

### *Ethanol Demand Driving the Expansion of Brazil's Sugar Industry*<sup>1</sup>

Rising ethanol demand in global markets is driving the growth of Brazil's sugar/ethanol complex with new investments in infrastructure and technology. The recent rise in crude oil prices, paired with a global effort for renewable energy development and a growing domestic demand for ethanol have been the key factors driving the recent expansion of Brazil's sugar and ethanol industries. As ethanol in Brazil is made from sugarcane, sugar industry developments are now increasingly linked to policy initiatives in ethanol markets.

Sugar represents a particularly important component of Brazil's economy, with the sugar/ethanol industry contributing 2 percent to national gross domestic product. The value of production in 2006 reached \$8 billion, which represents 17 percent of the country's agricultural output. The sugar sector generates 21 percent of total exports and employs 1 million people, or 2 percent of the labor force (UNICA and Confederação da Agricultura e Pecuária do Brasil, CNA).

Total sugarcane production, equivalent to 31 percent of world production in 2006, reached 423 million tons (fig. A-1). Brazil is also the largest raw and refined sugar producer, accounting for 20 percent of the world's sugar production (ahead of India and Australia). Sugar production in 2006 reached 28.7 million tons (fig. A-2). Brazil is the most efficient sugar producer in the world. The cost of production is on the order of \$170-\$210 per ton, while costs for other countries are significantly higher: \$250 per ton in South Africa, \$308 per ton in Mexico, \$525 per ton in the United States, and \$770 per ton in Italy (Organization for Economic Cooperation and Development).

Brazil is the world's largest exporter of ethanol and sugar (raw and refined) to world markets. Developments in Brazil significantly affect world sugar prices. In 2006, Brazil exported 18.3 million tons of sugar, accounting for 41 percent of the world's sugar exports. Brazilian ethanol exports in 2006 of 1 billion gallons represented 52 percent of the world's ethanol market (fig. A-3).

### *Rising Demand for Sugar and Ethanol Leads to Sugarcane Area Expansion*

Sugarcane in Brazil is cultivated on 6.2 million hectares, just 2.4 percent of total arable land in the country, compared with other crops, such as soybeans (20.7 million hectares) and corn (13.6 million hectares) (Companhia Nacional de Abastecimento, CONAB). The Brazilian Minister of Agriculture (MAPA) expects area planted to sugarcane to expand by 3 million hectares over the next 5 years by expanding sugarcane cultivation in degraded pastureland. Currently, about 50.1 percent of Brazil's annual sugarcane output is used to produce ethanol; the remaining 49.9 percent goes to producing sugar for domestic consumption and for export (Foreign Agricultural Service/USDA).

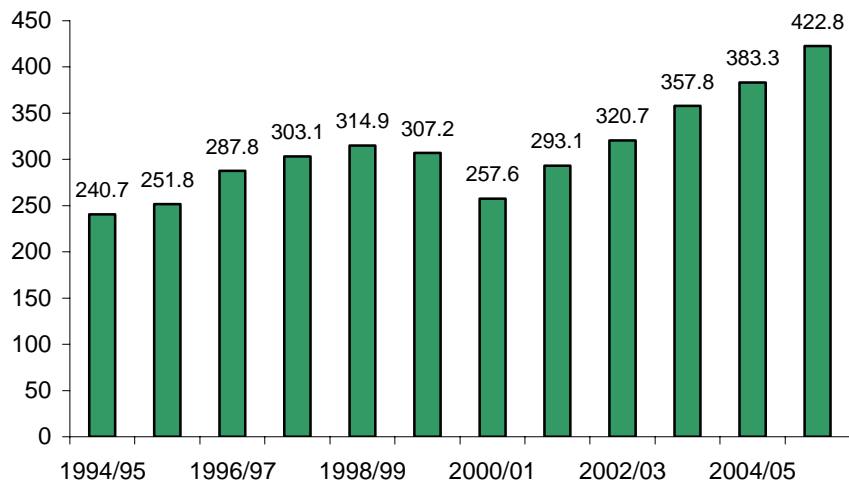
Sugarcane production is concentrated in two distinct regions: the Center-South and the Northeast (fig. A-4). The Center-South is Brazil's leading sugarcane-producing

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Figure A-1

**Brazil's sugarcane production**

Million tons

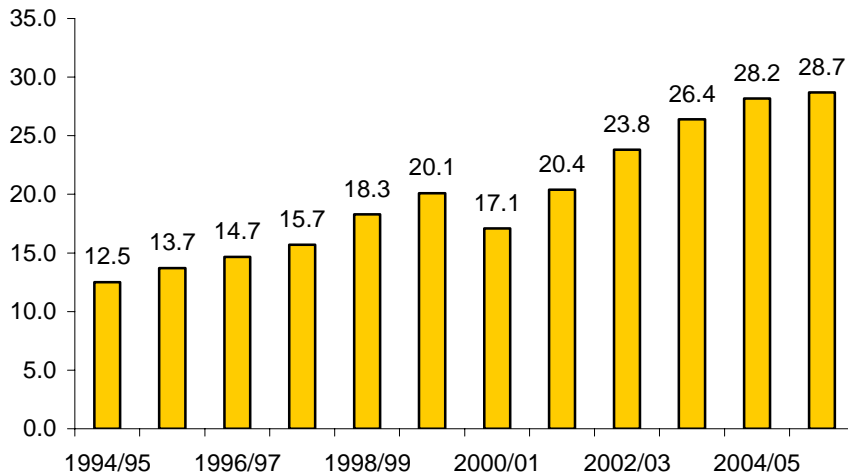


Source: UNICA.

Figure A-2

**Brazil's sugar production**

Million tons



Source: Foreign Agricultural Service, USDA.

Figure A-3

**Brazil's growing dominance among world's largest sugar exports**

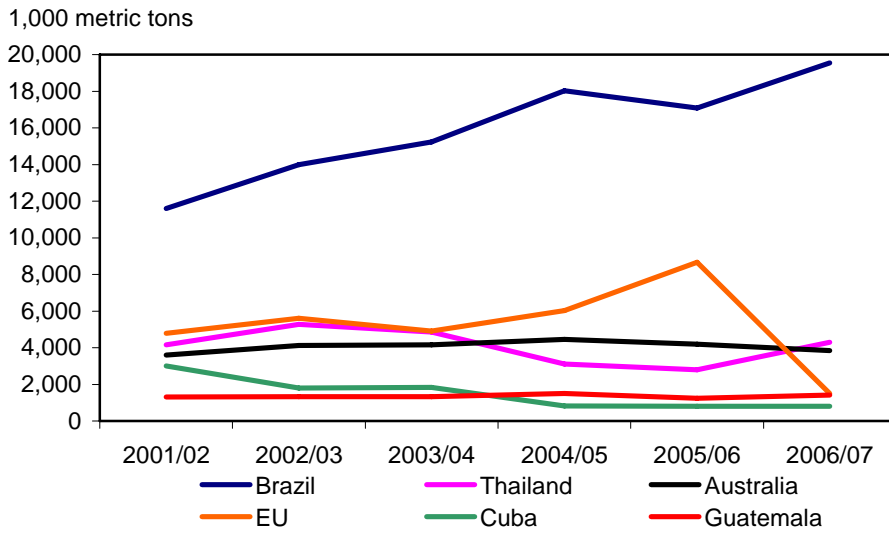
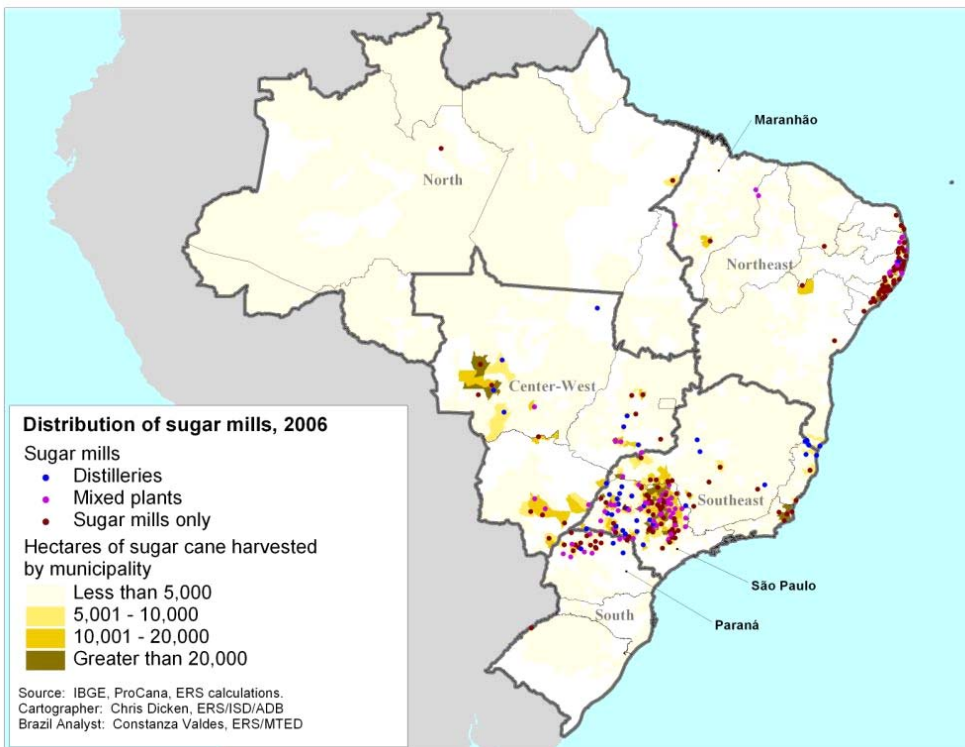


Figure A-4

**Brazil: Location of sugar plants and distilleries**



region as climatic and historical conditions favored the development of the industry in this region. The Center-South accounts for 85 percent of Brazil's sugarcane production and includes the State of São Paulo (Brazil's largest sugarcane-producing and sugarcane-exporting State, with 60 percent of all sugar produced in Brazil and 70 percent of Brazilian sugar exports). The Northeast accounts for the remaining 15 percent of production (table A-1).

In the Center-South, sugarcane production occurs between May and November, whereas in the Northeast, production occurs between September and March. Due to the topography, harvesting in the Center-South is done by machine. The cane is first harvested 18 months after planting, but one crop can be harvested four more times.

Brazil has 320 sugarcane processing plants, including sugar mills (producing only sugar), mills with distillery plants (sugar and ethanol production), and independent distilleries (only ethanol production); 226 of these are in the Center-South.

Domestic sugar consumption has been expanding as a result of rising incomes and population growth. Sugar consumption in 2005 reached 10.8 million tons, equivalent to about 40 percent of Brazil's sugar production in 2003-05 and representing a continuation of rapid growth in recent years.

To fulfill rising demand for ethanol, satisfy large domestic sugar requirements, and expand sugar exports, sugarcane output is set to reach 684.7 million tons by 2012, equivalent to a 62-percent increase over the 2006 level (MAPA). This production will require 40 new sugar mills and 16 distilleries in the Center-West (west of Sao Paulo, south of Goias, Mato Grosso, and Mato Grosso do Sul), with total investments of \$3 billion. This expected rate of expansion appears feasible: In 2005 alone, 12 new sugar mills opened in Sao Paulo and Minas Gerais.

Table A-1--Brazil's sugarcane area, production, yields, and ethanol production by region 2006

Regions	Area harvested 1,000 ha	Sugarcane production Million tons	Sugarcane yields kg/ha	Hydrous alcohol production -----1,000 liters-----	Anhydrous alcohol production
<b>Brazil</b>	6,189	475,726	77	9,105,438	7,746,041
North	22	1,420	65	54,862	6,130
Northeast	1,133	64,619	57	944,993	637,725
Southeast	3,941	327,843	83	6,635,993	5,050,565
South	489	36,829	75	478,524	905,685
Center-West	605	45,016	74	991,139	1,145,937

Source: IBGE, Producao Agricola Municipal. Culturas temporarias e permanentes 2006.

## ***Policies and Reforms Shape Brazil's Sugar Industry***

Economic liberalization and deregulation and ethanol policies have been key factors in Brazil's evolving sugar industry. The sugar industry was one of the most regulated sectors in Brazil until 1997. Prices of sugarcane and ethanol were controlled by the Sugar and Alcohol Institute (IAA), which set production quotas for all mills and distillers and, until its reform in 1997, operated the country's only legal exporter of sugar products.

The single most important factor driving the original expansion of the Brazilian sugar industry was the Proálcool program (Programa Nacional do Álcool), Brazil's national alcohol program. The program was created to reduce dependence on oil at a time when over 80 percent of the oil consumed was imported and Brazil was reeling from the major oil price rises of the 1970s. Initiated in 1975 as a government-mandated program to regulate the fuel alcohol content in gasoline, the Proálcool program was ultimately responsible for the expansion of sugarcane production and the development of two types of ethanol: hydrous alcohol for use in pure alcohol vehicles and anhydrous alcohol for blending with gasoline.

Since its inception, the Proálcool program has served to dampen the effect of increases in crude oil prices. The program provides incentives for greater use of fuel alcohol when oil prices are high or reduces the ethanol content in the gasoline blend when ethanol supplies are low in the face of rising international sugar prices and exports. By the 1990s, low sugar prices in global markets, combined with higher expected returns to soybeans and red meats and poultry, resulted in less area planted to sugarcane and diminished domestic support to ethanol production.

Prices are differentiated by regions: The producer price for sugarcane is significantly higher in the Northeast than elsewhere. The sugar industry in this region has benefited from the Brazilian Government's allocation of the U.S. sugar import quota to the region as an effort to help low-income farmers.

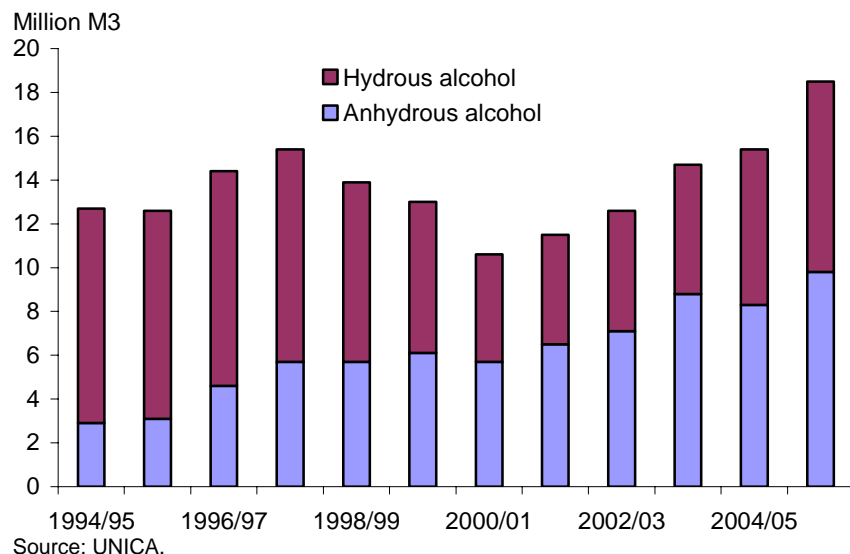
### ***A Pioneer in the Use of Ethanol in the Transport Sector***

A pioneer in the use of ethanol for transportation, Brazil has established the world's most competitive ethanol industry. Brazil is the lowest cost major sugar producer in the world, with high producer returns to sugar and ethanol production compared with other crops. Brazilian sugar producers have benefited from large amounts of available cultivable land, improved technological advancements, expansion of production capacity of mills, and a decades-old government policy that has encouraged the establishment of a vibrant ethanol industry. Brazil's production of 4 billion gallons in 2006 represented nearly 38 percent of the world total, second to the U.S., currently the world's largest ethanol producer (fig. A-5).

Brazil is the largest producer, consumer, and exporter of ethanol for fuel use. Ethanol represents 15 percent of the total supply of liquid fuels in the country. Currently, the Brazilian light vehicle fleet of 18 million units consumes 7.3 billion gallons of fuel per year: 4.2 billion gallons/year of gasoline and 3.1 billion gallons/year of hydrated or anhydrous ethanol. All gasoline sold in the retail market

Figure A-5

### Brazil's ethanol production



has a 23-percent addition of anhydrous ethanol. Ethanol is used almost exclusively for passenger cars and trucks; buses and work vehicles are powered by diesel.

Diesel consumption in 2005 was 59 percent of total fuel use (ANP, Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, Brazil). In 2003, scarcity of ethanol in the domestic market led to the introduction of the first car engines to run on hydrous alcohol—“flex-fuel” cars powered by gasoline and hydrated ethanol in any proportion (fig. A-6 and A-7).

Gasoline prices tend to vary less and are controlled by the Government. Brazil has 32,000 gas stations that offer pure ethanol for sale side-by-side with gasoline. The most significant incentive for ethanol is the favorable tax treatment it receives at the pump—the Brazilian Government assesses levies for gasoline that are about 0.54 cents per gallon higher than taxes on ethanol. Differential treatment under State tax regimes is even greater. In Sao Paulo, recent pump prices were \$2.05 per gallon for ethanol and \$4.01 per gallon for gasoline.

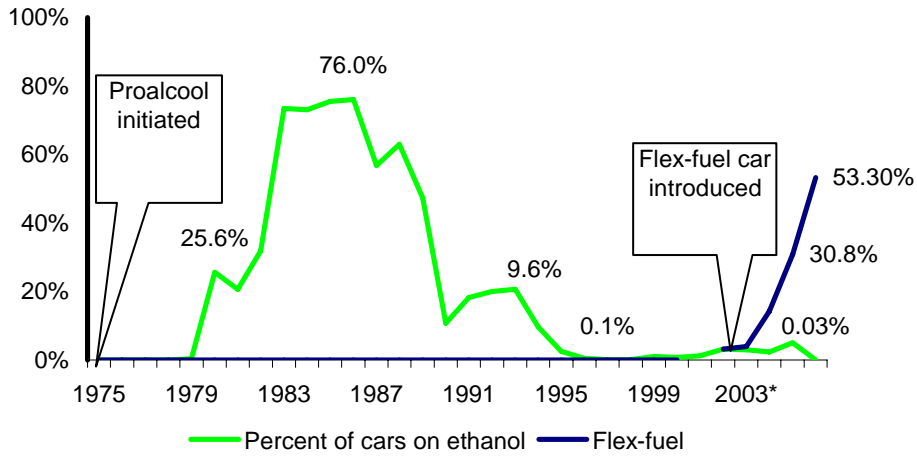
### ***Critical Factors for Future Growth in the Sugar/Ethanol Sector***

Brazil seeks to produce enough ethanol to replace 10 percent of the gasoline consumed worldwide by 2012, which requires doubling its current production and increasing the share of exports in total output to 20 percent from the current 15 percent. Sugar exports are also forecast to increase, with the share of sugar produced going to the export market increasing to 70 percent (MAPA).

Since 2002, Brazil’s sugar-ethanol complex has benefited from domestic and foreign demand, more favorable expected returns to sugarcane producers, expansion in arable land, and technological advancements in new sugarcane varieties. As demand for Brazilian ethanol continues to rise, the production of ethanol will

Figure A-6

**Percent of new sales of Brazilian cars running on ethanol**

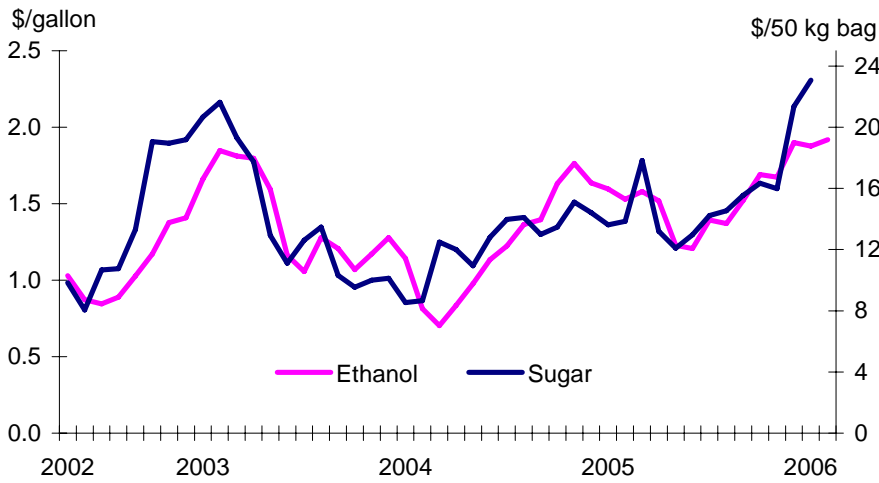


Source: Anfavea 2006.

\* From March 2003, includes flex-fuel cars (alcohol-gasoline).

Figure A-7

**Brazil's Domestic Prices for Sugar and Ethanol**



Source: CEPEA, ERS calculations.

continue to exceed that of sugar in the sugarcane production mix. Ethanol's share of sugarcane production is expected to rise as demand for flex fuel cars—which are expected to account for over 95 percent of all new cars introduced in the market—increases.

According to the Brazilian Ministry of Agriculture by 2008, over 60 percent of harvested cane is expected to go into ethanol production as ethanol production facilities continue to be built. Planting of sugarcane and construction of new sugar/ethanol mills generally require a startup phase of 3-5 years.

Despite recent rapid growth and new investments in the sector, ethanol supply still lags behind demand. In 2006, ethanol shortages led to rapid price increases to levels above those agreed upon by refinery owners and the Federal Government. These conditions forced the Brazilian authorities to intervene and reduce the percentage of ethanol mixed with gasoline sold at gas stations from 25 percent to 20 percent, which led to a reduction in the use of ethanol.

A major factor that will be key to the competitiveness and efficiency of Brazil as one of the world's largest producer and exporters of sugar is investment in infrastructure to reduce transportation costs from the mill to consumer centers and ports. Weak infrastructure is perceived to be a major problem in a number of areas, particularly maritime transport and port facilities. An additional factor would be increased domestic efficiency as the Government continues to deregulate its industry. Another important factor affecting the future of sugarcane production will be the influence of environmental concerns and policies relating to reforestation and burning of sugarcane for manual harvest.