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## Brazil's ethanol industry \*

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(first in a series)

The energy crisis of the 1970s brought about high gas prices and limited supplies that generated an intense interest in renewable fuels and weaning ourselves from foreign sources of oil. However, when gas prices plummeted in the 1980s, renewable fuels and energy independence were quickly forgotten.

The story evolved differently in Brazil. After investing heavily in renewable fuels in the 1970s, Brazil kept the program alive during the 1980s. This has given Brazil a head start in the current situation. With its robust ethanol program, Brazil has developed an extensive ethanol industry. In this article we will discuss the structure and growth potential of Brazil's ethanol industry. In future articles we will discuss Brazil's domestic usage and exports.

### Brazilian Ethanol Production

Brazil is the world's number two ethanol producer and the leading ethanol exporter, using sugarcane as its feedstock. Ethanol production has expanded in recent years as shown in Table 1.

**Table 1. Brazilian Ethanol Production**

Year *	Million Gallons
2003/04	3,910
2004/05	4,068
2005/06	4,174
2006/07	4,719
2007/08	5,916
2008/09**	7,054

\* marketing year = May – April

\*\* forecast

Source: GAIN report BR8013, USDA Foreign Agricultural Service, 2008.

Three types of production facilities exist in Brazil:

- Sugar mills (producing only sugar) – The sugarcane is washed, chopped, shredded and crushed between rollers. The juice (grapa) contains 10 – 15% sucrose. The remaining material (by-product) is called bagasse.
- Mills with distillery plants (sugar and ethanol production), and
- Independent distilleries (only ethanol production).

### U.S. and Brazilian Ethanol Comparison

The United States and Brazil are the two largest ethanol producers in the world as shown in Table 2. Together they account for almost 90 percent of world production.

**Table 2. World Fuel Ethanol Production (2007)**

Country	Million Gallons
USA	6,499
Brazil	5,019
European Union	570
China	486
Canada	211
Other	316
Total	13,102

Source: Renewable Fuels Association.

The feedstock for Brazilian ethanol is sugarcane. In the U.S. the feedstock is corn. Below is a comparison of Brazil's sugarcane-ethanol industry and the U.S. corn-ethanol industry.

### Labor and Environmental Impact

Traditionally, sugarcane fields have been burned just before harvest to remove leaves and fertilize the fields with ash. The smoke, which is blown into nearby towns, turns the sky gray and makes the air hazardous. However, a recent law bans the burning of sugarcane fields.

Sugarcane production requires hand labor at harvest. This creates a large group of migrant workers who can only find work a couple of months a year during sugarcane harvest. A skilled harvester can cut 1,000 pounds of sugarcane in an hour. Machines are replacing human labor for harvesting cane.

### Energy Balance

The energy content of sugarcane is divided into three equal parts. One-third of the energy is in the sucrose and is converted to ethanol. One-third of the energy is in the sugarcane tops and leaves which are left in the field. The remaining third is bagasse which is fibrous material that is left over after pressing the sugarcane.

Bagasse is burned to provide an energy source for the

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ethanol facility. Bagasse burning co-generates electricity which is used in the plant and also sold to the energy grid. However, only 12 percent of sugar-ethanol mills currently sell electricity to the grid. The cost to connect to the grid is very expensive. In addition, many mills are not located close to the grid.

Since sugarcane is replanted only once every six years and harvested with hand labor, it requires less energy for production than corn.

**Future Expansion**

Brazil has a natural advantage in ethanol production. It has a vast unused or little-used land area that can be converted to agricultural production. In addition, its tropical climate is well suited for sugarcane production.

The Sugarcane Technological Center (CTC) is the leading research center for sugarcane and ethanol in Brazil. It is responsible for over 80 percent of the research and development activities in this area. Brazil has made substantial investments in research to improve sugar

**Table 3. Comparison of Brazil and the U. S. Ethanol Industries**

<b>Brazil - Sugarcane</b>	<b>United States - Corn</b>
The sugar (sucrose) in sugarcane can be converted directly into ethanol.	The starch in corn is first converted into sugar. Then the sugar is converted into ethanol.
Sugarcane is planted every six years using cuttings.	Corn is planted every year using seeds.
Sugarcane provides five cuttings over six years and then is replanted.	Corn is harvested once each year.
Sugarcane yields about 35 tons per acre (entire plant) per harvested acre.	Corn yields about 8.4 tons per acre (entire plant) per harvested acre.
Sugarcane yields about 4.2 tons of sucrose per acre (10 to 15 percent of sugarcane yield).	Corn yields 4.2 tons of corn grain per acre (150 bushels) or 2.4 tons of starch.
An acre of sugarcane produces about 560 gallons of ethanol (35 ton yield).	An acre of corn produces about 420 gallons of ethanol (150 bushel yield).
Sugarcane feedstock is cheaper to grower than corn per gallon of ethanol.	Corn feedstock is more expensive to grow than sugarcane per gallon of ethanol.
Sugarcane-ethanol can be produced cheaper than corn-ethanol.	Corn-ethanol is more expensive to produce than sugarcane-ethanol.
The by-product of ethanol production is bagasse.	The by-product of ethanol production is distillers grains with soluble that is used as livestock feed.
The energy source for ethanol production is bagasse.	The energy source for ethanol production is natural gas, coal and diesel.
Currently about 9 million acres are used for ethanol production.	Currently about 28 million acres are used for ethanol production.
Brazil has great potential for expanding sugarcane acreage without limiting the acreage of other crops.	U.S. expansion of corn acreage will come at the expense of reduced soybean and other crop acres.
No subsidies for ethanol	Subsidy reduced from \$.51 per gallon to \$.45.
No import tariffs on ethanol	A \$.54 per gallon import tariff.

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cane varieties in recent decades. The research has produced varieties more resistant to drought and pests, along with higher yields and higher sugar content. During the last 30 years, sugarcane yields have increased three-fold.

acres by 2012/13. The number of sugar ethanol plants are expected to increase from 325 (2006/07) to 410 (2012/13). Ethanol production is expected to reach ten billion gallons. This compares to the current production of 7 billion gallons (Table 1).

**Table 4. Agricultural Land in Brazil (2007) \***

	Million Acres	Percent of Total Ag. Land
Cultivated Land (all crops)	190	21.6%
Soybeans	51	5.8%
Corn	35	3.9%
Sugarcane (all uses)	19	2.2%
Sugarcane for ethanol	8.4	1.0%
Pastures	426	48.6%
Available Land	261	29.8%
Total & Potential Agricultural Land	877	100%
Total All Land	2,103	

\* Total arable land excludes the Amazon Forest, the wetlands of the Pantanal, and other preservation areas, in addition to areas not traditionally suitable for agriculture due to topography, soil restrictions, etc.

Source: GAIN report BR8013, USDA Foreign Agricultural Service, 2008

Dedini Corporation is Brazil's largest builder of ethanol plants. They are developing a process that can convert the cellulose from bagasse, tops and leaves into sucrose for ethanol production. This technology has the potential to almost double the ethanol production from an acre of sugarcane.

According to Brazilian sources, sugarcane planted acreage (all uses) is expected to increase to over 25 million

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**Current Profitability**

The following profitability tools have been updated on [www.extension.iastate.edu/agdm](http://www.extension.iastate.edu/agdm) to reflect current price data.

**Corn Profitability** – A1-85

**Soybean Profitability** – A1-86

**Ethanol Profitability** – D1-10

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