall occur in the state of Louisiana and shall be in accordance with the terms and conditions set forth in the written agreement between the board and the certified market participant.
- (4) The ethanol shall be produced and sold for use in gasohol.
- (5) Any additional criteria the Board may establish by rules and regulations consistent with the provisions of this law.

**Emergency Rules**  
**Declaration Of Emergency**  
**Department of Agriculture and Forestry**  
**Office of Management and Finance**  
**Agricultural Industry Board**

In accordance with the emergency provisions of the Administrative Procedure Act (R.S. 49:953(B)) and R.S. 3:3704, the Department of Agriculture and Forestry, Agricultural Industry Board, has adopted the emergency rules detailed below. The board has

designated five Certified Market Participants, approved the Certified Market Participant contract form and authorized the commissioner of agriculture and forestry to execute contracts for participation in the ethanol program. In order to make certain that those contracting with the state of Louisiana, sell their ethanol for use in gasohol to be sold in Louisiana and that all taxes are paid and transferred into the Agriculture Incentive Fund, it is necessary prior to the execution of the participation contracts to expend and clarify the regulations with respect to the requirement that the gasohol sales occur in Louisiana, that all taxes on sales are paid and reported and that the proper documentation for these sales and taxes be submitted to the board so that it may assure compliance with the requirements of the Act and regulations.

Amend LR 7: XXXVI.17703 to include a definition for "sold for use in gasohol":  
§17703. Definitions

In addition to definitions listed below and unless otherwise provided, the definitions in R.S. 3:3703 shall apply to these regulations.

*Act* means the Agricultural Ethanol Production Law.

*Adjudicatory proceeding* means an open public hearing by the board to determine whether violations of the Act or these regulations have occurred. Such proceedings are conducted in accordance with the Louisiana Administrative Procedure Act (R.S.49:950, et seq.).

*Agency contract* means a contract between a certified market participant and an intermediary, such as a grain dealer or warehouseman, who purchases or stores agricultural commodities or products for use in ethanol.

*Agricultural commodities* or products means crops and products made from processing crops. Commodities or products shall include sugar cane, grains (rice, rough rice, corn, wheat, oats, rye, soybeans, barley, milo and grain sorghum), sweet potatoes and sugar beets. Products shall include syrup and molasses. Any other agricultural commodity or product capable of producing ethanol may be declared to be an agricultural product or commodity by the board.

*Applicant* means a person who applies for designation as a certified market participant.

*Authorized agent* means any representative of a certified market participant whose name has been filed with the board is empowered by the certified market participant and the board to act for or on behalf of a certified market participant.

*Blender* means any person who purchases and mixes ethanol and gasoline for sale as gasohol and who files the required reports with the Louisiana Department of Revenue and Taxation.

*Board* means the Agricultural Industry Board established by R.S. 3:3704.

*Capital costs* means all expenditures made for the acquisition of land, equipment, buildings, engineering, construction interests and other expenses necessary to build an ethanol facility.

*Central registry* means the public filing and listing of security devices encumbering agricultural crops, commodities or products maintained by the commissioner.

*Certified market participant* means an applicant approved by the board to participate in a cooperative endeavor authorized under this Chapter.

*Certified market participant confidential business plan* is a confidential financial document or series of documents presented by an applicant or certified market participant periodically with the board, containing proposed agency and producer contracts and all other confidential and financial audit information.

*Certified market participant contract* means a contract or cooperative endeavor between the board and a certified market participant relating to the production of ethanol.

*Commissioner* means the Louisiana Commissioner of Agriculture and Forestry or his duly authorized representative.

*Controlling interest* means ownership by an individual or his spouse, either individually or collectively, of an interest in a person or entity which exceeds 25 percent of any legal entity.

*Cooperative endeavor* means a contractual relationship between the State of Louisiana through the board with a person for a public purpose.

*Ethanol* means an ethyl alcohol which meets all of the following conditions in that it:

1. has a purity of at least 99 percent, determined without regard to any added denaturants;
2. has been denatured in conformity with one of the approved methods set forth by the United States Bureau of Alcohol, Tobacco and Firearms;
3. has been derived from agricultural commodities or products; and
4. has been produced in the state of Louisiana wholly from fermentation and distillation in the state of Louisiana.

*Ethanol facility* means a facility:

1. which is located in Louisiana;
2. owned or leased and shall be permanently constructed or converted and operated for the purpose of producing ethanol as its primary product from agricultural commodities or products;
3. whose entire production, fermentation and distillation shall occur in Louisiana; and
4. whose ethanol shall be produced and sold for use in gasohol in Louisiana.

*First point of sale* means: (1) the initial time when title to agricultural commodities or products passes from a seller to a buyer; or (2) the time when agricultural commodities or products are removed from storage.

*Fund* means the Agricultural Industry Incentive Fund established by R.S. 3:3706.

*Gasohol* means a fuel that contains not more than 90 percent gasoline and at least 10 percent ethanol.

*Gasohol multiplier* means the number 10, which reflects the fact that 10 gallons of gasohol contains at least one gallon of ethanol.

*Grain dealer* means any person who purchases agricultural commodities or products from producers, sells agricultural commodities for producers or represents producers in the purchase or sale of agricultural commodities. The term does not include producers who purchase grain commodities for their own use as feed or seed.

*Intermediary* means any person who purchases or stores agriculture commodities to be used to produce ethanol by a certified market participant. Grain dealers, warehousemen and warehouse operators are intermediaries.

*Licensee* means any person holding a license as a warehouse or grain dealer issued by the Louisiana Agricultural Commodities Commission.

*Person* means any individual, partnership, association, corporation or other legal entity.

*Principal managers* means the individuals or persons responsible for the daily operation of an ethanol facility.

*Principal office* means the location where the records of the certified market participant will be maintained in the state of Louisiana.

*Principal stockholders or owners* means any individual who owns directly or indirectly 10 percent of an ethanol facility operated by a certified market participant.

*Producer* means a farmer, individual or person that engages in the production of agricultural commodities or products.

*Producer contract* means a two or three party contract between and among an agriculture producer, certified market participant and intermediaries. such as a grain dealer or a warehouseman.

*Production records* means written evidence of the ethanol produced daily by a certified market participant.

*Rules or regulations* means the rules or regulations adopted by the Agricultural Industry Board under the authority granted by the Act.

*Security device* means any assignment, pawn, pledge, mortgage, privilege, lien or other device by which an interest in agricultural commodities or products is encumbered, either legally or conventionally, to secure the fulfillment of any obligation.

*Scale ticket* means the document issued to a producer when agricultural commodities or products are delivered to intermediaries such as a warehouse or grain dealer.

*Settlement sheets* means documents which reconcile contacts shipping tickets, charges, deductions and payments to determine the value and quantity of agriculture commodities or products received by the certified market participant.

*Shipping documents* means the written evidence of ethanol produced and shipped by a certified market participant.

*Sold for use in gasohol* means that ethanol will be blended with gasoline and Louisiana taxes are paid on the sale of gasohol in Louisiana. This intent is evidenced by any document of gasohol sales as reported to the Louisiana Department of Revenue and Taxation on its monthly Motor Fuels Report.

*Spot or spot sale* means a transaction where title to agricultural commodities or products passes from the producer to the buyer on the day of delivery, in which transaction the producer is paid promptly at the market price established on the day of delivery.

*Storage* means the physical possession by a warehouse, in any manner and/or under any type of fee arrangement, of agricultural commodities or products belonging to any person other than the owner of the warehouse. The term *storage* does not apply to a transaction in which title passes from the seller to the buyer upon delivery.

*Taxes imposed on gasohol* means any state tax levied on gasohol and includes any tax levied on gasohol under the provisions of R.S. 47:711, R.S. 47:802, R.S. 47:302(A), R.S. 47:321(A), and R.S. 47:331(A).

*Under substantial construction* means the certified market participant has entered into binding contracts for capital costs, including contracts for the purchase of land, engineering, capital construction and all other project costs, the total of which shall be not less than 25 percent of the project costs.

*Warehouse* means any building, structure or any other protected enclosure in which agricultural commodities or products or farm products are stored for the public for a fee. The term includes facilities which commingle commodities, facilities which preserve the identity of separate lots of agricultural commodities or products and facilities which dry and/or condition agricultural commodities or products belonging to any person other than the facility owner.

*Warehouseman or warehouse operator* means any person or entity operating a warehouse.

AUTHORITY NOTE: Promulgated in accordance with R.S. 3:3703 and R.S. 3:3704. Amend LAC 7:XXXVI.17711 amending Subsection A 3.b and adding Subsections A.3.e.iv. B.4 and D:

**§17711. Incentive Payments to Certified Market Participants**

A. Incentive Payments Application Procedure

1. A request for incentive payments shall be submitted in writing on the forms approved by the board.

2. The request for incentive payment form shall be a public record in accordance with R.S. 3:3707(E) and shall contain the following information:

a. name, address and phone number of certified market participant:

b. signature of authorized agent:

c. date submitted;

d. month for which payment is requested;

e. number of gallons of ethanol sold for which incentive payment is requested: and

f. certification by authorized agent that the information reported on the form is true, correct and complete.

3. The following information shall be submitted simultaneously with request for incentive payment and such information shall be exempt from R.S. 44:1 et seq. and be considered confidential information:

a. ethanol buyer's name, address and quantity:

b. total number of gallons of ethanol and gasohol sold in Louisiana;

c. copies of shipping and receiving documents; and

d. certification by authorized agent that the information reported is true, correct and complete, and

e. an affidavit in authentic form provided by the commissioner and executed by the blender attesting to the following:

i. the blender has purchased from \_\_\_\_\_, the certified market participant, \_\_\_\_\_ gallons of ethanol on the \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_, for use in gasohol to be sold in Louisiana;

ii. the blender shall on or before the twentieth day of each month file with the Louisiana Department of Revenue and Taxation report(s) or document(s) or pay monies as may be appropriate relative to taxes imposed on gasohol: and

iii. the blender shall mail to the certified market participant at its principal office and to the commissioner certified true copies of report(s) or document(s) filed or monies paid by the blender with the Louisiana Department of Revenue and Taxation.

iv. the blender shall attach as a schedule to his affidavit and mail to the commissioner a copy of a first-in, first-out perpetual inventory report showing each certified market participant's beginning inventory balance, shipments of ethanol received from said certified market participant during the month, sales of ethanol for said certified market participant that month and ending certified market participant's ethanol inventory. A copy of this schedule will also be sent to the certified market participant.



4. The incentive payments shall be made only to certified market participants who have contracts approved by the board.

**B. Procedures for Payment to Certified Market Participants**

1. Certified market participants must submit a written request for payment which shall be reviewed and approved as to form and completeness by the commissioner or his designee.

2. Within five working days of the fifth day of each month, the Commissioner shall notify each certified market participant of his approval as to form and completeness of application for the month's incentive payment. This approval shall be evidenced by a certificate or certificates, the Agricultural Industry Board Incentive Payment Certificate, in the form approved by the board, signed by the commissioner stating the payment application has been approved as to form and completeness. The commissioner shall on or before the fifth working day following the fifth day of each month issue to certified market participant their specific Agricultural Industry Board Incentive Payment Certificate. The certified market participant may, with board approval, assign those certificates to a producer, intermediary, blender, financial institution or other person.

3. The commissioner is authorized on behalf of the board to take all necessary steps to make payments to certified market participants from the Agricultural Industry Incentive Fund.

4. Each incentive payment made from the fund shall be applied first to the oldest outstanding certificate issued to the certified market participant until all certificates issued to the certified market participant shall be paid.

**C. Procedures For Adjustments In Incentive Payments Due To Overpayment**

In the event the request for incentive payment is inaccurate or erroneous, the commissioner shall notify the certified market participant and if the certified market participant agrees that an error has been made then the commissioner is authorized to deduct from any future incentive payment requested an amount sufficient to correct any error in payment plus legal interest. If the commissioner and the certified market participant do not agree, then the commissioner shall call an adjudicatory hearing before the board to consider the matter.

**D. Procedure for Other Adjustment of Incentive Payments**

If on a monthly basis the money in the fund is not sufficient to satisfy all outstanding obligations for incentive payments, the payments shall be divided proportionately among the certified market participants in accordance with the following formula: the payment received by each certified market participant shall be in the same proportion to the total funds available for incentive payments as the number of gallons of ethanol produced and sold by the certified market participant for use in gasohol sold in Louisiana bears to the total number of gallons of ethanol produced and sold by all the certified market participants for use in gasohol sold in Louisiana.

AUTHORITY NOTE: Promulgated in accordance with R.S. 3:3707, R.S. 3:3705 and R.S. 3:3704.

Bob Odom  
Commissioner

**Amend LR 7:XXXVI.17703 to include a definition for "sold for use in gasohol":**

**§17703. Definitions**

In addition to definitions listed below and unless otherwise provided, the definitions in R.S. 3:3703 shall apply to these regulations.

*Act* means the Agricultural Ethanol Production Law.

*Adjudicatory proceeding* means an open public hearing by the board to determine whether violations of the act or these regulations have occurred. Such proceedings are conducted in accordance with the Louisiana Administrative Procedure Act (R.S. 49:950, et seq.).

*Agency contract* means a contract between a certified market participant and an intermediary, such as a grain dealer or warehouseman, who purchases or stores agricultural commodities or products for use in ethanol.

*Agricultural commodities or products* means crops and products made from processing crops. Commodities or products shall include sugar cane, grains (rice, rough rice, corn, wheat, oats, rye, soybeans, barley, milo and grain sorghum), sweet potatoes and sugar beets. Products shall include syrup and molasses. Any other agricultural commodity or product capable of producing ethanol may be declared to be an agricultural product or commodity by the board.

*Applicant* means a person who applies for designation as a certified market participant.

*Authorized agent* means any representative of a certified market participant whose name has been filed with the board is empowered by the certified market participant and the board to act for or on behalf of a certified market participant.

*Blender* means any person who purchases and mixes ethanol and gasoline for sale as gasohol and who files the required reports with the Louisiana Department of Revenue and Taxation.

*Board* means the Agricultural Industry Board established by R.S. 3:3704.

*Capital costs* means all expenditures made for the acquisition of land, equipment, buildings, engineering, construction interests and other expenses necessary to build an ethanol facility.

*Central registry* means the public filing and listing of security devices encumbering agricultural crops, commodities or products maintained by the commissioner.

*Certified market participant* means an applicant approved by the board to participate in a cooperative endeavor authorized under this Chapter.

*Certified market participant confidential business plan* is a confidential financial document or series of documents presented by an applicant or certified market participant

periodically with the board, containing proposed agency and producer contracts and all other confidential and financial audit information.

*Certified market participant contract* means a contract or cooperative endeavor between the board and a certified market participant relating to the production of ethanol.

*Commissioner* means the Louisiana Commissioner of Agriculture and Forestry or his duly authorized representative.

*Controlling interest* means ownership by an individual or his spouse, either individually or collectively, of an interest in a person or entity which exceeds 25 percent of any legal entity.

*Cooperative endeavor* means a contractual relationship between the state of Louisiana through the board with a person for a public purpose.

*Ethanol* means an ethyl alcohol which meets all of the following conditions in that it:

1. has a purity of at least 99 percent, determined without regard to any added denaturants;
2. has been denatured in conformity with one of the approved methods set forth by the United States Bureau of Alcohol, Tobacco and Firearms;
3. has been derived from agricultural commodities or products; and
4. has been produced in the state of Louisiana wholly from fermentation and distillation in the state of Louisiana.

*Ethanol facility* means a facility:

1. which is located in Louisiana;
2. owned or leased and shall be permanently constructed or converted and operated for the purpose of producing ethanol as its primary product from agricultural commodities or products;
3. whose entire production, fermentation and distillation shall occur in Louisiana; and
4. whose ethanol shall be produced and sold for use in gasohol in Louisiana.

*First point of sale* means: (1) the initial time when title to agricultural commodities or products passes from a seller to a buyer; or (2) the time when agricultural commodities or products are removed from storage.

*Fund* means the Agricultural Industry Incentive Fund established by R.S.3:3706.

*Gasohol* means a fuel that contains not more than 90 percent gasoline and at least 10 percent ethanol.

*Gasohol multiplier* means the number 10, which reflects the fact that 10 gallons of gasohol contains at least one gallon of ethanol.

*Grain dealer* means any person who purchases agricultural commodities or products from producers, sells agricultural commodities for producers or represents producers in

the purchase or sale of agricultural commodities. The term does not include producers who purchase grain commodities for their own use as feed or seed.

*Intermediary* means any person who purchases or stores agriculture commodities to be used to produce ethanol by a certified market participant. Grain dealers, a warehousemen and warehouse operators are intermediaries.

*Licensee* means any person holding a license as a warehouse or grain dealer issued by the Louisiana Agricultural Commodities Commission.

*Person* means any individual, partnership, association, corporation or other legal entity.

*Principal managers* means the individuals or persons responsible for the daily operation of an ethanol facility.

*Principal office* means the location where the records of the certified market participant will be maintained in the State of Louisiana.

*Principal stockholders or owners* means any individual who owns directly or indirectly 10 percent of an ethanol facility operated by a certified market participant.

*Producer* means a farmer, individual or person that engages in the production of agricultural commodities or products.

*Producer contract* means a two or three party contract between and among an agriculture producer, certified market participant and intermediaries, such as a grain dealer or a warehouseman

*Production records* means written evidence of the ethanol produced daily by a certified market participant.

*Rules or regulations* means the rules or regulations adopted by the Agricultural Industry Board under the authority granted by the Act.

*Security device* means any assignment, pawn, pledge, mortgage, privilege, lien or other device by which an interest in agricultural commodities or products is encumbered, either legally or conventionally, to secure the fulfillment of any obligation.

*Scale ticket* means the document issued to a producer when agricultural commodities or products are delivered to intermediaries such as a warehouse or grain dealer.

*Settlement sheets* means documents which reconcile contracts, shipping tickets, charges, deductions and payments to determine the value and quantity of agriculture commodities or products received by the certified market participant.

*Shipping documents* means the written evidence of ethanol produced and shipped by a certified market participant.

*Sold for use in gasohol* means that ethanol will be blended with gasoline and Louisiana taxes are paid on the sale of gasohol in Louisiana. This intent is evidenced by any document of gasohol sales as reported to the Louisiana Department of Revenue and Taxation on its Monthly Motor Fuels Report.

*Spot or spot sale* means a transaction where title to agricultural commodities or products passes from the producer to the buyer on the day of delivery, in which transaction the producer is paid promptly at the market price established on the day of delivery.

*Storage* means the physical possession by a warehouse, in any manner and/or under any type of fee arrangement, of agricultural commodities or products belonging to any person other than the owner of the warehouse. The term storage does not apply to a transaction in which title passes from the seller to the buyer upon delivery.

*Taxes imposed on gasohol* means any state tax levied on gasohol and includes any tax levied on gasohol under the provisions of R.S. 47:711, R.S. 47:802, R.S. 47:302(A), R.S. 47:321(A), and R.S. 47:331(A).

*Under substantial construction* means the certified market participant has entered into binding contracts for capital costs, including contracts for the purchase of land, engineering, capital construction and all other project costs, the total of which shall be not less than 25 percent of the project costs.

*Warehouse* means any building, structure or any other protected enclosure in which agricultural commodities or products or farm products are stored for the public for a fee. The term includes facilities which commingle commodities, facilities which preserve the identity of separate lots of agricultural commodities or products and facilities which dry and/or condition agricultural commodities or products belonging to any person other than the facility owner.

*Warehouseman or Warehouse operator* means any person or entity operating a warehouse.

AUTHORITY NOTE: Promulgated in accordance with R.S. 3:3703 and R.S. 3:3704.

**Amend LAC 7:XXXVI.17711 amending Subsections A.3.b and A.3.e.iii and adding Subsections A.3.e.iv. B.4 and D:**

**§17711. Incentive Payments to Certified Market Participants**

**A. Incentive Payments Application Procedure**

1. A request for incentive payments shall be submitted in writing on the forms approved by the board.
2. The request for incentive payment form shall be a public record in accordance with R.S. 3:707(E) and shall contain the following information:
  - a. name, address and phone number of certified market participant;
  - b. signature of authorized agent;

- c. date submitted:
  - d. month for which payment is requested:
  - e. number of gallons of ethanol sold for which incentive payment is requested, and
  - f. certification by authorized agent that the information reported on the form is true, correct and complete.
3. The following information shall be submitted simultaneously with request for incentive payment and such information shall be exempt from R.S. 44:1 et seq. and be considered confidential information:
- a. ethanol buyer's name, address and quantity;
  - b. total number of gallons of ethanol and gasohol sold in Louisiana;
  - c. copies of shipping and receiving documents; and
  - d. certification by authorized agent that the information reported is true, correct and complete: and
  - e. an affidavit in authentic form provided by the commissioner and executed by the blender attesting to the following:
    - i. the blender has purchased from \_\_\_\_\_ the certified market participant, \_\_\_\_\_ gallons of ethanol on the \_\_\_\_\_ day of \_\_\_\_\_ 19\_\_\_\_\_, for use in gasohol to be sold in Louisiana;
    - ii. the blender shall on or before the twentieth day of each month file with the Louisiana Department of Revenue and Taxation report(s) or document(s) or pay monies as may be appropriate relative to taxes imposed on gasohol: and
    - iii. the blender shall attach to his affidavit and mail to the commissioner certified true copies of report(s) or document(s) filed or monies paid by the blender with the Louisiana Department of Revenue and Taxation.
    - iv. the blender shall attach as a schedule to his affidavit and mail to the commissioner a copy of a first-in, first-out perpetual inventory report showing each certified market participant's beginning inventory balance, shipments of ethanol received from said certified market participant during the month, sales of ethanol for said certified market participant that month and ending certified market participant's ethanol inventory. A copy of this schedule will also be sent to the certified market participant.
4. The incentive payments shall be made only to certified market participants who have contracts approved by the board.

#### B. Procedures for Payment to Certified Market Participants

- 1. Certified market participants must submit a written request for payment which shall be reviewed and approved as to form and completeness by the commissioner or his designee.
- 2. Within five working days of the fifth day of each month, the commissioner shall notify each certified market participant of his approval as to form and completeness of application for the month's incentive payment. This approval shall be evidenced by a certificate or certificates, the Agricultural Industry Board Incentive Payment Certificate. in the form approved by the board, signed by the commissioner stating the payment application has been approved as to form and completeness. The commissioner shall on or before the fifth working day following the fifth day of each month issue to certified market participant their specific Agricultural Industry Board Incentive Payment Certificate. The certified market participant may, with board approval, assign those certificates to a producer, intermediary, blender, financial institution or other person.

3. The commissioner is authorized on behalf of the board to take all necessary steps to make payments to certified market participants from the Agricultural Industry Incentive Fund.

4. Each incentive payment made from the fund shall be applied first to the oldest outstanding certificate issued to the certified market participant until all certificates issued to the certified market participant shall be paid.

#### C. Procedures For Adjustments In Incentive Payments Due To Overpayment

In the event the request for incentive payment is inaccurate Or erroneous, the commissioner shall notify the certified market participant and if the certified market participant agrees that an error has been made then the commissioner is authorized to deduct from any future incentive payment requested an amount sufficient to correct any error in payment plus legal interest. If the commissioner and the certified market participant do not agree, then the commissioner shall call an adjudicatory hearing before the board to consider the matter.

#### D. Procedure for Other Adjustment of Incentive Payments

If on a monthly basis the money in the fund is not sufficient to satisfy all outstanding obligations for incentive payments, the payments shall be divided proportionately among the certified market participants in accordance with the following formula: the payment received by each certified market participant shall be in the same proportion to the total funds available for incentive payments as the number of gallons of ethanol produced and sold by the certified market participant for use in gasohol sold in Louisiana bears to the total number of gallons of ethanol produced and sold by all the certified market participants for use in gasohol sold in Louisiana.

AUTHORITY NOTE: Promulgated in accordance with R.S, 3:3704, R.S. 3705 and R.S. 3707.

Bob Odom  
Commissioner

## Appendix II

### Alcohol Fuels Glossary

#### **alcohol -**

a class of chemicals (composed of carbon, hydrogen, and oxygen) which can be burned as fuel. Ethanol and methanol are the two main types being considered for fuel use.

Compare gasohol.

#### **anhydrous -**

containing virtually no water. Anhydrous alcohol (200 proof) can be mixed with gasoline without risk of separation.

#### **biomass -**

any plant material that may be used to produce food, feed, fiber, or energy, including grains, cornstalks and other agricultural residues, fruits and vegetables and their

processing byproducts, and bagasse (residue from processing sugarcane); wood products and residues from logging and paper manufacturing; and aquatic plants. The term is often used to include animal manure.

**Btu -**

a unit of measurement that provides a way to compare the energy available in different fuels or other energy sources. One Btu is the amount of heat energy it takes to raise the temperature of one pound of water one degree Fahrenheit.

**cellulosic material -**

crop stalks, forest residues, and portions of urban waste that can be processed into alcohol fuels once treated with acids or enzymes to break them down into fermentable sugars.

Use of these materials to make alcohol fuels on a large scale depends on improving the efficiency (now 20%) of this hydrolysis, or breaking down, step.

**conversion ratios (typical) -**

1 bushel of corn                   = 2.73 gal. of 190 proof ethanol or  
  = 2.55 gal. of 200 proof ethanol

1 ton of               = 0.8 tons of               = 121.21 gal  
  crop                fermentable               of 200 proof  
residue               sugar                   ethanol

1 barrel = 42 gallons

**denaturant -**

a substance added to ethanol to make it unfit for human consumption so that it is not subject to alcohol beverage taxes.

**destructive distillation -**

a process to produce fuel from cellulosic materials by heating them in the absence of oxygen, decomposing the material, and then distilling the resulting vapors. Compare hydrolysis.

**distillation -**

the last stage in making alcohol from fermentable sugars. The "beer" (fermented feedstock containing about 85% water) is heated in a distillation column, or still, to boil off the water and the alcohol, which is condensed and piped off to a storage tank. In "vacuum" distillation, the process takes place at lower pressure, which makes it possible to distill the alcohol using less heat energy.

**distillers' mash -**

a protein- and mineral-rich byproduct of alcohol production from grain. When water has been removed this byproduct is called distillers' dried grains, or DDG, and can be stored and transported without spoilage. Distillers' mash and DDG are currently used as animal



feed supplements (they have higher protein value--22-27%--than the original grain itself), and research is underway on using DDG as a human food supplement.

**ethanol (ethyl or "grain" alcohol) -**

an alcohol made from grains as well as from starch- and sugar-rich crops by fermentation and distillation); from cellulosic material (which must undergo hydrolysis first); or from petroleum products like ethylene (by reacting them with a catalyst). Ethanol can be blended with gasoline as an extender and octane booster. Ethanol contains 2/3 of the energy in Btus of an equal volume of gasoline but can provide more miles per Btu.

**excise tax, gasoline -**

a tax collected at the pump to support the construction and maintenance of highways. Gasohol is exempt until 1984 from the \$.04 federal excise tax and in some states from the state excise tax.

**feedstock -**

the raw material from which alcohol can be made, including distressed or substandard grain, grain sorghum, sugar beets, sugarcane, potatoes, fruits, vegetables, cheese whey, food wastes, and potentially, cellulosic materials and municipal solid waste.

**fermentation -**

a step in the production of ethanol from agricultural products. Bacteria or yeast added to a "mash" of grain, sugar beets, or other agricultural products, break down the sugars into alcohols. The resulting "beer" must then be distilled to produce alcohol of a "proof" suitable for fuel use.

**gasohol -**

a mixture of 10% 200-proof ethanol and 90% unleaded gasoline.

**hydrolysis -**

the first step in producing ethanol from cellulosic materials (like wood, urban waste, and vegetable residue). Hydrolysis uses enzymes and/or acid to break down cellulose into sugar before fermentation and distillation can take place. Compare to destructive distillation.

**methanol (methyl or "wood" alcohol) -**

an alcohol made from wood or carbonaceous urban waste (by destructive distillation), from natural gas (by reacting that gas with a catalyst), or from coal (by liquefaction--a technology that is being advanced for commercial use in this country). Methanol can also be used as a gasoline extender and octane enhancer but, since it tends to corrode certain seals and metals, is likely to come into wider use only if materials and engines are modified to accommodate it.

**net energy balance -**

the amount of energy available from a fuel when it is burned minus the amount of energy it takes to produce the fuel.

**proof -**

the volume of ethanol in a liquid. Proof is twice the percentage number, so a liquid that was 100% ethanol would be 200 proof. The higher the proof, the more Btus are available when the liquid is burned.

**rack price -**

the initial wholesale gasoline price as paid at the refinery delivery rack.

**still -**

the apparatus used to distill alcohol, that is, to remove water from it in successive stages in order to increase its proof.

## **Appendix III**

### **Louisiana Department of Commerce**

**10-Year Tax Exemption Program  
Cost Free Training  
Industrial Revenue Bonds  
Enterprise Zones**

The items contained in this section originally referred to Tax & Business Incentives provided by the State of Louisiana.

These items due to their nature change over time, and the original text has been omitted here.

However, many of these same incentives, or modified versions are still available. Please contact the [Louisiana Department of Economic Development](http://www.lded.state.la.us/tax_bus.html) ([http://www.lded.state.la.us/tax\\_bus.html](http://www.lded.state.la.us/tax_bus.html)) directly to obtain further information concerning Business and Tax Incentives such as:

Industrial Property Tax Exemption Programs

Enterprise Zone Programs

Cost-Free Training Programs

As well as other employment, workforce development, tax, and trade incentives.

Louisiana Department of Economic Development

101 France Street

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(504) 342-3000

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