

Background paper for the
**Competitive Commercial Agriculture in Sub-Saharan
Africa (CCAA) Study**

**SUGAR-BASED ETHANOL
International Market Profile**

Jennifer Nyberg
Trade and Markets Division
Food and Agriculture Organization of the United Nations

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SUGAR-BASED ETHANOL: International Market Profile

1 Introduction

Sugarcane is generally regarded as one of the most significant and efficient sources of biomass for biofuel (ethanol) production. Sugarcane offers production alternatives to food, such as feed, fibre and energy, particularly co-generation of electricity and ethanol. Strong linkages between world sugar and oil prices have emerged in recent years, driven in part by the relationships between sugar as the primary ethanol feedstock in Brazil, the dominant producer and exporter of both sugar and ethanol in the world. Given expectations of rising oil prices, the significant potential for expansion of global sugarcane production as ethanol feedstock has resulted in a heightened global focus on sugar and ethanol as internationally traded commodities.

Ethanol (ethyl alcohol) is an alcohol produced by fermenting and distilling starch crops that have been converted into simple sugars. Ethanol can be produced from any biological feedstock that contains appreciable amounts of sugar or materials that can be converted into sugar such as starch or cellulose.¹ Globally, sugarcane is the primary feedstock source (Brazil, El Salvador, Guatemala, Colombia, India), followed by maize (the United States and China) and other grains (the EU). Ethanol production is generally segmented into three major types: fuel ethanol, applications for industrial products and alcoholic beverages. Ethanol is used in the chemical industry as solvents as well as manufacture of industrial products such as detergents, paint, varnish and cosmetics. Ethanol is also used to produce vinegar, alcoholic beverages and has medical applications as an antiseptic and a component of drug formulas. The fast growing and most important market segment in international trade, however, is that of fuel ethanol.

Ethanol for fuel is by far the most important product type, with production at some 189 million barrels per year accounting for 70 percent of world output, and key to the further development of ethanol as an internationally traded commodity. Approximately 10 percent of total fuel ethanol production is traded internationally, although export markets are increasing rapidly. Fuel ethanol can be used directly in vehicles designed to run on pure ethanol (hydrated ethanol, which usually contains about 5 percent water content), or blending dehydrated (anhydrous) ethanol with gasoline (up to 25 per cent). Ethanol can be used to increase octane and reduce pollution from additives in unleaded gasoline, substituting for chemical additives such as methyl tertiary butyl ether (MTBE).² Two countries, Brazil and the United States, are the major fuel ethanol producing and consuming countries, accounting for 85 percent of global demand.

Many countries have either implemented or are actively formulating policy framework to develop bioenergy sectors, seeking ways to lessen the adverse impact of higher oil prices on national economies, as well as mitigate climate change and greenhouse gas emissions through initiatives such as the Kyoto Protocol, EU Biofuels Directive and the US Oxygenated Fuels Program. Currently, an estimated ten percent of global ethanol production (about four billion litres per year) is traded internationally, with Brazil by far the dominant global producer and exporter. Ethanol production and utilization has played an extremely important role in the development of the Brazilian energy sector for most of the past 30 years.

¹ Definitions of various types of bioenergy systems: bioenergy is energy produced from various biofuels or co-generation of electricity; biofuel is fuel produced directly or indirectly from biomass, such as fuelwood, charcoal, bioethanol, biodiesel, biogas (methane) or biohydrogen; biomass is material of biological origin excluding material embedded in geological formations and transformed to fossil, such as energy crops, agricultural and forestry wastes and by-products, manure or microbial biomass. Bioenergy includes all wood energy and all agro-energy resources. Wood energy resources are fuelwood, charcoal, forestry residues, black liquor and any other energy derived from trees. Agro-energy resources are energy crops, for example, plants purposely grown for energy such as sugar cane, sugar beet, sweet sorghum, maize, palm oil, seed rape and other oilseeds, and various grasses.

² The Emerging Biofuels Market: Regulatory, Trade and Development Implications, UNCTAD, New York and Geneva, 2006

A more diverse global ethanol market has started to take form in recent years, in terms of an internationally traded commodity. According to FO Licht, about 700 million liters (4.4 million barrels) of ethanol were traded internationally in 2004, less than 20 percent of total traded volumes (domestic and international) and a relatively low volume given the global market potential. New bioenergy policies and investment initiatives have emerged in many countries, such as the EU, the United States, Japan, Malaysia, Indonesia, South Africa, Colombia, the Philippines, Sub-Saharan Africa, particularly in the transport sector.

Currently, there is no established world price for ethanol, although the New York Board of Trade introduced an ethanol futures contract in 2004 that, with more liquidity and a greater number of suppliers, could eventually serve as a world reference price for global trade. As such, international trade tends to use the domestic spot price of anhydrous ethanol in Brazil as the world reference price. Further development of an international ethanol market will require a larger number of producers and exporters, a more diverse supply base (feedstock types), and an increased number of global producing and exporting countries. A larger and more diverse supply base would support the further development of an ethanol futures exchange and the emergence of an international pricing mechanism. Supportive policy and legislative framework is essential to further international market development, as well as the elimination of existing trade barriers in important energy markets, such as the United States, the European Union and Japan.³

2 Market Structure

2.1 Production

World production of ethanol from all possible starch and sugar feedstock increased from 30 billion litres to 46 billion litres between 2000 and 2005. According to the World Energy Council, global consumption of ethanol is expected to reach 54 billion litres by 2010, equivalent to about one percent of world oil consumption. A recent UNCTAD report found that the cost of large-scale industrial production of bioenergy products is high in developed countries, and that the production costs of biofuels may be as much as three times higher than that of petroleum fuels (without considering non-market benefits). The opposite is generally true in developing countries, where biofuel production costs, for example, in Brazil, tend to be much lower than in developed countries and very near to the world market price of fossil fuels.⁴ Significantly, UNCTAD has found that current ethanol production costs are about USD 0.20 per litre in Brazil and USD 0.40 per litre in India, roughly comparable to the pre-tax prices of gasoline and diesel in these countries.

The heightened focus on fuel ethanol, particularly, is not only due to the high oil prices of recent years, but also to the commitments of many countries to reduce greenhouse gas (GHG) emissions and meet GHG abatement targets under the Kyoto Protocol. Currently, the United States, Brazil and Japan have fuel ethanol programmes. Many other countries have initiated biofuel initiatives or are developing bioenergy policies, such as China, India, Colombia, Thailand and South Africa. Further expansion in ethanol demand, as well as an increasing number of initiatives to diversify possible feedstock, will also pressure food and feed prices, commodity markets and generate increased demand for energy-related agricultural products.

Country	2001	2002	2003	2004	2005
EU	2 563	2 564	2 539	2 621	2 872

³ The Whereabouts of a Fuel-Ethanol World Market, Eduardo de Carvalho, UNICA São Paulo, Brazil 2004.

⁴ The Emerging Biofuels Market: Regulatory, Trade and Development Implications, UNCTAD, New York and Geneva, 2006.

Other Europe	1 382	1 438	1 470	1 462	1 417
Africa	505	511	540	574	584
USA	8 122	9 595	12 063	14 316	16 600
Other N and C America	612	616	589	578	575
Brazil	11 504	12 708	14 568	15 338	16 103
Other South America	421	399	418	450	533
China	3 050	3 150	3 400	3 650	3 800
India	1 780	1 800	1 900	1 650	1 700
Other Asia	1 055	1 067	1 244	1 140	1 060
Oceania	176	182	164	149	149
Total	31 170	34 030	38 895	41 928	45 393

Source: ISO Ethanol Yearbook 2006 (ISO and FO Licht)

According to a recent FO Licht survey, 61 percent of world ethanol production was produced from sugar crops (sugarbeet, sugarcane or desugarization of cane and beet molasses). Grain, primarily maize, is the dominant feedstock for the rest of global output, and fundamentally, feedstock is the critical cost component in determining the profitability of fuel ethanol production.⁵ Approximately 90 percent of global output is concentrated in Brazil, the United States, the EU, China and India. Brazil and the United States are by far the largest producers, accounting for 35 and 37 percent, respectively, of global output in 2005. Brazil produces ethanol from sugarcane feedstock, while the United States produces ethanol from maize feedstock.⁶

Country	2000	2001	2002	2003	2004	2005
Australia	40	40	40	40	40	60
Brazil	10 065	11 009	11 961	13 660	14 283	14 821
Canada	238	238	250	250	250	250
China	0	0	289	800	1 000	1 000
Colombia	0	0	0	0	0	150
EU	210	280	420	545	640	950
India	0	0	0	150	100	300
Thailand	0	0	0	0	6	60
USA	6 171	6 684	8 151	10 617	12 880	14 755
Total	16 724	18 251	21 111	26 062	29 199	32 346

Source: ISO Ethanol Yearbook 2006 (ISO and FO Licht)

Global production, consumption and trade of fuel ethanol have increased significantly in recent years, nearly doubling between 2000 and 2005. Brazil and the United States are the dominant producers and consumers of fuel ethanol, with Brazil the primary origin for production, trade and consumption of sugar-based fuel ethanol. A growing proportion of global output is accounted for by the United States, from 37 to 46 percent over the same period. The largest ethanol production facility in the world is currently based in China (maize feedstock), and further growth is likely, as well as in the European Union. Prices for ethanol have been robust in the US and Brazil, not only reflecting high oil and gasoline prices but just as importantly the dynamics of ethanol supply and demand in each country - and in the case of Brazil, arbitrage with the sugar market. Relative tightness of molasses supplies constrained further ethanol output in emerging programmes in India and Thailand. Increased grain prices, particularly maize, are pressuring ethanol production costs in the EU and the United States.

⁵ World Fuel Ethanol Analysis and Outlook, Dr. Christoph Berg, FO Licht, April 2004.

⁶ Sugarcane is a more efficient converter into energy than maize in the case of Brazil and the United States: conventional chemical cultivation of sugarcane in the centre-south of Brazil, given average 85 tons per hectare yields and average 85 litres per ton, average ethanol output per hectare is 7225 litres; conventional cultivation of maize, given an average yield of 150 bushels per acre and 400 gallons per acre, the equivalent ethanol output per hectare is 3750 litres (UNICA).

2.2 Demand

Global demand for fuel ethanol has increased significantly over the past few years, driven by concerns over energy security, environmental sustainability and the need to mitigate climate change through the reduction of greenhouse gas emissions. Global fuel ethanol demand grew by nine percent between 2003 and 2005, from 27 to 30.6 million cubic meters, driven by emerging programmes in Canada, the EU, Japan, China, Thailand and others.⁷ Demand growth in the EU was very significant, with estimates at 65 percent between 2003 and 2005, mitigated by 53 growth in estimated EU supply over the same period. Strong growth for fuel ethanol markets should continue in the near future, as estimated global demand is expected to nearly double by 2010.⁸ The global supply of fuel ethanol is expected to increase by 45 percent over the same period, driven by increased output in the EU, Japan, China, India, Thailand and others, supplemented by imports from the global market. The EU, particularly, will need to import from ethanol from the world market to keep pace with domestic demand. Brazil and the United States are each expected to account for 29 percent of global demand by 2010, and the EU 19 percent.

Country	Supply				Demand			
	2003	2004	2005	2010	2003	2004	2005	2010
Brazil	14.7	15.4	16.0	20.5	13.0	13.5	14.0	18.0
USA	10.6	13.1	13.6	19.0	10.7	13.9	14.2	18.0
Canada	0.2	0.2	0.5	0.8	0.2	0.2	0.5	0.8
EU	0.5	0.7	1.5	8.0	0.5	0.7	2.0	11.7
Other	1.0	1.2	2.0	13.0	0.0	0.5	1.0	12.6
Total	27.0	30.6	33.6	61.3	24.4	28.8	31.7	61.1

Source: SE2T International Ltd (IEA 2005) and FO Licht

Countries generally use a combination of market regulation, mandatory blending ratios (ethanol-gasoline), tax incentives and excise taxes to support fuel ethanol production and demand. Mandatory blending essentially generates creates market demand for varying ratios, from an average 20 to 25 percent ethanol-gasoline in Brazil, to 5 to 10 percent in China, Thailand and the United States. Additional support is provided through credits for storing ethanol, a lower excise tax on fuel ethanol than on gasoline and investment concessions for new plant construction. Most cars produced today can run on low-level blends, while high-level mixes and pure biofuel require small engine adjustments.⁹

Brazil is the largest producer and exporter of sugar and sugar-based ethanol in the world. As the only country to utilize ethanol as a primary transport fuel, there are important technological, agronomic and institutional practices applicable to emerging ethanol programmes worldwide.

⁷ Brazil - Driver of Sustainable International Markets for Fuel Ethanol, Sergio Trinidad, SE2T International Limited, IEA, June 2005

⁸ Brazil, Colombia, Germany, France, Malaysia, the Philippines, Thailand, the United States and Dominican Republic have mandated ethanol-gasoline blending ratios at the national level. Mandated blends at the regional or state level are found in India (nine states and four federal territories), China (nine provinces), Canada (Saskatchewan and Ontario), and United States (Hawaii, Minnesota, Montana, Washington, Wisconsin). IEA Bioenergy Task 40 Sustainable Bioenergy Trade, Deliverable 8, January 2007.

⁹ The Emerging Biofuels Market: Regulatory, Trade and Development Implications, UNCTAD, New York and Geneva, 2006.

Brazil is the most competitive sugar producer in the world, and the efficiencies derived from co-production of ethanol and sugar results in ethanol production costs that are 40 to 50 percent lower than in the United States, the only other major global ethanol producer. Sugarcane yields have increased significantly over the past two decades, lowering production costs throughout the commodity chain. Approximately 50 percent of total sugarcane output in Brazil is directed toward ethanol production, with the centre-south region accounting for nearly 80 percent of all sugarcane feedstock. Reports indicate that ethanol output in Brazil is competitive in global markets at oil price levels as low as USD 35 per barrel.¹⁰

Brazil has produced ethanol from sugarcane since 1974, when the Proálcool Program was introduced as a way to reduce dependence on oil imports. Two state institutions were central to the successful development of the Brazilian sugar and ethanol complex: (i) the Institute of Sugar and Alcohol (IAA) to control domestic production and trade of sugar and ethanol through production quotas and fixed purchase prices for ethanol; and (ii) Petrobras to control domestic ethanol sales and distribution. Poor supply and demand management caused serious market disruptions in the early 1990s, and precipitated a significant shift in Government policy that eventually resulted in price liberalization, ended the Petrobras distribution monopoly and reduced subsidies to blenders. The Government no longer exercises direct control over ethanol production and exports, although mandates ethanol-gasoline blend ratios range between 20 and 25 percent, and controls sales from strategic ethanol reserves.¹¹

Brazil has a large fleet of vehicles that are engineered to function on 100 percent ethanol, as well as flex-fuel vehicles that are capable of functioning on pure ethanol or an ethanol-gasoline blend. Ethanol distillers sell pure anhydrous ethanol (99.8 percent alcohol) to wholesale blending operations that add water to sell hydrous (E100) ethanol (96.7 to 96.8 percent alcohol). The sales of flex-fuel vehicles in Brazil have increased nearly 100 percent over the past three years. Vehicle owners decide at the retail level whether to purchase pure or blended fuel ethanol. Retail prices of ethanol increased throughout 2006 and by year end, were about 75 percent of gasoline prices, basically the price level in which gasoline has a comparative advantage over ethanol.

The United States, the second largest producer of ethanol globally, uses maize as the primary feedstock and is also one of the largest consuming countries in the world. There are a wide variety of federal and state incentives, including excise tax exemptions, state level supports and blending ratios. Ethanol is one of the main beneficiaries of the Renewable Fuels Standard (RFS) provision, part of the United States Energy Bill of 2006. US ethanol demand is expected to continue the strong demand growth (25 percent between 2005 and 2006) of recent years. MTBE, an octane enhancer, has been banned in 20 US states, and ethanol (corn or sugar-based) is the primary substitute for gasoline blends. Every major US oil refinery planned to have MTBE phased out and replaced with ethanol by mid-2006, and this has increased the US reliance on imports of sugar-based ethanol as an additive for blending operations.

Other countries have also taken important steps that may result in increased ethanol demand globally. For example, ethanol accounts for approximately 20 percent of the emerging biofuels market in the EU, where bioenergy is dominated by biodiesel output from vegetable oils. The 2003 EU directive called for the use of renewable transport fuels, with targets starting at two percent and increasing to 5.75 percent by 2010. The directive allowed EU Governments to design country-specific policies to meet the established targets. Spain, Germany, Italy, Portugal and Sweden implemented a progressive tax in 2005 with certain exemptions from excise duties to

¹⁰ FAO Trade and Markets Division, Food Outlook, June 2006, Rome

¹¹ The Emerging Biofuels Market: Regulatory, Trade and Development Implications, UNCTAD, New York and Geneva, 2006.

encourage ethanol blending with gasoline. France has established production quotas for sugar beets, however announced tax incentives for biofuel production enable unlimited production of sugar-based ethanol production from sugar beets beyond these quotas. Tax incentives also apply in Thailand to promote the use of E10 fuel blends, while Australia, Canada and Japan provide investment and production subsidies. The Government of China provides subsidies for ethanol production, and mandates the use of E10 ethanol blends in several provinces. India announced the revision of a Sugar Development Fund in 2002 to include provisions on ethanol use, approving an ethanol-gasoline blend of five percent and an exemption of excise duties on sales of ethanol. Currently, most countries have imposed high import tariffs on biofuels to ensure that imported fuels remain uncompetitive vis-à-vis domestic supply.¹²

2.3 International Trade

Global trade is currently dominated by countries in North and South America, mostly Brazil, the United States, Central America and several Caribbean countries. Brazil currently accounts for some 50 percent of global ethanol exports, and is by far the most competitive global supplier. Ten countries accounted for 85 percent of imports from Brazil in 2005: United States, India, Japan, Netherlands, Sweden, South Korea, El Salvador, Jamaica, Nigeria and Mexico. Fuel ethanol accounts for the majority of global ethanol trade, which accounts for approximately ten percent of total global output. Slightly more than five billion litres of ethanol are traded globally, with trade growing about 10 percent per year. The key global market producers, importers and exporters include Brazil, the United States, the EU, several countries in the Caribbean Basin and Central America, Japan, Thailand, China and India. Significant trade barriers exist, as well as tax incentives, trade classification and standardization problems, lack of infrastructure (blending stations or flex-fuel vehicle fleets) that constrain more rapid development of ethanol as an internationally traded commodity. Some Central American and Caribbean countries, South Africa and Pakistan, are also becoming active exporters, using existing preferential trade arrangements, particularly in the case of Western Hemisphere ethanol trade.

The United States imported nearly 90 million litres of ethanol from Brazil in 2006, proving that Brazil origin ethanol is competitive in US markets, despite ocean freight and high import tariffs. Growth in the US market (24 percent from 2003 to 2004) continues to provide important opportunities for expanding exports from Brazil and other origins, particularly as US ethanol output is not keeping pace with demand. About 50 percent of US imports in 2004 originated in Brazil without using duty-free processing throughput in the Caribbean. These imports were competitive with domestic US production despite paying the full 2.5 percent plus 54 cents per gallon import duty on direct imports of fuel ethanol. Brazilian companies have purchased ethanol processing facilities in El Salvador and Jamaica, facilities that have duty-free access to the United States due to the Caribbean Basin Economic Recovery Act (CBERA, former Caribbean Basin Initiative). Similar investment activities are underway in Guatemala, Panama and the Dominican Republic.

¹² The Emerging Biofuels Market: Regulatory, Trade and Development Implications, UNCTAD, New York and Geneva, 2006.

BRAZIL ETHANOL EXPORTS BY MONTH 1996-2005 (million litres)										
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
January	29.60	11.67	14.72	18.26	37.75	8.75	89.95	104.24	141.95	121.52
February	42.64	.00	5.72	19.04	50.94	2.00	35.17	72.36	100.77	120.18
March	15.01	.00	4.01	16.00	54.27	.09	40.80	25.62	121.32	229.00
April	24.77	18.96	12.07	23.56	11.88	12.73	40.85	29.22	137.36	248.11
May	17.12	3.03	6.07	17.08	22.79	4.71	39.68	29.61	156.42	159.02
June	16.81	37.01	5.81	41.86	8.01	20.32	25.28	15.13	281.34	268.42
July	17.00	17.03	3.93	50.71	6.71	48.07	42.62	47.78	294.45	269.77
August	11.27	25.48	14.05	46.82	3.00	40.69	89.82	58.41	262.74	199.29
September	26.11	14.67	3.01	44.18	7.86	75.03	67.64	83.94	292.20	266.35
October	15.66	33.63	13.81	72.87	.00	38.56	117.93	104.63	157.08	285.51
November	8.11	9.74	33.71	28.14	5.84	47.64	81.37	77.21	240.81	219.30
December	34.90	8.10	.00	25.05	10.63	43.94	66.66	78.45	129.94	205.80
Total	259.00	179.32	116.91	403.57	219.68	342.53	737.77	726.60	2316.38	2592.27

Source: ISO Ethanol Yearbook, 2006

Biofuel trade regimes in the United States and European Union

There are two biofuel related trade regimes that will help shape the future development of global ethanol markets and trade: the United States and the European Union.¹³

The US imported some 800 million litres of ethanol (all types) in 2005, predominately Brazil origin, as well as Central America. A limited amount of ethanol may be imported duty-free under the Caribbean Basin Initiative (CBI) even if most of the steps in the production process were completed in other countries. More specifically, if produced from at least 50 per cent local (CBI) feedstock, ethanol may be imported duty-free into the US market. If the local feedstock content is lower, limitations apply on quantity of duty-free ethanol. Nevertheless, up to 7 per cent of the US market may be supplied duty-free by CBI ethanol containing no local feedstock. In this case, hydrous ethanol produced in other countries (mainly Brazil), can be shipped to a dehydration plant in a CBI country for reprocessing. After the ethanol is dehydrated, it is imported duty free into the United States. According to UNCTAD, imports of dehydrated (anhydrous) ethanol under the CBERA (CBI) are below the seven per cent ceiling (approximately three per cent filled in 2005). Dehydration plants are currently operating in Jamaica, Costa Rica, El Salvador and Trinidad and Tobago. Duty-free treatment of ethanol in the United States has raised concerns within the domestic ethanol industry, particularly in the case of Brazil reprocessing shipments for re-export to capture duty-free access the US market.¹⁴

The EU imported more than 250 million litres of ethanol between 2002 and 2004, with Brazil the largest ethanol exporter, accounting for 25 percent of the total, and subject to MFN tariffs on all shipments. The remaining 70 percent of EU alcohol imports entered under preferential trade arrangements (61 percent entered duty free and nine per cent at reduced duty), including the Generalized System of Preferences (GSP, applying to many developing countries), the Cotonou Agreement (ACP countries), and the Everything But Arms (EBA) Initiative for Least Developed Countries (LDCs). Duty-free and quota-free access is granted to LDCs under the EBA Initiative,

¹³ The discussion of the US and EU biofuels trade regimes borrows heavily from UNCTAD, *The Emerging Biofuels Market: Regulatory, Trade and Development Implications*, New York and Geneva, 2006.

¹⁴ Duty-free ethanol imports played a role during the negotiations of the US-Central America Free Trade Agreement (CAFTA). However, CAFTA did not introduce major changes as the agreement did not increase overall preferential access to the U.S. ethanol market, although it did establish country-specific shares for El Salvador and Costa Rica within the existing CBI quota. The other CAFTA countries retain existing CBI benefits on ethanol.

although ethanol exports from EBA countries have been negligible. New opportunities may emerge for sugar-producing LDCs, particularly due to increased sugar cane cultivation, and opportunities that may be available due to reform of the EU Sugar Regime. ACP countries qualify for duty-free access for both denatured and undenatured alcohol. Guatemala, Peru, Bolivia, Ecuador, Nicaragua and Panama, Ukraine, South Africa, Democratic Republic of the Congo, Swaziland, Zimbabwe, Egypt and Norway also benefit from EU trade preferences. A new General System of Preferences (GSP) regulation no longer provides for any tariff reduction on denatured or undenatured alcohol, but includes an incentive scheme for sustainable development and good governance. The European Commission initiated an anti-dumping investigation against Pakistan and Guatemala for dumping ethanol in May 2005, the two largest duty-free exporters over the 2002 to 2004 period. The proceedings were dropped in 2006 when the full customs tariff was restored on Pakistani imports.¹⁵

Lack of standardization of physical trade through harmonized classifications an issue

Analysis of tariffs on the various types of biofuels, including ethanol, is complicated by harmonized trade classification issues. Classification issues are related to the assignment of categories in the Harmonized Commodity Description and Coding System of the World Customs Organization, a classification system which is used for the identification of goods in international negotiations and in the resulting schedules of tariffs and quotas. A basic question is whether biofuels should be considered agricultural, industrial (manufactured) or environmental products. Starch and sugar-based ethanol are currently classified as agricultural products, although the Government of Brazil has proposed that ethanol be reclassified as a fuel commodity.¹⁶

Further expansion in Brazil key factor in development of global market

Reports indicate plans to expand production in Brazil with the objective of doubling ethanol exports by 2010, reaching some five billion litres per year. There are 89 new ethanol distilleries either planned or under construction, with ethanol processing capacity increasing some eight percent every year. Biofuels are a major part of the Petrobras strategy, and in late 2005, the company formed a joint venture in Japan to import and distribute Brazilian ethanol in that country. Petrobras is also studying the feasibility of a USD 225 million pipeline that would transport ethanol from sugarcane growing areas in Brazil to an export terminal in São Paulo state by 2008.

2.4 International market prices

World sugar trade provides an important basis for the establishment and future development of an ethanol futures market. Currently, there is no world price for ethanol, with spot Brazilian prices for anhydrous ethanol considered the world reference price. The new ethanol contract launched by the New York Board of Trade (NYBOT) in 2004 (7 750 gallons) is an approximation of the amount of ethanol that can be produced from 112 000 pounds of raw sugar, equivalent to the size of the Raw Sugar Contract Number 11. Spot ethanol prices in Brazil tend to be volatile, and have fluctuated significantly over the past few years. Prices averaged USD 0.60 per litre in 2002 to USD 1.02 in early 2006, when sugar prices also hit 25-year high prices, oil prices remained high and US refiners were preparing to import more ethanol from Brazil to comply with the US ban on MTBEs as an additive to gasoline.

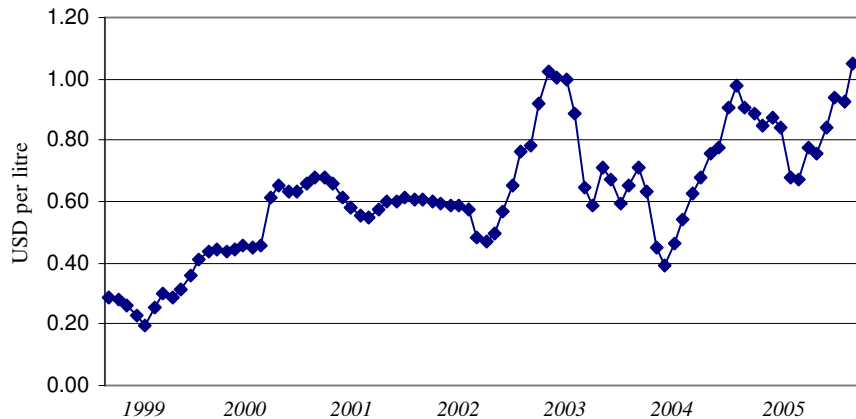
¹⁵ The Emerging Biofuels Market: Regulatory, Trade and Development Implications, UNCTAD, New York and Geneva, 2006.

¹⁶ Biofuels for Climate Change Mitigation: International Trade Issues for the G8+5 Countries 5 January 2007 (with minor revisions on 15 January 2007), Prepared for the G8+5 Climate Change Dialogue, Thomas L. Brewer, Associate Professor, Georgetown University, Washington, DC

An ethanol contract is traded on the Brazil Mercantile and Futures Exchange, although reports indicate that the contract suffers from a lack of liquidity, perhaps due to the need for terms related to physical delivery to international (ex-Brazil) ports. The new ethanol futures contract calls for Free-on-Board (FOB) vessel delivery of bulk liquid ethanol from any one of nine countries of origin.¹⁷ The NYBOT ethanol contract allows physical delivery to international ports, an important consideration in the further development of an international pricing mechanism.

Brazil Spot Ethanol Prices

Brazilian Mercantile and Futures Exchange



Ethanol export contracts from Brazil in recent years have become more similar to contracts for other internationally traded commodities, such as raw or refined sugar, soybeans or oil, a development many traders interpret as a sign that ethanol may become a world commodity. Sugarcane mills selling ethanol in Brazil have negotiated better contract and price terms to sell ethanol internationally by extending spot market volumes into longer-term contracts with flexible prices (indexed pricing formulas), particularly important given higher oil prices. Although traders indicate that the majority of ethanol export contracts are for one year duration, some mills have started seeking buyers willing to sign three-year contracts. A significant increase in domestic ethanol demand in Brazil between 2003 and 2004, due to the introduction of flex-fuel vehicles, also coincided with higher oil prices, and increased imports of ethanol from the United States as oil refiners and blending operations in 19 US states phased out MTBE.

The linkages between sugar, oil and ethanol prices are clear and very important considerations in future as the ethanol market continues to develop. Sharp increases in oil prices may tend to exert upward pressure on ethanol prices during harvest, and growing tendency to fix physical ethanol prices with the New York contract may emerge at times of volatile oil prices. The establishment of an international ethanol futures exchange was attempted during the oil crises of 1973 and 1979, however, failed due to lack of liquidity. There are considerations in the global market now that were less present three decades ago, such as concerns to abate greenhouse gas emissions for climate change mitigation and environmental sustainability.

¹⁷ The ethanol futures contract calls for Free-on-Board (FOB) vessel delivery of bulk liquid ethanol from the following country origins: Brazil, Costa Rica, El Salvador, Guatemala, Jamaica, Nicaragua, Panama, the Bahamas and the United States. The price is quoted in US cents per gallon with a minimum price fluctuation of one/tenth of one cent per gallon (equivalent of US \$7.75 per contract). Contracts are listed for Brazilian ethanol versus New York ethanol for February, April, June, September and November delivery, and ethanol must be biomass-derived, undenatured, anhydrous ethanol at 60 degrees Fahrenheit.

Impact of rising oil prices on ethanol-related demand for agricultural commodities

Normally, when crude oil prices increase, two main factors affect agricultural commodity markets. First, the production costs for the crop increase; under competitive conditions, this leads to a contraction in supply and hence raises commodity prices. Second, depending on the economics (including government incentives) of biofuel production, the increase in oil-based fuel prices provides an incentive to biofuel producers to expand production, which in turn expands demand for agricultural feedstock crops causing prices to increase further. At the same time, the expansion in biofuel supply may also be dampened by the parallel rise in commodity prices. The overall net impact on commodity markets will depend on the degree of increase in biofuel prices relative to the increase in total crop production cost. Recent analysis has shown that the effect of oil prices on production costs is comparatively much stronger than that on increased demand for biofuel related commodities, partly because the world share of bioenergy in total transport fuel consumption and the existing production capacity of biofuel remain relatively limited (Agricultural market impacts of future growth in the production of biofuels, OECD, Paris [2006]).

The impact of oil prices is likely to be greatest, however, for commodities that constitute an important source of demand for bioenergy. The best example of this is that of sugar (from sugarcane), which is currently the most economic of significant feedstock crops. In the case of sugar, there is evidence of a strong co movement between crude oil and sugar prices. A standard statistical test examined whether a long run relationship exists between these two prices and if so, how strong it is. The results showed that such a relationship does exist and it is much stronger than the price links between other seemingly unrelated commodities. In addition, it was established that signals from the oil market are transmitted much faster to the sugar market than in the reverse direction, leading to the conclusion that on average, sugar prices tend to follow oil prices.

The co-movement between sugar and crude oil prices has developed mostly because of the strong link between ethanol and sugar production in Brazil, the world's largest sugar producer and exporter accounting for about 38 percent of world exports and 19.5 percent of production. The growing number of Brazilian flex-fuel vehicles which can run on any combination of gasoline and ethanol directly influences the demand for ethanol. As consumers react to the relative price differential between ethanol and gasoline, any increase in the price of gasoline stimulates demand for ethanol, reduces sugar exports and raises world sugar prices. Similarly, a decline in crude oil prices would result in reduced ethanol consumption, a greater diversion of sugar volumes onto the world market, and a downward pressure on world sugar prices. At the world level currently, it is estimated that about 15 percent of sugar crops are converted into ethanol rather than sugar.

FAO Trade and Markets Division, Food Outlook, Ethanol Overview, June 2006

3 Market Situation and Outlook

Recent developments in the global ethanol market suggest the emergence of ethanol as an internationally traded commodity. Demand growth is robust, and for the first time, strongly supported not only by higher oil prices and greater need for energy security, but perhaps more importantly, by global environmental and sustainability concerns. Biofuels, such as ethanol, are central to worldwide efforts to abate greenhouse gases and mitigate climate change. Reports indicate that bioenergy could supply a maximum of slightly more than thirty percent of total global energy demand. Some developing countries, particularly Brazil, India, Thailand, Malaysia, Indonesia and potentially a number of African countries, such as Tanzania or Mozambique, have underutilised land and natural resources that could be used to significantly expand liquid biofuels production if oil prices stay high or increase further.

Latin America may continue to lead the world in sugar-based ethanol production, given high yielding sugarcane crops and the rich agricultural and natural resource base of many Latin American countries. Already important trade flows of ethanol from South America to North America, Japan and South Korea are likely to become more important. Additional export trade from Latin America to the European Union may emerge if the EU biofuels directives are implemented. A third trade flow in the Americas could consist of raw alcohol (anhydrous) from Brazil to the Caribbean for rehydration (reprocessing) and duty-free entry into the United States, although this volume is limited to seven percent of total US ethanol demand. India, Thailand and

Australia may emerge as small to medium sized exporting countries. Southern Africa is another potentially important supplier to the world market because of relatively high sugar cane yields and some under-utilized areas. Duty-free access to the European Union under the EBA may provide some significant opportunities for market development based on Southern African origin. Malawi, already a sugar-based ethanol producer (from molasses desugarization), initiated a pilot project to test the applicability and feasibility of flex-fuel vehicles in that country.¹⁸ Further development of the international ethanol market requires a long term commitment to research, blending mandates, domestic supports and a focus on systematic market development at all levels.

Globally, annual growth in ethanol output could be as much as 10 percent according to FO Licht. Cellulosic conversion of biomass into ethanol could reduce the cost of converting sugarcane into ethanol in the future, but could also potentially make investments in first generation processing technologies, particularly capital intensive sugar and ethanol processing facilities, obsolete as second generation fuels emerge at industrial scale. Challenges would include development of high tonnage varieties of sugarcane as well as economic processing costs of cellulose on a commercial scale. Currently, there is commercial scale production of ethanol from cellulosic biomass, however, research and development pilot projects are underway in the United States, Canada and Sweden. Cellulosic biomass may begin to supply feedstock for biofuel production at commercial scale within the next 10 to 15 years.¹⁹

The rate of growth in world is dependent upon several key factors. New investments are necessary that will diversify and expand the global supply base for ethanol export trade. New partnerships between importers and producer-exporters may be necessary, particularly if global ethanol (and other biofuel) output must increase rapidly, not only to meet growing world demand, but also to help forge trade that is environmentally sustainable – and this means investment assistance for many developing countries. New ways to price ethanol internationally are necessary, particularly vis-à-vis a futures market that would provide international delivery points, as well as provide the possibility to hedge risk against price volatility.

Bilateral and regional trade agreements have emerged as more reliable mechanisms to remove tariffs and non-tariff barriers that may affect biofuels trade than the Doha negotiations. Standardization of trade classifications is necessary, as well as ways to certify and label biofuels and feedstock to ensure that sustainability criteria contribute to global environmental goals, particularly those related to climate change mitigation. Furthermore, the emergence of carbon trading programmes related to ratification of the Kyoto Protocol may enhance the competitiveness of biofuels, particularly ethanol. Ethanol consumption, particularly sugar-based, results in reduced greenhouse gas emissions, thus, earning carbon credits that can be sold through the carbon markets. Japan and the EU have launched carbon-trading programmes, and similar carbon schemes may continue to emerge worldwide.

¹⁸ The five-year project is investigating the practicability of flex-fuel vehicles that use either 100 per cent locally manufactured ethanol, or a combination of ethanol and petrol (funding is USD 1 million). All cars in Malawi used leaded petrol blended with 20 per cent ethanol until February 2006, when the country switched to unleaded petrol blended with 10 per cent ethanol. Lilongwe Technical College is conducting the project jointly with the Department of Science and Technology, Government of Malawi.

¹⁹ Iogen, a firm based in Canada, announced in late 2004 its intention to build the first commercial-scale cellulose-to-ethanol plant. The plant, which takes leftover straw from surrounding farms and turns it into ethanol, is expected to come on stream in 2007, and should demonstrate that cellulosic technologies should put much less pressure on traditional crops, once commercially available. Cellulose-rich feedstock comprise agricultural wastes, including those produced during production of food crops and forest products (e.g. straw and leaves) and those resulting from conventional ethanol production (e.g. wheat straw, maize stover, rice straw and bagasse) and forest residues, such as under-utilized wood and logging residues, dead wood and excess small trees. They also include municipal solid wastes, such as wood, paper, cardboard and waste fabrics; wastes from the pulp and paper processes; and energy crops, such as switchgrass, miscanthus, hybrid poplar and willow.

Subsidized ethanol production and supports to domestic industries tend to provide justification for high import tariffs and the protection of infant industries, certainly the stage of emerging ethanol industries at the current time. Fuel ethanol supplies, particularly, will continue to be volatile in the absence of an effective international exchange and trade.²⁰ Despite some possible constraints, ethanol production, particularly fuel ethanol, is expected to continue to increase globally, with a greater number and diversity of global producers and suppliers. There are signs that ethanol is becoming an internationally traded commodity, with the promise of contributing to climate change mitigation, rural development and environmental sustainability.

²⁰ World Fuel Ethanol Analysis and Outlook, Dr. Christoph Berg, FO Licht, April 2004.

BRAZIL MERCANTILE AND FUTURES EXCHANGE
ANHYDROUS FUEL ALCOHOL FUTURES CONTRACT SPECIFICATIONS

<http://www.bmf.com.br/portal/pages/contratos2/pdf/cl130.pdf>

1. Underlying commodity - Anhydrous fuel alcohol, in accordance with the technical specifications of the National Petroleum Agency (ANP):

Methods of analysis

Characteristics Unit Specifications ABNT (1)/NBR (2) ASTM (3)

Appearance – (4) Visual

Color – Colorless to slightly yellow Visual

Total acids (as acetic acid) mg/l 30 max. 9866 D1613

Electric conductivity $\mu\text{S/m}$ (5) 500 max. 10547 D1125

Specific mass at 20°C kg/m³ 791.5 max. 5992 D4052

Alcohol content °INPM (6) 99.3 min. 5992 –

Ethanol content (7) % vol. 99.3 min. – D5501

Hydrocarbon content(8) % vol. 3.0 13993 –

Copper mg/kg 0.07 max. 10893 –

(1) Brazilian Association for Technical Standardization.

(2) Brazilian standard.

(3) American Society for Testing and Materials. The described methods may be used as alternative methods for imported alcohol characteristic evaluation, with the exception of the ASTM D4052 method, which can be used as an alternative method to determine specific mass.

(4) Clear and free of suspended matter.

(5) MicroSiemens/meter.

(6) National Institute of Weights and Measures.

(7) Required when the alcohol is not produced from sugar cane fermentation.

(8) Limits required for importation and distribution. For the producers to issue the Quality Certification an analysis is not required.

2. Price quotation - Brazilian Reals per cubic meter (1,000 liters) to two decimal places, free of any charges both tax-related and not tax-related.

3. Minimum price fluctuation - R\$0.20 (twenty cents of a Brazilian Real) per cubic meter.

4. Maximum daily price fluctuation - As established by BM&F in Circular Letters.

At any time, the Exchange may alter the price fluctuation limits, as well as their applicability to any delivery month.

5. Contract size - 30 cubic meters (30,000 liters) at 20° C (Celsius).

6. Delivery months - All months.

7. Number of authorized delivery months - Minimum of seven, as authorized by BM&F.

8. Last trading day - The sixth business day of the delivery month. On that day, neither opening of new short positions nor day trading shall be allowed.

9. Business day - For the purposes of this contract, a trading day at BM&F shall be considered a business day. However, for the purposes of the payment and receipt of amounts, as referred to in items 10, 11, 13.5, and 18.1, a day that is not a banking holiday in New York, USA, and is a trading day at BM&F shall be considered a business day.

10. Day trading - Buying and selling on the same day the same number of contracts for the same contract month shall be offset provided the transactions are executed on behalf of the same customer through the same Commodities Brokerage House and registered by the same Clearing member, or performed by the same Local and registered by the same Clearing Member. These transactions shall be cash settled on the following business day and their amounts shall be calculated in accordance with item 11(a), in observance to the provisions of item 19, where applicable.

**NEW YORK BOARD OF TRADE
CONTRACT SPECIFICATIONS**

ETHANOL FUTURES

Rule 12.00 Contract Terms

(a) No contract for the future delivery of Ethanol shall be recognized, acknowledged or enforced by the Exchange, or any committee or officer thereof, unless both parties thereto shall be Members, provided, however, that Members shall offer their contracts for clearance to the Clearing Organization which shall become by substitution a party thereto in place of a Member, and thereupon the Clearing Organization shall become subject to the obligations thereof and entitled to all the rights and privileges of a Member in holding, fulfilling or disposing thereof.

(b) The Ethanol deliverable under the Ethanol Futures Contract shall be biomass-derived, undenatured, anhydrous ethanol at 60° Fahrenheit meeting the following criteria*:

(i) *Ethanol content minimum volume of 98%; determined using ASTM D 5501-94 (Reapproved 1998)² or any further amended version of such standard.*

(ii) *Methanol content maximum of 5,000 ppm (parts per million) by volume; determined using ASTM D 5501-94 (Reapproved 1998) or any further amended version of such standard.*

(iii) *Solvent-washed gum content maximum of 5.0 mg/100ml; determined using ASTM D 381-03 or any further amended version of such standard.*

(iv) *Water content maximum volume of 0.8%; determined using ASTM E 203-01 or any further amended version of such standard.*

(v) *Inorganic Chloride content maximum mass of 40 ppm; determined using ASTM D 512-81 (1985)^{e1} Procedure C or any further amended version of such standard.*

(vi) *Copper content maximum of 0.1 ppm; determined using ASTM D 1688-02 Test method as modified in D 4806 or any further amended version of such standard.*

(vii) *Acidity (as acetic acid CH₃COOH) maximum of 70 ppm; determined using ASTM D 1613-03 or any further amended version of such standard.*

(viii) *pHe 6.5 to 9.0; determined using ASTM D 6423-99 or any further amended version of such standard.*

(ix) *Appearance - visibly free of suspended or precipitated contaminants (clear and bright)*

(c) For the purpose of the Ethanol Futures Contract Rules, the term ‘origin’ shall mean either the geographic location where the Ethanol’s anhydrous state is achieved or where the Ethanol is stored. The origins deliverable under the Ethanol Futures Contract are as follows:

(i) *Brazil, Costa Rica, El Salvador, Guatemala, Jamaica, Nicaragua, Panama, the Bahamas and the United States.*

(ii) *An origin may be added or deleted as deliverable, upon recommendation by the Ethanol Committee, by action of the Board by a two-thirds vote of the Board; provided that any such addition or deletion shall only affect deliveries in months beyond the last month in which there is an open Position at the time of such action of the Board.*

*The above chart addresses specification requirements for biomass-derived denatured anhydrous ethanol. This chart is based upon a copyrighted chart in standard D 4806 for denatured fuel ethanol of ASTM International, 100 Barr Harbor Drive, W. Conshohocken, PA 19428-2959 and refers to a number of copyrighted ASTM International standards. The information is used with permission; ASTM International, however, is not responsible for any changes made by the Exchange. The two-digit code following the ASTM standard refers to the year such standard was last updated. The year in parentheses refers to a later edition with no amendments to the cited standard.