II. GLOBAL LANDSCAPE

1. SOUTH AMERICA

Source: World Factbook

A) INTRODUCTION

The opportunities presented by biofuels are commanding attention throughout the region. As in other parts of the world, a desire to ease dependence on petroleum-based energy sources and concern about environmental degradation are driving much of this interest. There is also a strong desire in South America to increase the economic returns of the basic agricultural commodities on which much of the region relies. These combined pressures have prompted various efforts to promote biofuels research and production.

Brazil clearly leads the field, and many of its neighbors look to the Brazilian model as a guide for their own development plans. In countries as diverse as Argentina, Colombia, and Peru, governments are seeking to create the infrastructure and regulatory and financial framework for the nascent industry. Private sector participation is uneven, with Argentina and Colombia leading the way.

B) GOVERNMENT POLICIES

Several common assumptions underlie official efforts to support the regional biofuels industry:

1. A recognition that a clear regulatory framework for the industry is essential to encouraging investment.

2. A desire to create a mix of incentives and mandates to support biofuels, including tax breaks, R&D support, and mandatory fuel blending standards.

3. An understanding that extensive agricultural reform will be necessary to increase feedstock availability, including improving productivity and extending acreage under cultivation.

4. A realization that private sector investment, including foreign investment, must provide the bulk of the capital for the industry's production, processing, and transport needs. A further realization that foreign capital will be critical in facilitating technology transfer.

The pace at which countries in the region are acting on these understandings varies depending on existing resources, the organization of the agricultural sector, R&D capacity, attractiveness to foreign investment, and perhaps most importantly, the political will of the government.

Argentina and Colombia are perhaps best placed to realize their biofuels production potential. Chile's program is in the early stages, but the country has the organizational capacity to move forward rapidly. Peru has taken important steps but has yet to put in place a comprehensive framework for development of the industry. Much work remains ahead for Bolivia and Ecuador, which have only embryonic biofuels efforts. Venezuela, with its huge oil reserves and deficit in sugar production has not made biofuels a priority.

Policy Implementation
In Colombia, the Uribe Administration has pushed for a more robust ethanol industry. Since 2001, a series of laws and regulations have established fuel blending mandates, regulatory standards, and incentives for biofuels production. Colombia's fuel oxygenation program now covers 57% of the country.

Argentina enacted a new biofuels law (informally known as SFL) in 2006. While similar to the Brazilian approach in terms of incentives, fuel blending requirements, and regulatory authority, it lacks purchase guarantees and provisions for the involvement of small-and-medium size enterprises. In addition, the requirement that fuel blending be performed at the petroleum refinery will entail major additional infrastructure expenditures for transport. Implementing regulations for the SFL, expected to emerge from the Congress in the coming months, will provide a clearer indication of the resources that will be available to this new sector.

Peru has established an initial legal framework for the promotion of biofuels and put in place a Program for Biofuels Promotion and a Technical Commission for Biofuels. The Amazon region is receiving particular attention as a source of biofuels production. However, implementing regulations are still needed to guide potential investors. For its part, Chile is just beginning to address biofuels. There is currently no production, and the Renewables Law passed in 2003 still awaits needed regulatory guidelines. With its significant production of wood chips, Chile's greatest potential likely will be in cellulosic biofuels research.

Ecuador has instituted policies to promote fuel diversification and has significant potential feedstock resources in sugar and palm oil. However, the absence of a clear regime for investment and agricultural expansion is a substantial obstacle to further development. Venezuela, as a major oil producer and net importer of sugar, has an

agreement with Brazil for ethanol, but has not acted to promote domestic production. Bolivia has established fuel blending mandates but has not drafted concrete plans for sugarcane-based biofuels production. With an appropriate regulatory and investment framework, significant potential exists in this sector, as well as for soy-based biodiesel.

Cooperation with Brazil
Brazil conducts a range of cooperative activities on biofuels with most of the countries in the region. Peru has a cooperative research program with Brazil on biotechnology and biofuels, and the two countries recently signed an agreement to jointly develop alternative crops for biofuels. The state oil companies of Brazil and Colombia have a technical cooperation agreement on information sharing and joint ventures in which biofuels figure prominently. Chile and Ecuador have not formalized relationships with Brazil on biofuels, but there are informal efforts to share information and develop a common agenda. Cooperation between Argentina and Brazil has occurred at the provincial level and through broader energy consultations in Mercosur. Biofuels cooperation between Venezuela and Brazil is conducted through the national oil companies, PDVSA and Petrobras.

C) CURRENT SITUATION

The overwhelming proportion of biofuels production in the region goes to domestic consumption, in many cases by same entities that produce the fuel. Only Brazil has measurable exports. It sent 340 million liters of ethanol to the United States in 2004, over 140 million liters in 2005 and a projected 1.2 billion liters in 2006. Tariff barriers are an important obstacle to expanding exports to the US market. Colombia and Peru, which have negotiated free trade agreements with the United States, have a potential advantage in this respect. Indeed, Colombia is planning a major expansion of its palm oil production as a biodiesel feedstock, with an eye to the export market.

D) PRIVATE SECTOR

Private-sector interest and activity tend to follow government engagement. In Colombia, where there are already five operational ethanol distilleries, a variety of investment projects have been announced, largely by Colombian groups but with some foreign involvement, including Svensk Etanol of Sweden. In Argentina, about 20 private companies currently produce biofuels, but principally for their own consumption. In the biodiesel sector, however, investors are pursuing commercial production, with the participation in one case of the Spanish firm Repsol. Japan's Mitsui is also studying the possibility of building an ethanol plant in the province of Santa Fe.

There is some minor local investment in Peru, and China has expressed interest in an ethanol investment in Ecuador. In Bolivia, limited production capacity exceeds even more limited demand, and in Venezuela, PDVSA, in cooperation with Petrobras, is the sole investment player in the sector.

E) RESEARCH & DEVELOPMENT

Regional R&D activity is unevenly distributed. A broad range of research activity exists in Colombia, including a public-private partnership, the Corporation for Industrial Development of Biotechnology and Clean Production; research sponsored by the state oil company, Ecopetrol; university research into palm oil based biodiesel; and work by the sugar and palm oil producers associations to improve yields and identify optimum varietals for feedstocks. In Argentina, where there is a long history of interest in biofuels, Repsol YPF has established a Biofuels Research Center, giving the private sector a leading role in the R&D effort. Government research remains limited in scope. However, several universities are promoting biofuels, and particularly biodiesel, through research and involvement in initiatives like the New Technologies for Biofuels Network. Elsewhere in the region, R&D efforts are much more limited.

Source: World Factbook

A) INTRODUCTION

Argentina has both the means and the motivation to pursue large-scale production of biofuels. The country is the world's largest exporter of soybeans, a primary biodiesel feedstock, and boasts a sophisticated agribusiness sector. Argentina is also heavily dependent on fossil fuels and is seeking ways to diversify its energy matrix. These conditions have already prompted soy farmers to produce biodiesel for their own use in a bid to reduce their exposure to volatile prices.

The Argentine government is taking the lead in creating the conditions for the development of a domestic biofuels market, both through production incentives and demand guarantees in the form of mandatory blends. Complementing the government's initiative, the academic and private sectors have engaged in research and development and invested in production facilities. As the biofuels industry expands, however, current infrastructure constraints might become a substantial obstacle.

B) GOVERNMENT POLICIES

Background

The Argentine government has a long history of promoting the biofuels industry, which began in 1922 with preliminary studies on the domestic use of ethanol as an engine fuel. In 1928, the first successful experiment was completed using a Ford Model T and an 80% ethanol mix. In 1979, several Argentine automakers helped create the country's first ethanol program (Programa Alconafta).

By 1985, the country's entire northwest region had become part of the program, and a second phase, to promote sugar exports, was about to begin. Then, a series of bad harvests, the high price of sugar in the international market, and unfavorable internal market conditions nearly drove the ethanol industry to extinction by the early 1990s.[1]

It was not until 2001 that the government reestablished the National Program for Biofuels (Resolution 1076/2001). Together with the Biodiesel Competitiveness Plan (Decree 1396/2001) it brought new light to the decaying industry.[2]

In 2004, the Secretary of Agriculture, Cattle, Fish and Food joined the renewed effort by issuing its own National Biofuels Program to promote the production and use of biofuels, support and advise the rural sector, collaborate with institutions dedicated to R&D, and advertise the use of biofuels as a way of promoting public and private investment.[3]

The New Biofuels Law

Most recently, the Argentine government provided a general legal framework for all these programs by approving the Ley de Biocombustibles.[4] Also known as Senator Falco's Law, or simply SFL, it establishes new rules to promote the biofuels industry and closely follows the Brazilian model.[5]

In particular, the SFL designed a combination of fiscal incentives and blending quotas to promote the industry. It also provides tax breaks for biodiesel and ethanol producers, including exemption from (a) the Value-added Tax (VAT) on capital goods and infrastructure projects related to these activities; (b) the income tax on goods affected by

production; (c) the Hydro-Infrastructure Tax (Tasa de Infraestructura Hidrica); and (d) the general fuels tax. On the mandates side, the SFL required a 5% blending of biodiesel into regular diesel and of ethanol into gasoline by 2010. Together, the provisions aimed to encourage investment and provide a consumer base for the biofuels industry. New investment is expected to stimulate the development of infrastructure and technological research.[6] The SFL made the executive branch responsible for regulating the biodiesel market and tasked the National Assistant Commission with supporting the executive and suggesting policy adjustments.[7]

In most respects, SFL mirrored Brazilian legislation. But the similarities end when it comes to offering benefits to biofuels producers. In particular, the Argentinean model does not (a) guarantee minimum biodiesel purchases; (b) establish future brackets for biofuels blends; or (c) require any sort of social engagement by biodiesel producers. Small-and-medium enterprises are likely to receive more benefits, but their participation is not currently a requirement under the legislation.

The SFL also creates a significant obstacle to efficient production through its requirement that the 5% blending take place at petroleum refineries. Experts have pointed out that in many cases pure biofuels will need to be transported hundreds of kilometers to reach the few existing large refineries that supply the country and the international market.[8]

The SFL was approved by both houses of congress on May 12, 2006, and President Kirchner signed the regulatory framework into law in February, 2007. The law creates the obligation to replace naphtha and diesel with a minimum 5% biofuels blend by 2010, which would equal 600 million liters of biodiesel and 250 million liters of ethanol. The government will provide direct subsidies to spur production and VAT refunds to attract investment.[9]

Local Government Involvement

The SFL does not mandate provincial involvement in biofuel development. Instead, it extends an invitation to all provinces that wish to join the central government's biofuels efforts.[10] Several provinces have accepted that invitation. Rio Negro recently signed an agreement with the Ministry of Production and the Biocoms Foundation to launch a program for the production and consumption of biofuels in the province. The Province of Entre Rios announced in July 2006 that it would begin 16 refining projects, several of which will be devoted to the production of biofuels. In addition, the Province of Buenos Aires has been researching the feasibility of constructing a processing plant, an inititiave known as the Biocom Project.[11] Neuquen Province is also promoting a study, called CODESU (Consortium for the Sustainable Development of Ucayali) to assess the feasibility of opening a biodiesel plant. In addition, Argentina's Santa Fe province recently created an energy department that will oversee all issues related to biofuels. The government will provide incentives, including the transfer of public land without charge, and hopes to attract biofuels experts able to provide technical support to the developing industry.[12]

Relations with Brazil and Regional Cooperation

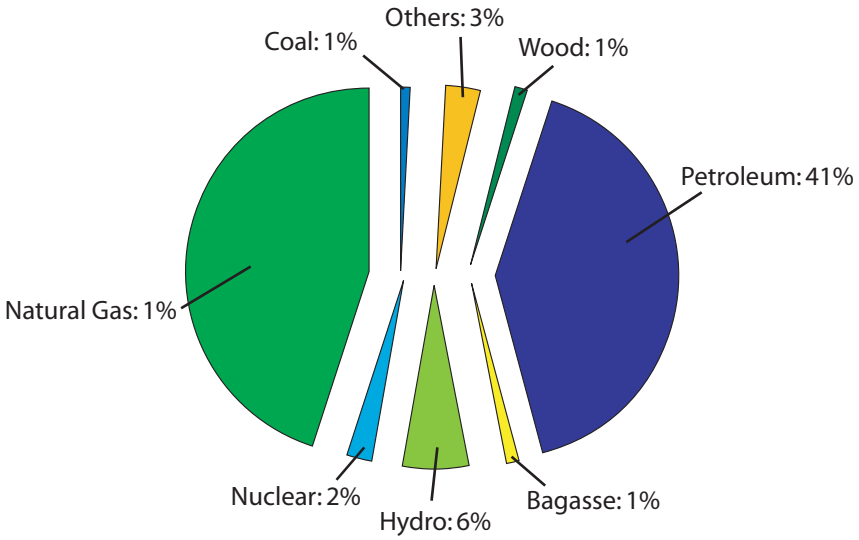
At the moment, there are no formal cooperation agreements between Brazil and Argentina on bioenergy issues. Neuquen province launched a research program in partnership with Petrobras to advance the production of biofuels in the province, but the program has not advanced significantly in the three years since it was signed. Argentina and Brazil have, however, engaged in extensive discussions on a unifying energy regulatory framework through the regional organization Mercosur.

C) CURRENT SITUATION

Energy Matrix

A glance at Argentina's energy matrix shows how small a role bioenergy plays today. Combined, fossil fuels represent almost 88% of Argentina's energy use.

Chart 1.1.a: Argentina's Energy Matrix (2004)

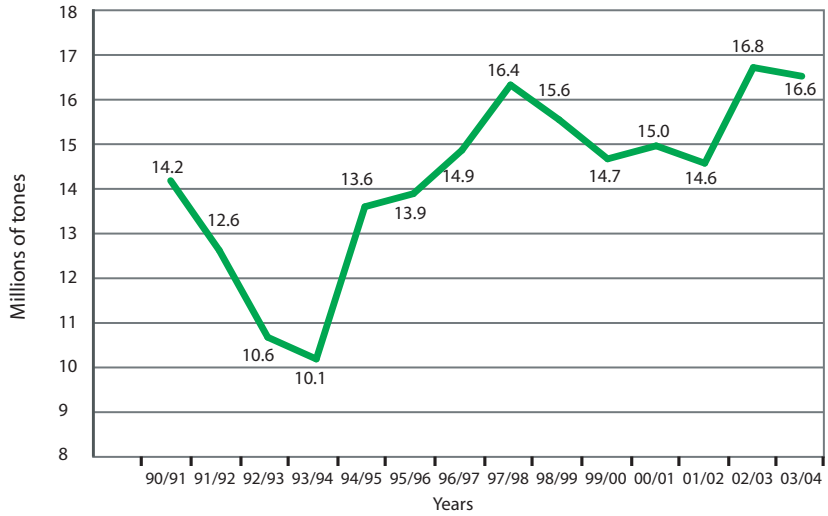


Source: Secretary of Energy

Ethanol Production

Once a growing industry, the ethanol sector today is largely dormant. In Argentina, as in Brazil, sugarcane is the main feedstock. For climate reasons, production of sugarcane is concentrated in the north of the country, called the NOA region, which accounts for 98% of domestic sugarcane production.[13]

Chart: 1.1b: Sugarcane Production in Northern Argentina (NOA)



There is not yet any significant production of sugarcane for ethanol. However, SFL's mandatory blending provisions will likely change that soon. Indeed, it is expected that demand for ethanol may reach 200 million liters by 2008.[14]

Biodiesel Production

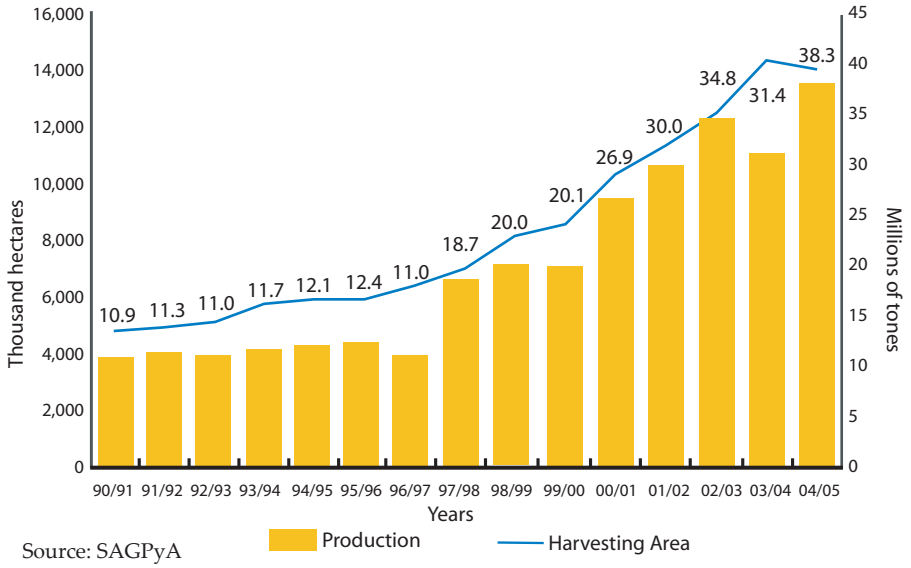
The production of biodiesel is relatively new and difficult to quantify. Most biodiesel is used by the same companies that produce it to fuel their own machinery and processing plants. Vegetable oils and a small portion of animal fat have supplied the necessary raw materials for existing biodiesel production.

Argentina produces a large amount of soy and sunflower seeds, and any expansion

in biodiesel production would likely rely on those crops.[15] During the last 15 harvest seasons (from 1990-91 to 2004-05), Argentina tripled its soy production, to 38.3 million tons. It is now the world's third largest soy producer and the largest soy oil exporter. Genetic upgrading of seeds and more advanced harvest management have ensured that production increases continue despite fluctuations in climatic factors.[16]

In 2003, there were 45 soy plants with a processing capacity of 98,000 tons per day, which increased to 100,000 tons per day in 2004. With a similar amount of land harvested, total production grew by 21.2% during 2004-05 and has increased slightly in 2006. Even this scale of growth is not enough to meet increasing demand, however, and processing companies have already announced major new investments.

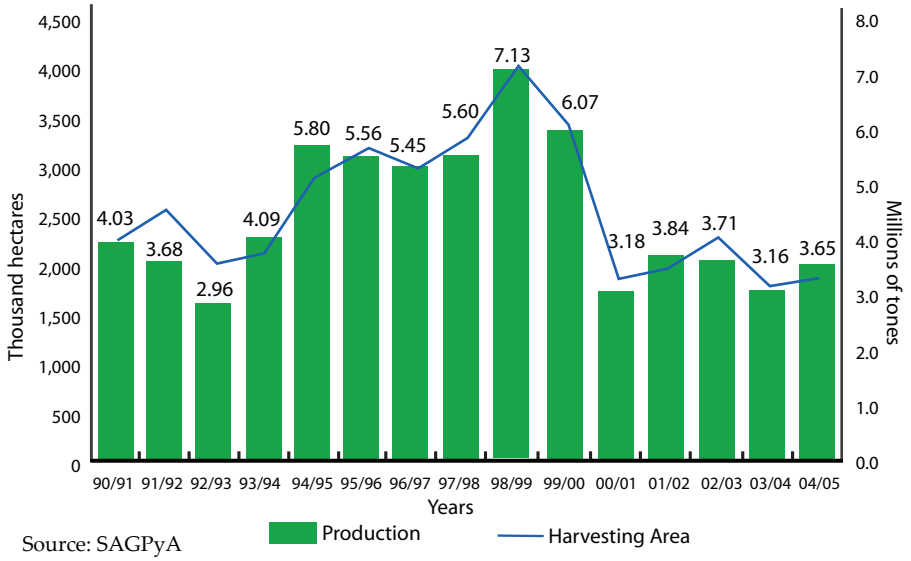
Chart 1.1c: Soy Production and Harvesting Area



Source: SAGPyA

Sunflower is a distant second to soy as a likely feedstock, though both crops may be needed to meet demand increases associated with blend requirements. The sunflower industry shows clear signs of expansion. Most factories are small and further investments to expand land and increase production are announced on a regular basis.

Chart 1.1d: Sunflower Production and Harvesting Area



Source: SAGPyA

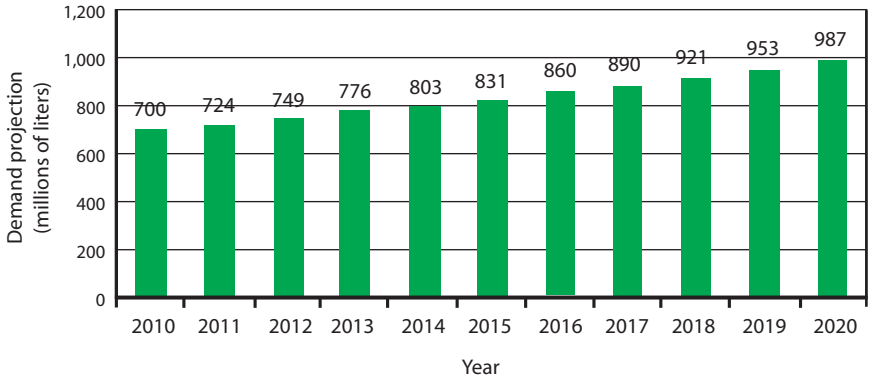
Table 1.1a: Cultivated Land Area for Soybeans Required to Substitute Current Diesel Consumption

Table 9. Cultivated land area for soybeans required to substitute 5 %, 10 %, 50 % and 100 % of current diesel consumption in Argentina

Fuel blend	Total consumption, 2004 (Mt/year)	Equivalent quantity of soybean (Mt)	Land required (Mha)	% of total cultivated area in 2004
Diesel	11.4			
B5	.57	3.167	1.435	8.9
B10	1.14	6.333	2.871	17.8
B50	5.7	31.667	14.353	89
B100 (pure biodiesel)	11.4	63.333	28.71	178

Source: Bakovich, 2005

Chart1.1e: Projection of Biodiesel Demand



Projection of biodiesel demand between 2010 and 2023 assuming a 5% blend in diesel, and a 3.5% annual growth in fuel demand. Source: IIR-INTA, 2005.

Demand for biodiesel should reach 650 million liters by 2008, and over one billion liters by 2023.[17]

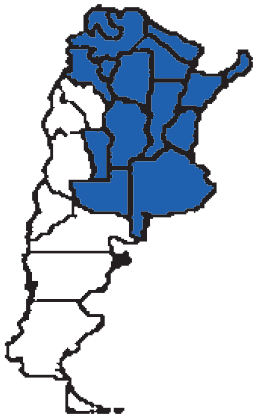
Production and Supply Chain Infrastructure

Because the biofuels industry is at an early stage of development, the necessary supply chain has not yet been established, and the future shape of the production chain remains unclear. Producers foresee that logistics (storage facilities, shipping procedures, etc.) will be a major obstacle as the industry grows. They insist that Argentina's biofuels infrastructure will need major improvement if the country is to meet the blending mandate established by the SFL. For example, there are still no storage tanks or prepared locations near ports for the processing plants. The government expects that the new legal framework will prompt the needed infrastructure, as the private and public sector combine resources through concessions and partnerships. To date, however, no biofuels infrastructure projects have begun, the new tax incentives notwithstanding.

Production Capacity and Land Availability

Argentina's climatic conditions, especially in the central and northern regions of the country, lend themselves to cultivation of feedstock, including sugar, soy, corn and sunflower. Argentina has 90.5 million hectares of arable land, only 30% of which (27.2 million hectares) is in use.

Map 1.1a Geographic Dispersion (Soy, Sunflower)



Source: SAGPyA

The possibility of expanded soy production has created concerns about the desertification that may accompany extensive harvesting. To address this concern, the Argentine Secretary of Agriculture is studying the potential of other crops, such as canola.[18]

D) PRIVATE SECTOR

As of May 2006, there were nearly twenty companies producing biofuels in Argentina. An estimate by the Argentine Secretary of Agriculture indicates that there is significant investment in the biodiesel industry, but almost none in ethanol. What interest there is in ethanol is in applying US technology for corn-based production, but no projects have been decided upon as of yet.

The main companies investing in biodiesel for commercial purposes, rather than for internal consumption, include:

OilFox has recently announced that it will build a plant to produce around 20-30 million liters per month. The company is promoting research into new technologies and has resources available for the development of a biodiesel processing facility that employs used oil as feedstock. In addition, the company has reached an agreement with the Argentine Air Force to conduct biodiesel tests on aircraft.[19]

Repsol-YPF will invest $30 million in a new biodiesel plant, scheduled to become operational in 2007, which will produce 120,000 tons per year.[20]

Grupo Vincentín, a major Argentinian vegetable oil producer, has announced a $25 million investment to build a biodiesel processing plant that will reach production levels of 300,000 tons annually. Grupo Vincentín is already planning further investments of approximately $75 million on a new plant that would export most of its production to Germany.[21]

BIOFE has a production plant in Santa Fe with capacity to produce 15,000-20,000 liters per day.

Horreos de Argentina Project, through an alliance with West Central Iowa, will produce soy flour specialized for the production of biodiesel.

In the ethanol industry, there appears to be only one relevant private-sector player:

Mitsui Argentina, a subsidiary of the Japanese Mitsui Co., is studying the possibility of opening an ethanol plant in the city of Rosario, in the province of Santa Fe.

E) RESEARCH & DEVELOPMENT

Research and development has grown significantly in the past few years with the involvement of the private, public, and academic sectors.

A highlight in the private sector is Repsol-YPF's project to study the potential of biodiesel production in Argentina. The company announced the creation of a Biofuels Research Center (Centro de Investigaciones de Biocombustibles) to be opened in the city of La Plata. As one of ten major private oil companies in the world, the largest private energy company in Latin America, and the largest refiner of petroleum in Argentina, Repsol-YPF's engagement suggests a favorable trend in the local biofuels industry.[22] OilFox's agreement with the Argentine Air Force to test biodiesel is a further sign of private-sector activism.

The Academic community has also become involved with the growing biofuels industry. The Buenos Aires Engineering University (FIUBA), for instance, recently established a dedicated Renewable Energies Department. The initiative is helping design pilot-projects for biodiesel production in the laboratory, studying the physical and chemical properties of biodiesel, and conducting engine tests with biofuels. In addition, the university is part of a "New Technologies for Biofuels Network", which helps coordinate a wide range of researchers from across Latin America.[23]

Another significant initiative comes from the National Technology University (UTN)'s Córdoba campus, which hosts a Technology Research Center (Citelac). The center has been conducting a series of lab tests to obtain biodiesel from animal fat. Cintec has successfully transformed pig fat into biodiesel and is encouraging local meat plants to supply the necessary raw material, which is currently wasted. On its Buenos Aires campus, UNT is developing another series of experiments, in partnership with the Universidad Nacional del Litoral and the Institute for Rural Engineering, to improve the energy efficiency of biodiesel with different types of engines and crop yields.[24]

Federal and local governments now provide direct support to some research projects. The Argentine Secretary of Science and Technology, for example, recently approved a $35,468 grant for a feasibility study on extracting pure hydrogen from ethanol and using it for car fuel.[25] The government of Buenos Aires province has been researching biofuels since 2000 through the Biocom Project.[26]

F) CONCLUSION

Argentina has a decades-long, but fitful experience with biofuels. Its vast agricultural resource base (including sugar, soy, corn, and oilseeds), relatively sophisticated economy, and educated populace make it a potentially significant producer. Although various initiatives have been launched in the past few years, including a newly enacted federal biofuels law that offers tax breaks and mandates fuel blending, considerable work remains to provide adequate incentives and establish a workable framework for infrastructure development. Transportation and storage capacities are limited, and national and local government roles have to be better defined. R&D activities have been expanding and several new private initiatives are underway in the biodiesel sector (although none in ethanol). Technical cooperation with Brazil, which is now rudimentary, could help remove obstacles to increased production. With the right combination of regulatory measures, infrastructure financing, and efforts to attract foreign investment, the biofuels sector could become significant.

Endnotes

[1] SAGPyA & IICA Argentina, Perspectivas de los Biocombustibles en la Argentina y en Brasil (Buenos Aires: SAGPyA & IICA Argentina, Oct. 2005), 41.

[2] The National Program for Biofuels passed formally as Resolution 1076/2001 along with the Biodiesel Competitiveness Plan as Decree 1396/2001. In that same year, Resolution 1076/2001 addressed eventual environmental concerns and problems related to the industry, and the Secretary

of Energy and Mining issued the Resolution 129/2001, which determined quality requirements for pure biodiesel (B100).

[3] SAGPyA, 23.

[4] Argentina, Ley de Biocombustibles 26-093/2006 (Buenos Aires: Republic Argenitna, 2006).

[5] Shafik Asal, Rémi Marcus and Jorge A. Hilbert, "Opportunities for and Obstacles to Sustainable Biodiesel Production in Argentina," Energy for Sustainable Development X.2 (2006), 49.

[6] Ibid, 51, 55.

[7] Argentina, article 2-4, Ley de Biocombustibles 26-093/2006 (Buenos Aires: Republica Argenitna, 2006).

[8] Ibid.

[9] "Kirchner Signs Biofuels Law Regulatory Framework – Argentina," Business News Americas, 12 Feb. 2007 <http://www.bnamericas.com/story.jsp?sector=9&idoma=I&noticia=382080>.

[10] Argentina, article 20, Ley de Biocombustibles 26-093/2006 (Buenos Aires: Republica Argenitna, 2006).

[11] SAGPyA, 49.

[12] "Santa Fe Creates Energy Department with Biofuels Focus – Argentina," Business News Americas, 2 Feb. 2007 <http://www.bnamericas.com/story.jsp?sector=9&idioma=I&noticia=381005>.

[13] SAGPyA, 43.

[14] Ibid, 48.

[15] Ibid.

[16] Ibid.

[17] Argentina, Secretary of Agriculture, Cattle, Fishing and Food, 12 Oct. 2006 <www.sagpya.gov.ar>.

[18] La Nacion, 30 May 2006, Oct. 2006 <http://www.lanacion.com.ar/>.

[19] Ibid.

[20] Ibid.

[21] "Construirán una planta de biodiésel en San Lorenzo," Diario La Nacion, 6 May 2006, 30 May 2006 <http://www.nuestromar.org/noticia.php?tp=28&nt=7101>.

[22] Diario La Nacion, 7 June 2005, 12 Oct. 2006 <http://www.lanacion.com.ar/>; Diario El Cronista 12 Dec. 2005, 12 Oct. 2006 <http://www.cronista.com/.>

[23] Silvia Daniela Romano, "Cultivos no tradicionales y su Impacto en las Economías Regionales," Jornadas sobre Biocombustibles, Mendoza, 3-4 April 2006.

[24] "Una Nueva Aplicación: Buscan Hacer Biodiesel con Grasa Vacuna," AgroDiario, 1 Aug. 2006, Oct. 2006 <http://www.agrodiario.com.ar/despachos.asp?cod_des=1845&id_seccion=33>; Diario La Nacion, 29 July 2006; SAGPyA, 25.

[25] SAGPyA, 2005.

[26] Ibid.

Source: World Factbook

A) INTRODUCTION

The private sector is leading efforts to develop a biofuels industry in Bolivia. The government has not yet shown a serious commitment to include biofuels in its energy matrix, and has thus far established only rudimentary policies to support the sector. Research and development is almost nonexistent. Still, the country does have significant potential to produce biofuels given its established production of sugarcane and soy. Yet new regulations and stronger government commitment would be needed to support the industry.

B) GOVERNMENT POLICIES

So far, few regulations have been approved in Congress to promote a sustainable biofuels industry. In July 2005, the Executive created a very basic law that established two simple rules: First, Bolivia was to prepare itself for 10%-25% ethanol blends with gasoline, also known as "alconafta", by 2010.[1] Second, the Executive would be in charge of planning the incentives and projects for the development of a domestic industry capable of meeting those blending quotas.[2] The law states explicitly that Bolivia's chosen crop for biofuels will be sugarcane and that ethanol will be blended into gasoline at 25%, a level that does not require engine modifications.[3]

No concrete executive plan for the sugarcane industry has been established by the government, and the consequences are apparent in the industry's slow development.

Relations with Brazil

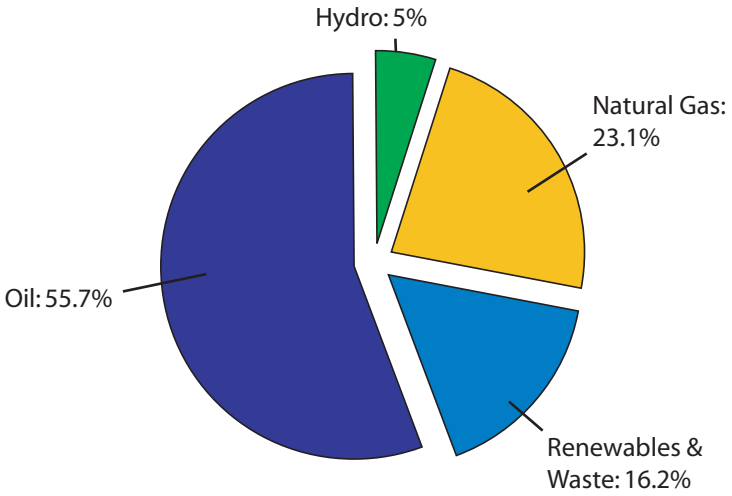
In 2003, Bolivia entered talks with Brazil regarding the transfer of sugarcane-based ethanol technology. However, negotiations have been suspended due to increasing tension since Bolivia nationalized its natural gas industries in May 2006 (Brazil imports more than 50% of its natural gas from Bolivia).[4] It is unclear how this move will affect interest and domestic demand in the biofuels sector. In addition, Bolivia has excluded sugarcane from a trade deal with Brazil and other Mercosur countries.[5]

C) CURRENT SITUATION

Energy Matrix

The country's reticence with respect to biofuels can be explained in part by its strong preference for oil and natural gas, which are entirely domestically produced.

Chart 1.2a: Bolivia's Energy Matrix (2003)



Source: IEA

As noted, natural gas and oil are major industries in Bolivia. As shown in the following table, annual production has grown steadily.

Table 1.2a: Natural Gas and Petroleum Production (1995-2004)

	NATURAL GAS		PETROLEUM	
	(MMPC)	(MMPCD)	(bbl)	(bpd)
1995	188,809	517.3	10,347,385	28,349
1996	186,397	510.7	10,653,255	29,187
1997	188,662	516.9	10,214,047	27,984
1998	189,623	519.5	13,793,472	37,790
1999	176,613	483.9	11,850,425	32,467
2000	200,729	549.9	11,463,859	31,408
2001	252,671	692	13,064,935	35,794
2002	314,537	862	13,245,316	36,289
2001	252,671	692.2	13,064,935	35,794
2002	314,537	861.7	13,245,316	36,289
2001	252,671	692.2	13,064,935	35,794
2002	314,537	861.7	13,245,316	36,289
2003	361,007	989.1	14,434,607	39,547
2004	446,997	2,469.6	16,953,699	46,448

MMPC: million cubic feet bbl: Barrels
MMPCD: million cubic feet / day bpd: Barrels / day

Source: Ministerio de Hydrocarburos & Energia

The steady increase in investments in both industries reinforces the view that the government's priority is keeping these domestic commodities as major components of the matrix.

Table 1.2b: Investments in Natural Gas

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Exploration	69.81	130.38	374.56	372.20	256.79	168.99	113.47	108.58	86.66	86.61
Production	29.22	140.42	230.25	208.55	185.33	237.38	231.31	171.96	149.26	241.89
TOTAL	99.03	270.80	604.81	580.75	442.12	406.37	344.78	280.54	235.92	328.50
Pipeline: Yacuiba - Río Grande							283.00			
TOTAL							627.78	280.54	235.92	328.50

Source: Ministerio de Hydrocarburos & Energia

Nevertheless, experts have noted that it is precisely because of this reliance that Bolivia should diversify its matrix. In addition, there are opportunities in biofuels that might prove attractive investments in Bolivia.

Capacity Expansion
Currently, Bolivia has robust sugarcane production, which could help meet the demand that will be generated by the 10% mandatory blend. The nation produces more than 4.8 million tons of sugarcane each year, with 105,000 hectares under cultivation.

Almost all sugarcane production goes to the production of refined sugar, which greatly exceeds domestic demand.[6] At least some of this excess, which is currently being exported, could be used for ethanol production, thereby decreasing Bolivia's exposure to global sugar price volatility.

To that end, Bolivia is in the process of constructing 15 distilleries for the production of ethanol.[7] Officials from the largest distilleries, Unagro S.A. and Guabirá Distillery, claim that major government investments are still necessary to implement the law and begin production. The supply necessary to meet the mandatory quota established in July 2005 is 90 million liters annually.[8]

According to business representatives, investments of up to $70 million and an additional 50,000 hectares of cultivation are necessary to meet this initial demand. This investment would have a significant social impact by creating 60,000 jobs directly linked to the ethanol industry.[9]

When it comes to biodiesel, the potential capacity expansion seems even greater, a dynamic similar to that in Brazil. While Bolivia does not produce one single ton of oilseed, the country has significant soybean production: 1.7 million tons in 2004 alone.[10] Possible incentives for the biofuels industry could create new options for soy producers to diversify their business.

D) PRIVATE SECTOR

Despite the significant potential for biofuels in Bolivia, it is still not clear where expansion will occur. A closer look at the trends in the private sector can help to clarify this issue.

Bolivia's two largest sugarcane refineries are Unagro S.A. and Guabirá Distillery. Unagro S.A. is a union of sugarcane producers in the eastern region of Santa Cruz. Unagro's only sugarcane plant, Ingenio Azucarero "Roberto Barbery Paz", has an annual processing capacity of 115,000 metric tons of sugar and 12,000 metric tons of ethanol.

Guabirá Distillery is one of Bolivia's oldest sugar companies and it is also located in the eastern region of Santa Cruz. In addition to ethanol, Guabirá processes refined sugar, alcohol, and fertilizers. The company has almost 28,000 hectares of sugarcane and is planning to expand. In 2006, Guabirá launched a $6.5 million subsidiary, Guabirá Energía S.A., devoted entirely to producing clean energy from sugarcane derivatives.[11] Today the company has a production capacity of 300,000 liters a day, but since there is not enough demand, the distillery currently produces around 30,000 liters of ethanol per day.[12] Most recently, Guabirá S.A. annouced a second phase of expansion during which $11 million will be invested by 2008.[13]

E) RESEARCH & DEVELOPMENT

Bolivia conducts little research on biofuels. University departments related to energy tend to focus their studies on natural gas and petroleum. This focus reflects the relative underdevelopment of the industry and the lack of government leadership, including initiatives and financing to promote research in the field.

F) CONCLUSION

With Bolivia's attention focused on the most effective utilization of its vast natural gas reserves, biofuels development unsurprisingly has a lower priority. Land reform issues and the government's perceived hostility to at least certain forms of private foreign investment further complicate the picture. The absence of technical cooperation with Brazil, partly a result of gas industry tensions, limits progress, especially without significant domestic R&D. While the necessary agricultural resources are apparently available, regulatory, infrastructure, and financing issues will likely restrain active biofuels development.

Endnotes

[1] Ley 3086/05, article 1o.
[2] Ley 3086/05, article 2o.
[3] Ley 3086/05, article 1o.
[4] "Gov't announces measures to guarantee natgas supply to consumers," Financial Times 19 May 2006.
[5] American Sugar Alliance, 31 Oct. 2006 <http://www.sugaralliance.org/desktopdefault.aspx?page_id=136&resource_id=661>.
[6] FAO Stats, 10 Oct 2006 <http://faostat.fao.org>; American Sugar Alliance, 31 Oct. 2006 <http://www.sugaralliance.org/desktopdefault.aspx?page_id=136&resource_id=661>.
[7] GTZ (German Technical Cooperation), Conference Handout for Biofuels for Transportation: Global Potential and Implications for Sustainable Agriculture and Energy in the 21st Century (Berlin: GTZ, May 2006).
[8] "Una ley autoriza la producción de alcohol carburante en Bolivia," 14 Aug. 2006 <http://www.fedebiocombustibles.com/bolivia-alcohol-carburante.html>.
[9] Ibid.
[10] FAO Stats, 10 Oct. 2006 <http://faostat.fao.org>.
[11] "Guabirá anuncia proyecto para generar electricidad," Los Tiempos 14 Feb. 2006, 31 Oct. 2006 <http://www.lostiempos.com/noticias/14-02-06/14_02_06_eco5.php>.
[12] National Federation of Biofuels, 14 Aug. 2006 <http://www.fedebiocombustibles.com/guabira-unagro.html>.
[13] "Guabirá anuncia proyecto para generar electricidad," Los Tiempos 14 Feb. 2006, 31 Oct. 2006 <http://www.lostiempos.com/noticias/14-02-06/14_02_06_eco5.php>.

Source: World Factbook

A) INTRODUCTION

While currently nonexistent, the biofuels industry in Chile has been gaining increasing attention as the government pushes for a more diversified energy matrix. Reducing dependence on foreign energy is unquestionably the strongest incentive for the biofuels market in Chile.[1] As of 2004, 72% of Chile's domestic energy consumption came from foreign sources (an 18% increase since 1995).

Chile is also interested in finding other uses for its agricultural production, which could reduce its exposure to unstable prices, and which might produce higher profits and accelerated industrial and agrarian development. Environmental concerns constitute a further incentive for development of the biofuels industry.

Studies have highlighted the potential for promoting agricultural development through bioenergy incentives, and the government has sponsored an initial assessment on how to promote the industry.

B) GOVERNMENT POLICIES

To face the immediate challenge of diversifying its energy matrix, the Chilean government has employed two simultaneous strategies: (a) the development of a biofuels industry; and (b) a policy of incentives for renewable generation of electric energy.

The Ministry of Agriculture recently devoted $1 million to study the optimal feedstock for a biofuels industry.[2] This effort has not yet yielded definitive conclusions, but it is the first significant sign of government interest. The Ministry of Agriculture and the Ministry of Mines and Energy have joined forces to assess the potential for a sustainable industry.[3]

In March 2003, the government issued a Renewables Law (Law 19.940/2003) that made several modifications to the energy operation and transmission system and created mechanisms to promote the use of Non-Conventional Renewable Energies (NCRE) for power generation, such as hydroelectric, geothermal, and solar power. The goal is to achieve a 15% NCRE level, or 320 MW, by 2010. Thus far, the law mandates that 5% of the energy applied to the transmission system come from renewable sources, which in the long run could include cogeneration from biofuels plants.[4]

The Renewables Law includes a number of additional incentives. For instance, it ensures that small generators (up to 9 MW) can make sales to the spot market without discrimination, offering them simplified commercial treatment and greater price stability. In addition, the law guarantees the right to access the main distribution networks in order to transmit generated energy and removes toll charges for access to the main transmission system for non-conventional sources of less than 20 MW.[5]

However, the Renewables Law is still a "short law" (Ley Corta), meaning that it is awaiting regulatory guidelines. These are expected to include guidelines for fiscal incentives, regional integration of the energy grid, and specific quotas for each renewable source.[6]

Most recently, the Bachelet Government organized a public-private advisory commis-

sion to make recommendations regarding the development of the biofuel industry. The commission recommended the exemption of biofuels from specific taxes and encouraged a government mandate to ensure demand.[7] The report did acknowledge that it may be more economically prudent to import biofuels from more competitive producers such as Brazil, Argentina, Bolivia or Peru.[8] According to Odepa, a division of the agriculture ministry, biodiesel will only be competitive with diesel in Chile if oil prices reach $72 per barrel.[9]

Relations with Brazil

According to the Chilean Institute for Agrarian Development (INDAP), the two governments have been in continuous contact to develop a partnership. In July 2006, a meeting took place between the Brazilian Agriculture Minister and a working group from Chile's Agricultural Ministry. On that occasion, Brazilian representatives highlighted Chile's potential in biofuels and stressed that Brazil is willing to help Chile diversify its energy matrix.

The development of a common agenda on tax, technology transfer, logistics, and legal aspects, is still pending. Brazilian officials have suggested that Chile begin by adding 5%-10% of corn or wheat-based ethanol fuel to its cars, which would not require any changes in car engines.[10]

C) CURRENT SITUATION

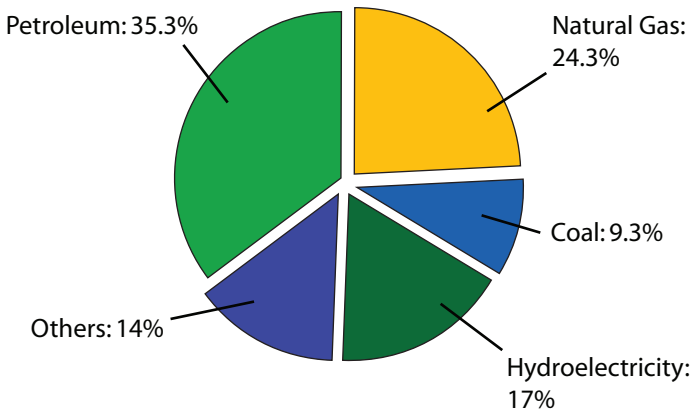
The Chilean power sector has been under-funded for many years. Hydroelectric (which is 100% domestic) has lost 2% of its share of the energy matrix to natural gas (which is 80% imported). Indeed, natural gas grew 16% from 1996 to 2004.[11] The goal of the Renewables Law is to reverse this trend.

Biofuels are still a secondary option for diversifying Chile's energy matrix. Nevertheless, experts from the Ministry of Mines and Energy and other agencies insist that a comprehensive strategy combined with fiscal incentives will permit the Chilean biofuels industry to grow exponentially in the coming years.[12]

Energy Matrix

A closer look at the country's energy matrix shows that 68.9% of Chile's energy supply comes from non-renewable fossil fuels. 99% of the petroleum, 80% of the natural gas, and 96% of the coal consumed by Chile are imported, which leaves the country vulnerable both in terms of supply and price.

Chart 1.3a Chile's Energy Matrix (2004)



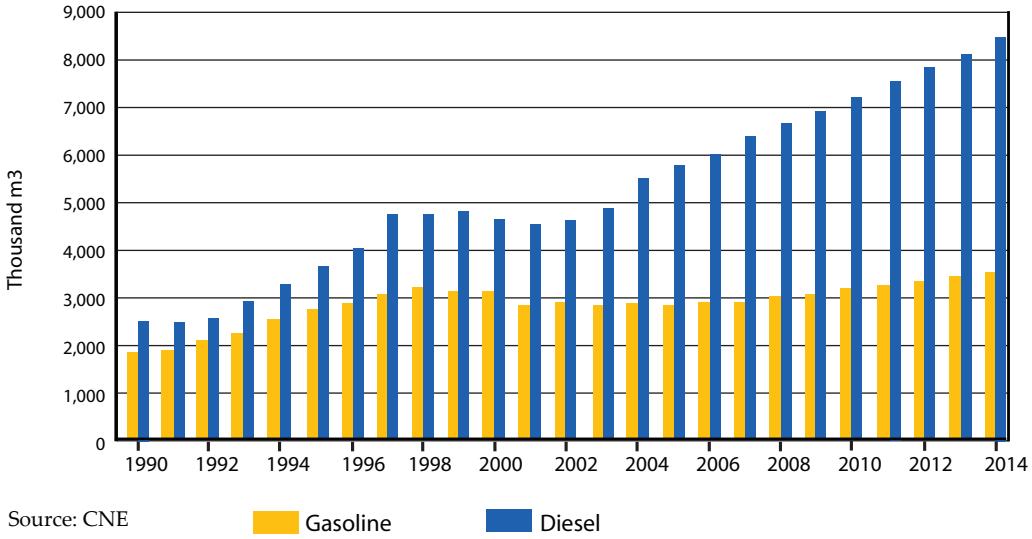
Source: National Energy Commission (CNE)

The diversification of the matrix to include renewable sources of energy is essential. The Chilean Minister of Mines and Energy, Karen Poniachik, has stated on several occasions that Chile could begin producing agro-fuels by 2008 with the proper strategy.

Chile needs to first decide on the best crop (or crops) for biofuels production and then to establish a regulatory framework of incentives for production and quality control.[13]

Production and Consumption Capacity
Because there is no established biofuels industry in Chile, there are no current consumption levels to report. Several studies, however, have assessed potential demand given the government's plan to include biofuels into the country's energy matrix (see Government Policies). In the last decade, for instance, Chile has significantly increased its consumption of regular diesel, which has surpassed gasoline. In 2005, road transportation alone consumed 3.6 billion liters of diesel.

Chart 1.3b: Chile's Fuel Consumption (1990-2014)



Source: CNE

An eventual introduction of a 5% biodiesel blend (B5) would produce demand of 250 million liters by 2010, and 289 million liters by 2014. Thus far, rapeseed has been the most studied crop for future biodiesel production in Chile. Today, domestic production occurs on approximately 37,000 acres and is mainly used for salmon feed.

In terms of ethanol demand, the introduction of a mandatory 5% blend with gasoline (E5) would create estimated demand of 157 million liters of ethanol by 2010, and 176 million liters by 2014. Corn has been identified as the most probable crop for ethanol production in Chile. In 2004, domestic production was around 1.3 million tons from 119,000 acres and is used for both human consumption and animal feed.

D) PRIVATE SECTOR

Investments are limited, although several projects have recently been finalized and should be initiated in the coming months.

ENAP, the National Oil Company of Chile, and IANSA, a multinational group of agribusiness companies, announced a joint study to produce fuels from vegetable oils. The parties signed an agreement in March 2006 to carry out a six-month feasibility study.[14]

Petrobras, the Brazilian state-owned oil company, has announced its interest in investing in an ethanol plant in Chile. According to several newspapers, the company is in the process of finalizing investment plans. After the July 2006 International Seminar on Agroenergy and Biofuels in Santiago, a Petrobras official confirmed the company's interest in developing the Chilean biofuels industry.[15]

The lack of more extensive private-sector involvement in Chile reflects the country's very recent engagement with the industry.

The Cellulosic Opportunity
In addition to the current opportunities for private-sector investment in biofuels, advances in cellulosic research might open new paths. Currently, wood chips are Chile's third-largest export (11.8% of total exports) and are shipped to 86 countries. The leading destinations are Japan, the United States, South Korea, and Western Europe. It is estimated that wood chip exports will reach $3 billion by 2010.

While the majority of Chile's pulp and plantation industry is domestically owned and operated, major foreign investors include New Zealand's Carter Holt Harvey and Fletcher Challenge, Shell of the Netherlands, and from the United States, Simpson Timber, International Paper, Scott Paper, CitiBank, and two pension funds, RII-UBS and Xyem. Japan's Mitsubishi, Sumitomo, and Daio Paper each have eucalyptus plantations as well as joint ventures with various Chilean companies in the wood chip export business. Direct multinational logging in native forests includes Cranefield of Canada and the US-based Trillium company/Savia investment group, which has a large-scale project covering 250,000 hectares in Tierra del Fuego.

A breakthrough in cellulosic technologies for ethanol could turn what is already a commercially viable industry into a remarkable opportunity for Chile.

E) RESEARCH & DEVELOPMENT

As Chile is just beginning to assess its potential for biofuels, there has been relatively little R&D. However, as discussed, the Ministry of Agriculture designated $1 million to promote agroenergy R&D through the Agricultural Innovation Foundation (FIA).

FIA is responsible for promoting innovation related to domestic agricultural production in Chile. The institution is also in charge of significant financing mechanisms for private projects and government programs related to agriculture. Its studies will focus on the possibilities of using corn and sugarcane based ethanol for an initial 10% blend (E10) with gasoline and the use of edible oils, mainly soy and rapeseed, for an initial 20% blend (B20) with regular diesel.

The R&D environment is likely to improve if FIA's current studies endorse a government decision to offer incentives to the biofuels industry.

F) CONCLUSION

Chile is still in the starting blocks on biofuels development, despite its clear need for energy diversification. The country currently has no biofuels production. Some initial indications of interest have come from the Chilean national oil company and Petrobras. Research has not yet identified the optimal crop for biofuels development, although corn seems to be favored. The government has passed a Renewables Law, but it will require considerable elaboration before it can become a viable blueprint for development of the industry. Chile's long-term opportunity would appear to rest on advances in cellulosic research. Wood chips are the country's third-largest export, projected to increase to $3 billion in 2010. A breakthrough in cellulose technology could open the door to significant biofuels production.

Endnotes

[1] Chile is currently in a dispute with Argentina and Bolivia over the price and supply of gas, which could be economically disruptive.

[2] The resources are being operated by the Foundation for Agrarian Innovation (Fundacion para Innovacion Agrária - FIA), linked to the Ministry of Agriculture of Chile.

[3] Fernando Flores, "El agro aprieta el acelerador," FernandoFlores.cl, 31 Jul. 2006 <http://www.fernandoflores.cl/node/1536>; "Diputados proponen cambios a Ley Corta II," Diario Pyme, 19 Jul. 2006 <http://www.diariopyme.cl/newtenberg/1845/article-73222.html>.

[4] Ley 19.940/2003.

[5] Ley 19.940/2003, Articles 71-7 and 91.
[6] Ley 19.940/2003
[7] "Chile's Biofuels Discussions Show Diversity of Stakeholders' Perspectives," Biopact, 6 Feb .2007 <http://biopact.com/2007/02/chiles-biofuels-discussions-show.html>.
[8] Ibid.
[9] "Govt: Biodiesel Competitive if Oil Hits US $72/b – Chile," Business News Americas, 23 Jan. 2007 <http://www.bnamericas.com/story.jsp?idioma=I&sector=9&noticia=379901>.
[10] INDAP, 29 Sept. 2006, 12 Nov. 2006 <http://www.indap.cl>.
[11] Chile, Ministry of Mines and Energy, National Energy Commission (CNE), Seguridad Energética: Escenarios y Estrategias (Santiago: Ministry of Mines and Energy, National Energy Commission, May 2006).
[12] Fernando Flores, 2006; "Diputados proponen cambios a Ley Corta II,"Diario Pyme, 19 Jul. 2006 <http://www.diariopyme.cl/newtenberg/1845/article-73222.html>.
[13] Fernando Flores, "El agro aprieta el acelerador", 31 Jul. 2006 <http://www.fernandoflores.cl/node/1536>; "Diputados proponen cambios a Ley Corta II," Diario Pyme, 19 Jul. 2006 <http://www.diariopyme.cl/newtenberg/1845/article-73222.html>.
[14] House of Representatives, 10 Sept. 2006 <http://www.camara.cl/diario/noticia.asp?vid=18547>.
[15] "Petrobras interesado en biocombustibles en Chile," 29 Jul. 2006 <http://www.chilepotenciaalimentaria.cl/?p=1146>.

Source: World Factbook

A) INTRODUCTION

Colombia is second only to Brazil in the Americas for biodiversity and is positioning itself to be a hemispheric leader in the production of clean fuels. Biofuels could help Colombia diversify its fuel consumption and agricultural production, create jobs in the agriculture sector, and provide an alternative to the production of illicit substances. The transport sector will be critical. According to the Ministry of Mines and Energy, transport accounts for 30% of total energy consumption, in part due to subsidies that encourage inefficient use. The government is addressing this issue by gradually decreasing subsidies, launching a public awareness campaign, and promoting alternatives like natural gas and biofuels.[1]

B) GOVERNMENT POLICIES

As in most countries, biofuels production in Colombia has been spurred by government policy, namely mandatory blend targets that create a guaranteed domestic market for early production. With the exception of Brazil, Colombia has the most developed regulatory framework in the region.

The Colombian government has promoted ethanol much more actively than biodiesel. In 2001, the Colombian government passed Law 693, which outlines several expected benefits of fuel standards, including reductions in hydrocarbon and carbon monoxide

emissions, maintenance and generation of jobs in the agricultural sector, and agro-industrial development. The law also stated that fuel used in metropolitan areas with more than 500,000 habitants should, by no later than 2002, have oxygenated components such as carburant alcohols, including ethanol and other oxygenating alcohols (the law states that private parties can participate in the production, distribution and commercialization of these alcohols.) Although not clearly defined in the legislation, the law also grants ethanol special privileges in energy self-sufficiency policies.[2]

In 2002, legislation was enhanced by Law 788, which exempts fuel alcohol from the Value Added Tax (VAT), as well as others. A 2005 regulation set the price for a gallon of carburant alcohol as $3,906.89 at the door of the refinery (roughly equivalent to $1.70 per gallon). It also guaranteed purchases by bulk distributors. 2005 also saw the introduction of a desired 10% ethanol blend that the government hopes to increase to 25% within 20 years. (There are reports that the government is considering a near-term increase of the ethanol blend to 20%.) A February 2006 regulation included the international price of sugar in the calculation of ethanol price. Recent regulations have also addressed the production, handling, and storage of ethanol and other additives.[3]

The government began to develop a biodiesel framework in 2004. Law 939 creates incentives and tax exemptions for the production and commercialization of biodiesel for use in diesel engines, and a Ministry of Mining and Energy resolution extends incentives for a 5% biodiesel blend.

Income generated by crops used as biodiesel feedstock (including cocoa, rubber, palm oil, citric acid, and fruits) is tax-exempt. The law also delineated the oils that can be blended with regular fuels, including ethanol, biodiesel, biometanol, biodimetileter (biomass), synthetic biofuels, biohydrogen, and pure vegetable oils. Quality standards provide that diesel fuel for use in engines can contain biofuels of vegetable or animal origin.

Relations with Brazil

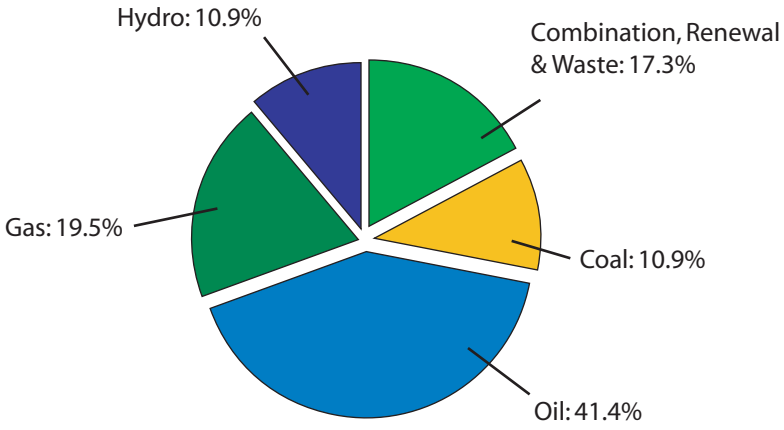
In October 2006, Ecopetrol, Colombia's state-owned energy company, signed an accord with Petrobras, its Brazilian counterpart, for the joint development of biofuels and distribution systems for petroleum byproducts. The companies agreed to sponsor studies on new production ventures, transportation and infrastructure, and technological support.[4] The agreement marks the first substantial cooperation between the two countries on biofuels.

C) CURRENT SITUATION

Colombia is heavily dependent on oil. In 2005, Colombia produced approximately 526,000 barrels of oil a day, exporting about half of that production, the majority of which is bound for the United States.[5] Oil accounts for 41.4% of domestic energy consumption, significantly higher than the global average of approximately 35%. The dependency owes much to inefficient consumption facilitated by subsidies, a problem the government is seeking to address.

Energy Matrix

Chart 1.4a: Colombia's Energy Matrix (2003)



Source: IEA

Current Production
Colombia produces both ethanol from sugarcane, cassava, and maize, and biodiesel primarily from palm oil.

Table 1.4a: Biofuels Feedstock Production (tons)

Crop	Type of energy	2003 production	2004 production	2005 production	%change 04-05
Sugar	Ethanol	16.574.312	16.961.864	7.717.120	4,5
Cassava	Ethanol	1.840.717	1.943.098	2.059.683,9	6,0
Maize	Ethanol	1.208.595	1.398.724	1.556.222	11,3
Palm Oil	Biodiesel	526.610	630.388	654.555	3,8

Source: Sociedad Colombiana de Agricultores

Ethanol Production
2005 has been labeled the beginning of the ethanol era in Colombia. Ethanol has created a promising new outlet for the country's agriculture sector, and particularly for sugarcane producers, who have been vulnerable to price volatility in the international sugar market. Of the approximately 200,000 hectares planted with sugarcane, 50,000 is now going to ethanol production, taking an estimated 15%-25% of surplus sugar off the market, according to the Agriculture Ministry.[6]

Colombia is a highly efficient producer of sugarcane. In 2004, it ranked 7th in the world for total quantity produced and did so with a yield of 93 tons per hectare, compared to 74 tons per hectare in Brazil, but unlike Brazil, Colombia depends on irrigation, which drives up costs. Thirteen of the country's fourteen refineries are located in the fertile Cauca Valley. They produce more than 99% of Colombia's sugar thanks to a climate that permits year-round production.[7] The first stage of ethanol production in Colombia relies on this existing industry. Already five of these refineries have added distilleries to their plants and are producing together more than one million liters of ethanol daily. These facilities are capable of meeting demand in the areas participating in the first phase of the ethanol program.

Table 1.4b: Sugar Industry Moves Into Ethanol

Refinery / Distillery	Commenced Operation
Ingenio Incauca	October 2005
Ingenio Providencia	October 2005
Ingenio Risaralda	January 2006
Ingenio Mayagüez	March 2006
Ingenio Manuelita	March 2006

Source: Asocaña

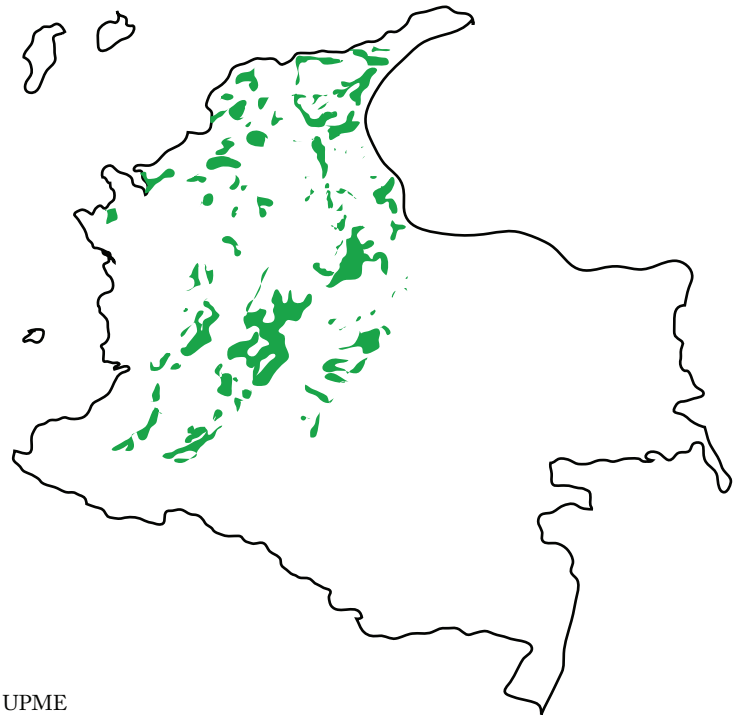
Further expansion may spread production beyond just this most productive region. The distribution system will involve truck transport from distilleries to local supply centers near major cities run by the country's three major distributors: ExxonMobil, Terpel and Texaco. There, the distributor blends the ethanol into the oil, and the fuel is then moved by tanker truck to local service stations. The chart below shows projected future capacity of projects throughout the country.

Table 1.4c: Capacity Potential of Identified Ethanol Projects

Location	Capacity (l/day)	Feedstock
Hoya del Río Suarez	300.000	Sugar Cane
Vegachí (Antioquia)	350.000	Sugar Cane
Valle del Cauca	300.000	Sugar Cane
Costa Norte	300.000	Sugar Cane- Yuca
Cundinamarca	150.000	Sugar Cane
Llanos Orientales	100.000	Yuca- Sugar Cane
Eje Cafetero	250.000	Sugar Cane
Huila	200.000	Sugar Cane
Nariño	150.000	Sugar Cane

Source: Asocaña

Map 1.4a: Zones for Potential Cane Expansion



Source: UPME

Colombia is also pioneering the use of cassava for ethanol production. There are already 128,000 hectares planted with cassava, and cultivation is rapidly growing. One plant using cassava is already operational and produces 20,000 liters a day. Two more plants, with a capacity of 75,000 liters a day, are under construction, and work on a project twice that capacity began recently in the state of Cordoba.[8]

The production of ethanol is expected to more than triple by 2020, thanks to both increased land dedicated to cassava farming, and what one can assume is production efficiencies in molasses and sugarcane based ethanol.

Table 1.4d: Ethanol Area by Feedstock (ha)

Area	2006	2010	2015	2020	2020/2006
Sugar Cane	37,000	72,000	72,000	72,000	35,000
Molasses	0	43,000	43,000	43,000	43,000
Cassava	3,000	34,000	70,000	100,000	97,000
Total	40,000	149,000	185,000	215,000	175,000

Source: UPME

Table 1.4e: Ethanol Production by Feedstock (1,000 liters)

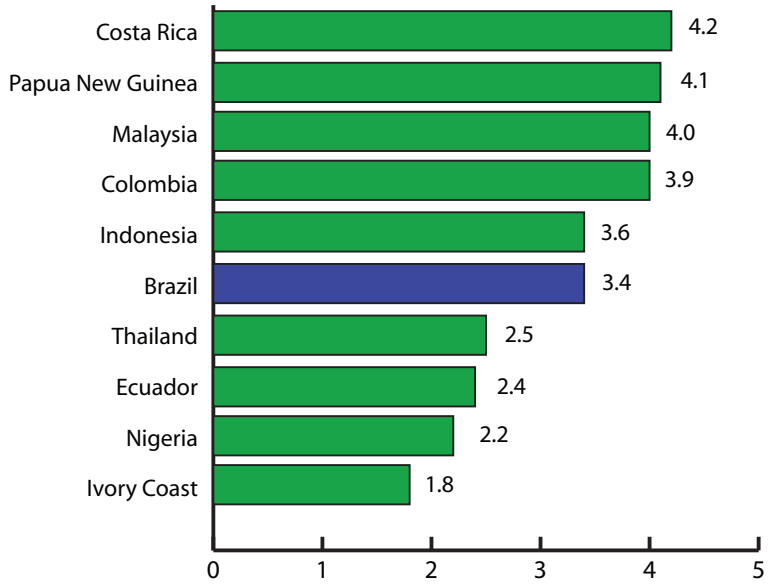
Production	2006	2010	2015	2020	2020/2006
Sugar Cane	858,082	1,469,863	1,469,863	1,469,863	611,781
Molasses	0	733,300	733,300	733,300	733,300
Cassava	20,000	632,500	907,500	1,595,000	1,575,000
Total	878,082	2,835,663	3,110,663	3,798,163	2,920,081

Source: UPME

Biodiesel

Biodiesel activity, both in terms of projects and research, is focusing on the African Palm. While Colombia produces large quantities of soy and other oilseeds, these commodities are not particularly competitive and production is declining. Colombia leads the Americas in palm production, and is the fifth-largest producer and exporter of palm oil in the world (fourth in terms of yield per hectare).

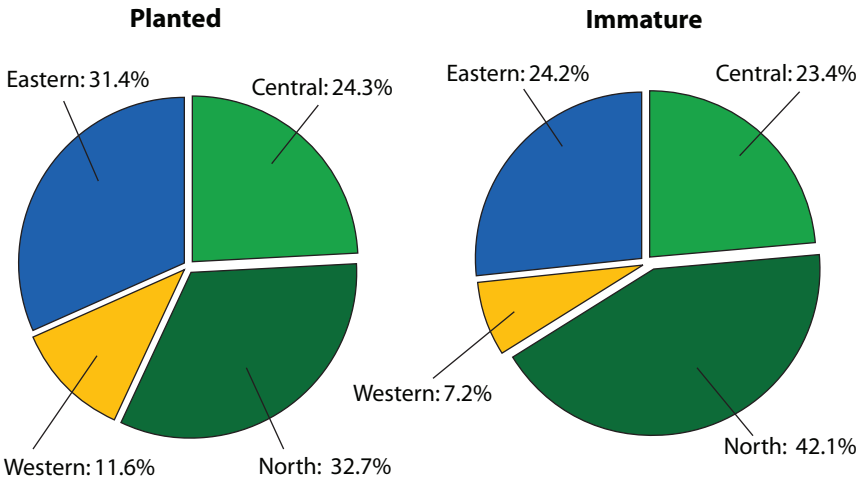
Chart 1.4b: Top Global Palm Oil Producers (2004) (billion liters)



Source: Fedepalma

A national plan for the development of the palm oil agroindustry calls for an additional 640,000 hectares by 2020, an expansion that is expected to create 100,000 new jobs and 300,000 indirect jobs, with the added benefit of offering an alternative to drug cultivation.[9] Palm grows throughout the country, but rapid expansion is occurring in the north, according to Fedepalma, the industry association.[10] The Colombian government is supporting this expansion through Finagro, a group extending credit to integrate producers, commercial and industrial, public and private entities in support of industrial agriculture.[11]

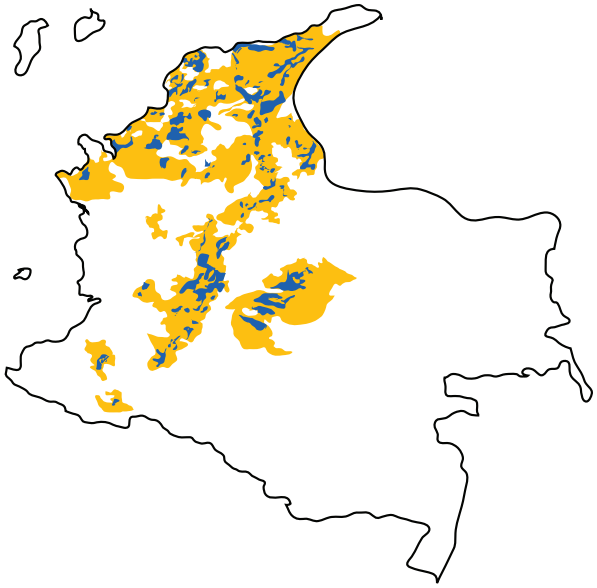
Chart 1.4c: Planted and Immature Palm Oil by Region



Source: Fedepalma

Interest in biodiesel is increasing in all four productive regions of the country. Producers in the country's banana industry in Urabá are reportedly exploring the palm-based biodiesel industry in an effort to diversify the region's agriculture sector, which produces an excess of bananas. The region would like to use more of its billion plus hectares of arable land, only 30% of which is under cultivation.[12] Fedepalma claims that, with expanded cultivation along these lines, producers could meet the demands of a 15% blend requirement. The association contends, however, that producers are waiting for clear signals that the government will help create a market for the product.[13] The map below shows areas determined to be suitable for palm cultivation.

Map 1.4b: Areas of Potential for African Palm



Source: UPME

Domestic consumption

The Government's national ethanol plan has now created a base level of demand. The 10% blend requirement in Bogota, Valle del Cauca, and the coffee-producing areas, regions which represent 57% of Colombian transport oil consumption, now requires nearly all current ethanol production.[14] Expanding the 10% blend to the rest of the Colombian market, planned for 2007, is expected to increase consumption to 700 million liters a year and require a trebling of land dedicated to feedstock cultivation.[15]

Biodiesel consumption in Colombia is still small-scale, although some local communities have made it a primary fuel. The town of Gaviotas, for example, has a plant sponsored by the University of Colorado in Boulder which produces biodiesel for use by the community.

Export

There are currently no exports of ethanol or biodiesel. Ethanol producers plan to meet domestic demand before considering the export market, but they are keenly aware of its potential, particularly in the US market. Should a recently negotiated free trade agreement gain Congressional approval, Colombia would enjoy tariff free access to that rapidly growing market. The US market is all the more appealing because supply shortages and high-cost production have driven up prices, which are 30% higher than in Colombia. The free trade agreement may affect Colombian ethanol in another way: unrestricted trade with the US means that high fructose corn syrup will enter the market and threaten the sugar industry. Ethanol provides an alternative outlet for sugarcane that may help offset this impact.[16]

D) PRIVATE SECTOR

The biofuels sector has grown up from almost nothing in the past two years, but major investments are needed for its continued expansion. To meet domestic demand, the industry will require an estimated $400 million in investment over the next five years and $100 million in new infrastructure for distribution. The five existing ethanol distilleries in the Cuaca Valley alone required at least $80 million and benefited from existing infrastructure and proximity to Colombia's most efficient sugarcane production.[17] The industry could technically remain concentrated in the Cuaca Valley, but with no available land for expansion, any increase in ethanol production there will come at the expense of sugar production. Moreover, transporting the ethanol to more distant markets adds an estimated 7-8% to the cost.

To effectively service local markets then, ethanol production facilities will need to be constructed as greenfield projects,[18] a requirement that makes finding investors more challenging. While Colombia is one of the most attractive regional markets for international investors, "green" investors have not flocked to these new projects. Absent major new investment, it is unlikely that there will be sufficient productive capacity to meet the 2007 target of a 10% ethanol blend throughout the country.[19]

A number of factors limit investor enthusiasm. Many of the new projects needed to ensure countrywide distribution are located in areas less suited to sugarcane production due to climate, topography, and a lack of transport infrastructure. Still, some projects are moving forward, including a $7 million investment by local company Petrotesting in an ethanol facility in Llanos Orientales with production capacity of 20,000 liters a day.[20]

Another area of potential private sector investment is electrical and steam cogeneration. Bagasse, a sugar byproduct, is burned by many sugar mills to produce electricity and steam. Usually, the primary purpose is to dispose of the bagasse and to produce enough energy to meet the needs of the sugar mill. However, advanced technology has been developed to produce energy in excess of sugar mill needs which can be sold on the market. Colombia's sugarcane industry association, Asocaña, estimates that with investments in high-pressure boilers and increased utilization of cane waste, plants could generate 200 MW of excess electricity for sale to the national grid. This generation could help address the estimated 660MW and 1,160MW of additional power capacity that will be needed in 2009-2013. According to the group's annual report, however, investments of this kind will require additional economic incentives.[21]

There is a great deal of enthusiasm surrounding biodiesel production, both for the domestic market and for export. Most areas with productive potential are concentrated near the coast, making exports viable. Unlike with ethanol, there is ample room for expansion. According to industry association Fedepalma, there are already 8 biodiesel plants with an installed capacity of 685,000 tons each year. As the mandated 5% blend will require just 200,000 tons, producers are looking to export markets. To date, investment in the sector has come exclusively from local actors, largely from companies already in the palm-oil business.

E) RESEARCH & DEVELOPMENT

For a relative newcomer, the biofuels industry in Colombia has sparked a considerable amount of research interest and activity.

The Corporation for Industrial Development of Biotechnology and Clean Production (Corpodib), a public-private institution affiliated with the National University, has taken the lead in the research effort behind Colombia's national biofuels plan, including zoning the country for the production of biofuels feedstocks. Corpodib has conducted studies of ethanol plant design, fermentation, energy consumption, and solid and liquid disposal.[22] On biodiesel, it conducted studies of new technology, the national market, and raw material costs. It also established a pilot plant for biodiesel production in cooperation with Transmilenio, the public transportation system of Bogota, which

tested and used the biodiesel in its buses.[23] Corpodib has continued to study how to optimize biofuels production processes.[24]

The government is also promoting biofuels R&D through the state energy company Ecopetrol and the National Institute for Science and Technology, Colciencias, which in January 2006 sought proposals for the establishment of "centers of excellence" – including one on biomass and biofuels.[25]

The Colombian Sugarcane Research Center (CENICAÑA) is financed by the sugar mills and individual sugar producers who comprise the Colombian Association of Sugar Producers (ASOCAÑA), much like the CTC in Brazil. Its research agenda is established by a board representing the financing institutions and has historically focused on developing improved varieties with higher sugar content, earlier maturity, resistance to disease, and susceptibility to mechanized harvest.[26] These developments have contributed to the productivity of the industry, which has grown more than 50% since 1980.[27]

The holding company Petrotesting, which owns the only cassava-based ethanol refinery, has partnered with the Cali-based International Centre for Tropical Agriculture (CIAT) to study the optimal cassava plant for ethanol production. CIAT is the global leader in cassava studies and has 6,000 varieties in its gene bank.[28]

The Universidad Nacional de Colombia and the University of Antioquia are studying the optimization of biodiesel production through transesterification with methanol from Tenera, a hybrid of the African palm grown in the country. A public-private collaboration, the research is being done by Interquim S.A. with financing from Colciencias, the national institute for science and technology. The project is advocating a mandatory national 30% biodiesel blend, which would require an additional 270,000 hectares of palm cultivation and create an estimated 70,000 jobs.[29]

Cenipalma, a private institution jointly funded by the federal government and palm oil producers, is also researching biodiesel production. In January 2005, it opened an experimental farm to identify the optimal varieties of palm. Cenipalma has long been engaged in developing high-yield varietals for the country's palm oil industry and is hoping to raise oil yields to 12 tons per hectare from a current average of four.[30] The organization has since partnered with the palm oil union Fedepalma and Pro-Palma to conduct a nationwide viability study for palm-oil biodiesel production.

F) CONCLUSION

After Brazil, Colombia is one of the leading countries in the region in all aspects of biofuels development, from the strong foundation of appropriate natural resources and government regulations to research & development initiatives and the pace of private sector investment. While the further expansion of sugarcane-based ethanol production faces hurdles, the country's biodiesel industry shows incredible promise, both for the domestic market and as a major export industry.

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A) INTRODUCTION

A slow shift is underway in Ecuador toward the production of ethanol and biodiesel. Private investment and research are showing interest in the industry, and there is strong potential for a domestic market. Yet, the government has yet to play the major role it must—particularly with respect to budgets and land use—to capitalize on these trends.

B) GOVERNMENT POLICIES

Subsidies and Inefficiency

In recent years, the government has attempted to solve some of its pressing energy security issues. Ecuador's energy sector has long been heavily subsidized, inefficient, poorly managed, and almost entirely dependent on petroleum [Chart 1.5a]. For instance, in 2005, total subsidies totaled $718 million: $281 million for liquid petroleum gas (LPG), $357 million for diesel, and $80 million for electric energy. The general use of electricity for commercial, industrial, and domestic purposes is highly inefficient, and there is no legal framework for managing consumption or promoting efficiency.[1]

Experts have pointed out that the current state of Ecuador's energy sector is the result of a decade of government policies that divorced the power sector from the oil sector and obstructed an integrated energy policy. This bifurcation left the country heavily dependent on oil and hugely inefficient in its use. The government has now initiated

reforms to address the issue.[2]

Diversifying the Matrix
The National Council for Electricity, which has demonstrated a growing commitment to energy security in the past few years, has designed a threefold strategy to improve energy consumption efficiency, reduce subsidies for the power sector, and diversify the country's energy matrix. Accordingly, the government has been working to create a Clean Energy Fund that will increase the use of renewable sources for power generation, such as solar, wind, hydro, biomass and residues. The goal is to make the electrical sector more efficient and less dependent on government subsidies.[3]

On energy diversification, the government has two major policy initiatives. The National Program for Biofuels (Programa de Biocombustibles), established through Executive Decree 2332, declares the production, commercialization and use of biofuels to be in the national interest. It creates a Consultative Council for Biofuels with direct access to the President's Office. The Environmental Regulation for the Operation of Hydrocarbon Industries, passed in 2001, promotes the production of oxygenated additives, such as ethanol, for blending with gasoline.[4]

Following on these initiatives, the government launched an Ethanol Program in 2004 to promote the cultivation of sugarcane for ethanol production. The program seeks to achieve a 5% ethanol blend by the end of 2006 in the city of Guayaquil. If successful there, the plan would be extended to the rest of the country.[5] The government's strategy for biodiesel is very similar, though it seeks a 10% blend of palm-based biodiesel into regular diesel. No city has been chosen yet for the biodiesel pilot project.[6]

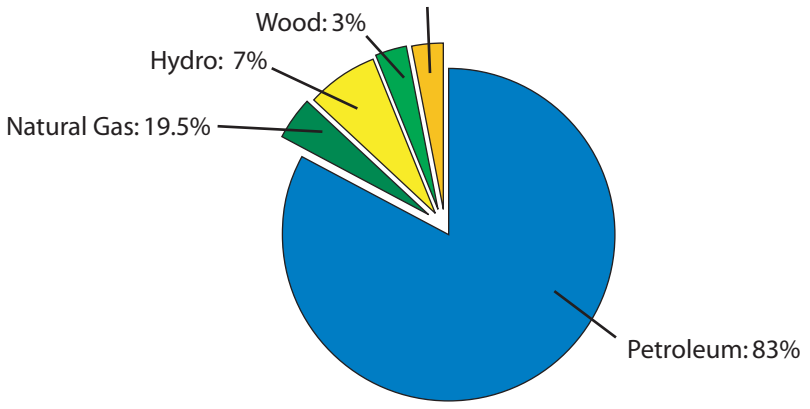
Despite having passed key legislation in 2004, the government has only recently announced its intention to designate funding and specific land for production expansion. Detailed plans for the implementation of biofuels projects are still lacking.[7]

Relations with Brazil
In 2004, Ecuador and Brazil signed a memorandum of understanding on energy, but the document did not include biofuels.[8] In July 2006, the countries held a joint symposium to explore possibilities for cooperation on the biofuels industry in Ecuador. This symposium was a result of contacts between President Alfredo Palacio and President Lula da Silva at the Summit of the Americas in November 2005.[9]

C) CURRENT SITUATION

Energy Matrix
As discussed, Ecuador's energy sector has been heavily subsidized, inefficient, and dependent on oil and natural gas.

Chart 1.5a: Ecuador's Energy Matrix



Source: OLADE

Production Capacity and Land Availability
Ecuador has great potential to expand ethanol production. The country has a variety of microclimates optimal for sugarcane, high quality soil, and a large supply of available labor. Approximately 76,000 hectares are already dedicated to sugarcane cultivation, and current ethanol production is approximately 60,000 liters per day. [10]

The Ethanol Program seeks to achieve augmented production by diverting most existing sugarcane production to ethanol from sugar. The plan envisions the possibility of expanding sugarcane production by 50,000 hectares, which would allow for a 10% blend with gasoline, instead of the initial 5%. Given projected annual gasoline consumption of 2.38 billion liters by 2008, the expected demand for ethanol, at a 10% blend, would be nearly 651,000 liters per day, or 237.6 million liters a year, more than 10 times today's production.[11]

Ecuador has a robust palm oil industry, which could provide feedstock for biodiesel. Approximately 207,000 hectares are dedicated to palm, which yield 350,000 metric tons of palm oil. 57% of this palm oil is consumed domestically and the rest is available for export.[12] With consumption of diesel expected to reach 3.74 billion liters by 2008, the expected annual demand for biodiesel, at a 5% blend, is around 512,000 liters per day or 186.5 million liters annually. The government plans to rededicate most of its exports of palm oil to biodiesel for domestic consumption.[13]

D) PRIVATE SECTOR

Thus far, Ecuador's private sector has been reluctant to invest significantly in the biofuels industry. A major concern is the lack of a clear plan for expanding the land available for sugarcane production. Despite the establishment of a legal framework for the biofuels industry, the government's ethanol and biodiesel projects still exist on paper only, and no implementing regulation has been signed.[14]

The Etanolsa Guayas, a union of 4,000 sugarcane producers from the Simón Bolívar region, has repeatedly complained that the government has failed to authorize funds for a refinery to support its 30,350-hectare expansion, which was approved by the legislature in 2000. Similarly, the National Ecuadorian Union of Sugarcane Producers (UNCE) has pressured the government to expand sugarcane production. Both groups are hopeful that government support will be forthcoming soon.[15]

The private sector has also been disappointed with the government's pace on biodiesel. The National Association of Producers of African Palm (ANCUPA) has proposed a series of projects for the government's consideration, but no final decision has been made.[16]

Most sources agree that the government's initiative in Guayaquil is closest to becoming operational. However, investment of $30 million is still required.[17] The Bejar Trading Company, an Ecuadorian subsidiary of China Dalian International Cooperation Holdings has discussed investing in the project, but little information about the negotiations has been made public.[18]

E) RESEARCH & DEVELOPMENT

Research and development on biofuels in Ecuador has been moving slowly. One significant initiative is the Network for Biotechnology Cooperation for Agriculture (Red de Cooperación Técnica en Biotecnología Agropecuaria). The Network is a project of the Food and Agriculture Organization, which has operated in Ecuador since 1991. It aims to facilitate technology transfers between institutions enaged in biotechnology for agricultural applications.[19] The network has supported several studies of sugarcane applications, including ethanol. One key goal is to improve the production yield per hectare. Current production is 74 tons per hectare for irrigated land, similar to Brazil's yield without irrigation. Sucrose levels, however, are below 10%.[20]

The Escuela Politécnica Nacional (EPN)'s science department has also been active in

research. In recent studies, EPN has been able to produce small quantities of ethanol from wood residues and paper trash, such as newspapers. Trajano Ramírez, a chemical engineer who also works with the Network, coordinates the project, which aims to expand wood-based ethanol production through governmental support and private investments.

F) CONCLUSION

As in most countries, implementation is the key to biofuels development in Ecuador. The absence of an integrated energy policy, continued subsidies for petroleum-based products, limited R&D, and poor sugarcane yields all impede the country's biofuels effort. Exploratory discussions are underway on cooperation with Brazil, but no substantive work has begun. The private sector is interested in biofuels but is unwilling to commit until the government elaborates its legal framework and actively supports land expansion for sugarcane production. Until the government becomes more active, progress will be slow.

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A) INTRODUCTION

Paraguay ranks 106th out of 120 countries in economic competitiveness, according to the World Economic Forum's Global Competitiveness Report.[1] Like many of its neighbors, Paraguay suffers from a variety of maladies, including official inefficiency, corruption, and crime, which continue to obstruct Paraguay's industrial development and integration into the global economy. Despite these challenges, Paraguay's economic growth averaged 3.5% between 2003 and 2005, and the national poverty rate has declined in recent years.[2]

Paraguay is a borrowing member of the Inter-American Development Bank and has been a member of Mercosur since 1991. Trade with Brazil forms a large part of its GDP.

B) GOVERNMENT POLICIES

Following the oil shock of 1973, Paraguay followed the lead of Brazil and the United States and launched a national ethanol program. However, government support for the program declined with the fall of oil prices and by the early 1980s, it had dissolved completely.[3]

In a second attempt at biofuels production, Paraguay launched its Ethanol Program in

1999. The program mandates a blend of up to 20% with most gasolines, although it is estimated that the country's ethanol production capacity can only support a blend of 18%. The Ethanol Program also provides a tax incentive for ethanol use, by reducing the standard fuel tax of 50% to just 10%.[4]

In 2001, the Paraguayan government issued Decree No. 12.111, which created a working group to study the technical and economic feasibility of biodiesel. The group found that, given the high and volatile price of oil, the substitution of a reasonable percentage of biofuels was economically viable and would help limit the economic impact of fluctuating fuel prices.[5]

A Biofuels Law, enacted in 2005, supported the findings of the working group and declared the development of biofuels, including biodiesel, a matter of national interest. It mandated the use of local resources as feedstock for ethanol and biodiesel, provided market support in the form of incentives, and reduced licensing requirements for biofuels-related activities.[6]

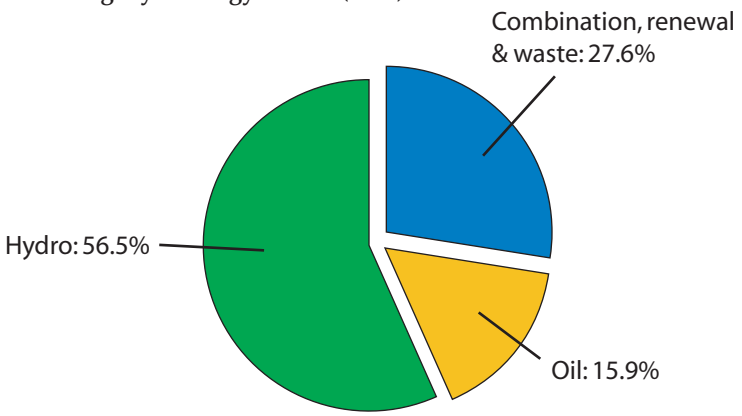
Most recently, a program enacted in 2006 called Ethanol 85 raised the required percentage blend of ethanol to 24%, greatly increasing demand for the fuel. According to Paraguay's Ministry of Industry and Commerce, the nation's ethanol demand has reached 465,000 liters per day.[7] As of October 2006, regulations on biofuels quality standards and other matters were still pending.[8]

Relations with Brazil
Paraguay has several bilateral agreements with Brazil, including for technical cooperation on agrarian development and for training and professional capacity-building. The countries have reached an agreement to cooperate on the development of biofuels technology.[9] Recently, ministers from the two countries agreed to support an initiative set forth by the Paraguayan Ministry of Industry and Commerce for a business seminar on Investments and Integration of Production Chains for Biofuels. The conference is scheduled to take place in early 2007.[10]

C) CURRENT SITUATION

Energy Matrix
The majority of Paraguay's energy comes from hydropower, with less than 16% of its energy derived from oil [Chart 1.6a].

Chart 1.6a: Paraguay'a Energy Matrix (2003)



Source: International Energy Agency[11]

Paraguay's electricity sector is controlled by its state-owned utility, the National Electricity Administration (ANDE), which operates the Acaray hydroelectric dam, six thermal power plants, and shares responsibility for two hydroelectric dams with Argentina. With Brazil, ANDE jointly manages the Itaipu dam, currently the world's largest.

Paraguay uses 16% of its electricity yield from Itaipu and exports the rest to Brazil. The country consumes only 1% of the power derived from the 3,500-megawatt capacity Yacyreta dam and exports the remainder to Argentina.[12]

Paraguay consumed 4.5 million liters (28,000 barrels) per day of oil in 2006, all of it imported (the country does not produce any oil). The state-owned petroleum company, Petroleos Paraguayos (Petropar), has a monopoly on the import and sale of petroleum products and operates the country's only refinery, the Villa Elisa facility, which has a capacity of 1.2 million liters (7,500 barrels) per day.[13] In 2005, Petropar signed a deal with Venezuela that grants the company preferential terms for crude oil imports.[14]

Biofuels Production

Paraguay has 39.73 million hectares of land, 67,000 of which is irrigated. 7.47%, or nearly 3 million hectares, is considered arable and 0.94%, or 373,462 hectares, is used for permanent crops. The Paraguayan economy is largely based on small farms, with sugarcane, corn, wheat, cassava, and soybeans as the major agricultural products.[15] Given this agricultural strength, Paraguay has good potential to become a large-scale producer and net-exporter of biofuels.

Ethanol

Cereal grains and other starch crops account for a large part of Paraguay's agricultural cultivation, and could be used to produce ethanol. The country annually produces 1.1 million tons of maize (corn), 5.5 million tons of cassava, 3.6 million tons of sugar cane, and 715,000 tons of wheat. Based on net exports, maize, sugar cane, and wheat have the greatest potential to serve as feedstock for ethanol production.[16]

Biodiesel

Of the nation's agricultural products, soybeans are the most promising resource for large-scale production of biodiesel. Paraguay is expected to produce 3.6 million tons of soybeans in 2006 and is consistently a net exporter.[17] Additionally, the country produced 125,660 tons of palm kernel equivalents, 27,660 tons of rapeseed and mustard seed, and 440 tons of oilseed in 2004.[18]

Studies show that Paraguay is currently using only 10% of its arable land. An estimated 20,000 acres of arable land could be used to cultivate biofuels crops, especially soybeans, without diverting farmland from food crops.[19]

D) PRIVATE SECTOR

Soybean production has expanded dramatically in Paraguay in recent years: soy accounted for 10% of the country's economy and 50% of its exports in 2005. Large multinational agribusinesses like Cargill, a U.S. grains conglomerate, have been the prime drivers of this expansion and will play a large part in the future development of a domestic biodiesel program.[20]

E) RESEARCH & DEVELOPMENT

Paraguay currently has agreements with the United States to facilitate the transfer of technology and research related to biofuels production. Paraguay has also increasingly looked to Brazil for expertise, and the two nations have an accord to cooperate in the development of biofuels technology.[21]

F) CONCLUSION

Paraguay's total dependence on imported oil and its robust agricultural economy make it a strong candidate for a domestic biofuels industry. The country grows a number of feedstock crops suitable for both ethanol and biodiesel production, and studies show that there is potential to expand the cultivation of these crops to underutilized land without diverting land from food crop cultivation. The passage of pending legislation and continued technical cooperation with the Brazilian government would help the country realize its biofuels potential.

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A) INTRODUCTION

Peru has taken a number of important steps to promote its domestic biofuels industry. As with many other countries in the region, Peru began by establishing a regulatory framework and mandated blends of biofuels, which should soon be followed by investments and R&D incentives.

The need to decrease reliance on traditional sources of energy is a strategic requirement for Peru and the strongest motivation to develop biofuels. In addition, the use of ethanol has been promoted as an instrument to reduce pollution, foster development in rural areas, and create jobs across the country. Finally, it is anticipated that the ethanol industry may serve as an alternative to narcotics and assist Peru's fight against illegal drugs.

Peru's established sugarcane production and the work the government has done to lay a legal and regulatory foundation are positive, but further budget and tax incentives will be necessary to develop the nascent industry.

B) GOVERNMENT POLICIES

In recent years, Peru has worked to establish an initial legal framework for the promotion of biofuels through two main instruments, the 2003 Biofuels Market Law (Ley de Promocion del Mercado de Biocombustíbiles), also known as PMB Law, and the 2005

Supreme Decree 03.
The PMB Law established a series of guidelines for promoting biofuels and created a Program for Biofuels Promotion (PROBIOCOM) and a Technical Commission for Biofuels (TCB).[1] The two bodies will promote production and trade of biofuels, strengthen R&D initiatives, invest in human resources, and create incentives for commercialization. A particular focus of both institutions will be fostering the production of biofuels in the Amazon region as an alternative to drug cultivation.[2] The TCB will also work in cooperation with the National Environment Council in order to ensure that expansion in the Amazon region is pursued responsibly.[3]

In 2005, a Supreme Decree required blends of 7.8% ethanol with gasoline and 5% biodiesel with diesel. It also called for ethanol production to begin in the regions of La Libertad, Lambayeque, Ancash, Piura, Barranca and Huaura by July 2006; in the regions of Loreto, Ucayali, Amazonas, San Martín, and Huánuco by January 2008; and in the rest of the country by January 2010. The Decree also envisions biodiesel commercialization in the regions of Loreto, Ucayali, Amazonas, San Martín, and Huánuco by January 2008; and in the entire country by January 2010.[4]

As of late January 2007, ProInversion, Peru's private investment promotion agency, will coordinate a subcommittee tasked with outlining technical standards for ethanol and biodiesel as part of Probiocom. Representatives of Industrias del Espino, Peruana de Combustibles, Heaven Petroleum, Biodiesel Perú, Repsol, automobile manufacturers association Araper, and local universities will participate in the subcommittee.[5]

Both the PMB law and the Decree insist that biofuels crop projects comply with national environmental laws and reinforce anti-narcotics initiatives.[6]

Challenges to the Framework
An initial legal framework is in place, but recent analyses have highlighted the need for implementing regulations. The Center of Rural Promotion, a Lima-based research center linked to the Peruvian Ministry of Agriculture, has recommended a number of changes to the current framework. For instance, the center points out that ethanol may not be competitive with regular fuels if taxes and incentives are not structured appropriately, especially given future fluctuations in the relative prices of sugar and oil. According to the study, the production of palm oil-biodiesel would cost approximately $0.50 per liter, a level that may be too high to be viable without state intervention in the form of tax incentives or price subsidies. The study also recommends increasing gasoline blends to 10% ethanol and diesel mixes to 20% biodiesel.[7]

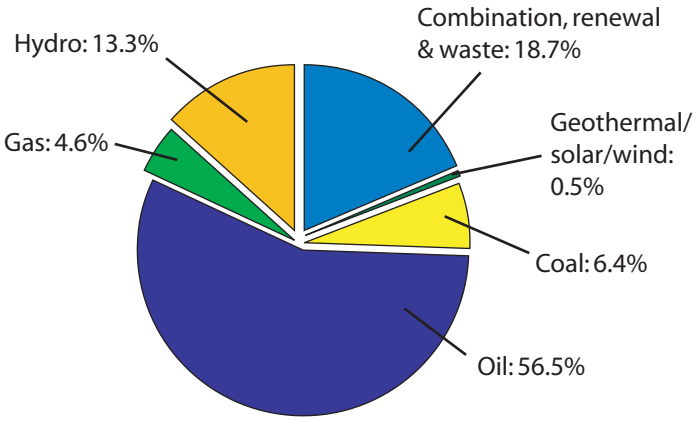
Relations with Brazil and Regional Cooperation
In February 2006, Peru's National Counsel of Science, Technology and Technological Innovation (CONCYTEC) renewed a program on biotechnology and biofuels with Brazil's Agricultural Research Corporation.[8] The governments of Brazil and Peru also signed an agreement in June 2006 to work together on projects related to the development of alternative crops for biofuels.[9]

The Free Trade Agreement (FTA) Peru signed with the US allows it to export biofuels into the US market and creates an opportunity for ethanol and sugar producers. However, there is some concern in Peru that recent agreements signed with Mercosur could threaten the domestic biofuels industry by allowing lower-cost Brazilian product access to the market before Peru's industry reaches cost efficiency.[10]

C) CURRENT SITUATION

Energy Matrix
Peru is heavily dependent on non-renewable sources of energy, which account for almost 70% of consumption.

Chart 1.7a: Peru's Energy Matrix (2003)



Source: International Energy Agency

Production Capacity

Peru has a number of crops that can be used for biofuels production, including sugarcane, sorghum, corn, yucca, potatoes, and rice. Peru is particularly competitive in sugarcane, boasting the highest yield per hectare in the world.[11] According to the Food and Agriculture Organization, the Peruvian sugarcane industry in 2004 produced 120 tons per hectare compared to just 73 tons per hectare in Brazil. The industry is also growing; production in 2004 increased 5%.[12]

80% of Peru's sugarcane goes to sugar production, and ethanol production is consequently quite low; in 2003, the country produced just 30.4 million liters. Using 2004 gasoline sales figures, it is estimated that 102 million liters of ethanol will be needed to reach the PMB's planned 7.8% blend standard by 2010.[13]

One of the strategies for expanding production is to increase cultivation in the Amazon region, which may have as much as 2 million hectares of available land. The northeastern region of San Martin is particularly promising. It currently has 3,500 hectares of sugar cane but there are plans to develop another 7,500 and build 45 distilleries.[14]

The principal challenge to such projects is establishing transportation logistics in the jungle. A 1,029 kilometers pipeline is being planned to transport product to the Boyóvar port in Piura, but this project will require investment of US$185 million.[15]

There is no significant biodiesel production to report, though Peru does produce significant quantities of palm oil, soy, and sunflowers, all of which can be used for biodiesel.

D) PRIVATE SECTOR

Peru's biofuels market is still in its early phases. The Peruvian Association of Sugar and Biofuels Producers forecasts that investments of approximately $400 million will be needed in the next decade.[16] Several companies appear to be positioning themselves as leaders in this developing market. One is Palma Selva SA, which manages several major projects in the Lima region. The company owns 1,800 hectares dedicated to biofuels feedstocks and is expanding production of both sugarcane and palm oil. The company has already established partnerships with Coimex Trading Co., from Brazil, and US-based Coler & Colantino Consortium.

Another company, Pure Biofuels, is also emerging as an important player, with aspirations of becoming the leading biodiesel producer in Latin America. Pure Biofuels will construct its first biodiesel refinery near the Callao port in Lima, investing $30 million

in the project. The plant, which is to be operational by November 2007, will have an initial annual production capacity of 180,000 tons of biodiesel, with expansion to 360,000 tons per annum planned by 2009. The company will also increase investment to $100 million in the next four years to cultivate feedstock in the Andes and Amazon regions. Pure has also signed pre-sale MOUs with local Peruvian fuel distributors for the entire production of the Callao facility. [17]

In January 2007, Texas-based company Maple announced plans to begin ethanol production from its project in coastal Peru in the second quarter of 2009. The company aims to begin testing sugarcane in a pilot area in March, with full-scale planting to start in November.[18]

E) RESEARCH & DEVELOPMENT

The government anticipates that research and development for new biofuels technology will be led by national universities and by the National Council of Science, Technology and Technological Innovation (CONCYTEC). These entities will help create the technology and design infrastructure for the production, commercialization and distribution of biofuels.[19]

CONCYTEC has already begun research on the production of biodiesel based on oil resources from the Amazon. For its part, the Universidad Nacional Agraria La Molina (UNALM) has begun research on the production of biodiesel from edible oils and has created small-scale prototypes.[20]

F) CONCLUSION

The elements for the development of a sustainable biofuels sector in Peru appear to be in place. A basic legal framework has been approved. Fuel blending targets have been established, environmental concerns are being addressed, and the country already has a high-yield sugar cane industry the expansion of which could feed ethanol production. Peru has also concluded two cooperation agreements with Brazil and has negotiated preferred access to the US market although this agreement is still pending approval by the US Congress. Importantly, several private-sector firms have made initial investments in biofuels production. Questions remain, however, about the feasibility of government plans to expand sugar cane production in the Amazon region and, more broadly, whether biofuels can be competitive with petroleum products.

Endnotes

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Source: World Factbook

A) INTRODUCTION

Uruguay currently ranks 73rd out of 120 countries in global competitiveness, according to the World Economic Forum.[1] The nation continues to struggle to establish itself as a contender in the global economy as well as to improve the livelihoods of its people. In the 2005 United Nations Human Development Report, Uruguay was ranked 46th in human welfare, which includes measures of poverty, health, and education.[2]

Uruguay began liberalizing its economy in the 1970s, focusing on the opening of trade barriers and financial flows. In 1991, Uruguay became a member of Mercosur (the Southern Cone Common Market). As a result, its economy and energy policies were and continue to be highly integrated with those of other Mercosur members, particularly Argentina and Brazil. Eight years later, in 1999, Uruguay experienced a major recession due to low commodity prices and struggling export markets. A devaluation of Brazil's currency and economic crisis in Argentina contributed to the country's dire situation, putting drastic downward pressure on Uruguay's exports and tourist revenues. Uruguay was forced to borrow extensively from international financial institutions, particularly the IMF. Finally, in 2003, Uruguay managed to recover and achieve economic growth, which has continued up to the present with the help of healthy export markets and increased trade with the United States. According to the U.S. State Department, Uruguay presently enjoys a favorable investment climate, with a strong legal system and open financial markets.[3]

B) GOVERNMENT POLICIES

In 2003, the Uruguayan Government approved Law No. 17.567, which states that the production of biofuels is in the "national interest," and is therefore eligible for a variety of fiscal incentives and tax exemptions.[4] The government also created an official, inter-institutional National Biofuels Commission to advise authorities on the framework for state policies related to biofuels production and use. The Commission is composed of members of the National Direction of Energy and Nuclear Technology (DNETN), the Ministry of Cattle (MGAP), the National Administration of Oil, Alcohol and Portland Cement (ANCAP), the University of the Republic (UdelaR), and the National Institute of Agricultural Research (INIA).[5] These ministries and institutions have identified a number of reasons to expand the biofuels industry in Uruguay, including:

- Providing jobs and improving livelihoods in Uruguay's rural areas;
- Reducing consumption of petroleum;
- Limiting greenhouse gas emissions; and
- Diversifying the country's power matrix.

The Uruguayan government has also established a National Program of Bioethanol (Pronabio-E), ostensibly to coordinate the production of ethanol in different agricultural regions throughout the country. Pronabio-E is currently working with the municipalities of Montevideo, Canelones, Maldonado, and Treinta y Tres, as well as unions and institutions from the states of Bella Unión, Paysandú, Salto, and Durazno. The program focuses especially on the processing of sugarcane for ethanol production, and Pronabio-E predicts that an expanded sugar-alcohol industry will have great economic, social, and environmental benefits.[6]

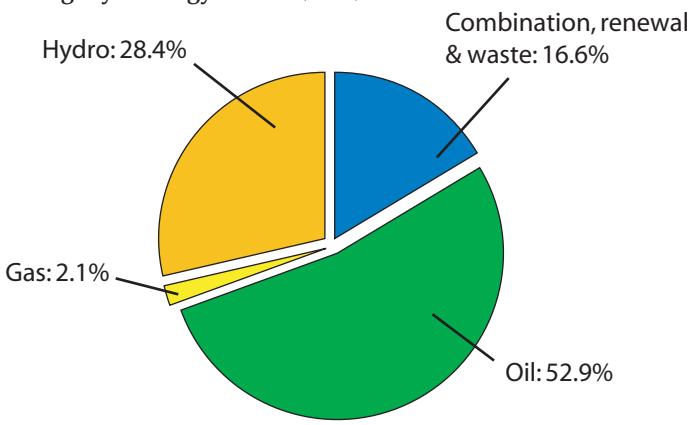
The creation of the Biofuels Commission and Bioethanol Program reflects the Uruguayan government's interest and investment in the cause of sustainable energy resources and environmental protection. While additional steps will have to be taken to establish a clear regulatory framework regarding biofuels production and use, including blend targets, the government of Uruguay has already made a great deal of progress.

Relations with Brazil
Uruguay and Brazil are both members of the Mercosur trading bloc and the countries have a number of additional bilateral agreements. While the two countries have not established formal cooperation on biofuels, there is discussion of establishing a shared research center to develop new cane varieties suitable to their common conditions.

C) CURRENT SITUATION

Energy Matrix
The primary source of Uruguay's energy is oil, followed by hydropower [Chart 1.8a]. Oil consumption reached roughly 5.7 million liters (35,700 barrels) per day in 2005, almost all of which was imported. The nation's only refinery, the La Teja facility near Montevideo, has the capacity to refine 8 million liters (50,000 barrels) of oil a day.[7] The National Administration of Combustibles, Alcohol and Portland Cement (ANCAP), which is state-owned, controls the oil sector in Uruguay.

Chart 1.8a: Uruguay's Energy Matrix (2003)



Source: International Energy Agency[8]

Uruguay, along with Paraguay, signed a deal in 2005 to receive preferential terms for crude oil imports from Venezuela, a newly-accepted member of Mercosur. In December 2005, Uruguay's ANCAP and the state petroleum company of Venezuela, Petróleos de Venezuela (PDVSA), agreed to conduct a feasibility study on an $800 million plan to double the capacity at the La Teja facility, including an upgrade of the refinery to allow it to better process heavier, Venezuelan crudes.[9]

The nation's four hydroelectric plants provide the majority of the nation's electricity; the Terra, Baygorria, Palmar, and Salto Grande plants have a combined capacity of 1,538 megawatts. In addition, in May 2006, Uruguay and Argentina agreed to study the feasibility of a new, 265-megawatt, hydro facility to be constructed near Salto Grande. These plants can cover the nation's energy demands under normal conditions, but shortfalls in water supply, due to seasonal variation, are covered either through imports, or through oil- and diesel-run generators. During peak demand periods, the country's National Administration for Electricity Use and Transmission (UTE) will also rely on thermal power plants and mobile diesel generators.[10]

Biofuels Production

Uruguay has 17.36 million hectares of land, 210,000 hectares of which are irrigated. 1.37 million hectares, or just under 8%, are arable, and 42,300 hectares, or 0.24% of total land are dedicated to permanent crops.[11] Uruguay depends on agriculture, which accounts for nearly 10% of the nation's GDP and more than half of its exports.[12] In terms of starch crops available for ethanol production, Uruguay produces rice, wheat, corn, and barley.[13] The nation is the largest exporter of rice in Latin America and the Caribbean, exporting over 1.2 million tons per year.[14] It also produces some 500,000 tons of wheat, 400,000 tons of barley, and 200,000 tons of corn annually.

Ethanol Potential

The primary ethanol feedstocks listed above, produced in surplus and exported, could be redirected toward ethanol production, allowing Uruguay to develop a value-added industry. Uruguay is a net exporter of both rice and barley, making those crops the most promising foundation for an expanded ethanol industry.[15]

Countries that are significant importers of gasoline are also good candidates for ethanol production. An ethanol plant that produces 40 million liters a year (the average output of ethanol plants in Brazil) could supply a 1.1 million liters a day (7,000 barrels) gasoline market with a 10% ethanol blend. Uruguay imports only 159,000 liters (1,000 barrels) per day of gasoline, and only 524,600 liters (3,300 barrels) per day of diesel fuel.[16]

Biodiesel Production
There is a domestic biodiesel market and there are strong incentives to further develop this market, given the importance of diesel to the country's electricity supply and the country's dependence on oil imports, including diesel. In 2004, Uruguay produced 5,390 tons of oilseed and 377,000 tons of soybeans from 245,350 hectares, both of which can be used as feedstock for biodiesel production.[17] There are three biodiesel plants in Uruguay, two of which are located in Montevideo. However, they do not utilize the above mentioned crops as feedstock; one uses fried cooking oil waste, and the other uses animal fat.

D) PRIVATE SECTOR

Uruguay is in the very early stages of developing a significant biofuels industry. As such, private investment is especially important. As of June 2006, several German and Canadian investors were planning to invest $45 million in an ethanol plant in Treinta y Tres, a rice-growing region of Uruguay. The plant would use the hulls and stalks of the rice, which are usually disposed of as waste products.[18] The project, if completed, will significantly increase the capacity of ethanol production at Treinta y Tres.

Several other firms are cooperating to launch new biofuels projects and expand existing ones. COPAGRAN (Cooperativas Agrarias Nacionales), EcoDiesel, and Cooperativa Cradeco initiated a program in April 2006 to expand production of biodiesel from oilseeds.[19] The project will cost US$70 million and is slated to begin in 2007. It will establish 25 micro-plants around the country to produce biodiesel using sunflower, soybean, and canola oilseeds near the fields where the grains are cultivated.

E) RESEARCH & DEVELOPMENT

Information available regarding research and development efforts in Uruguay is limited. The University of the Republic monitors the production standards for the country's largest biodiesel plant.[20] At least one professor in the University's Department of Chemistry, Dr. María Antonia Grompone, is involved in the study of oils and fats, including for biodiesel production.

There is also a growing number of companies involved in research and development for the sector. Biodiesel Uruguay currently serves as a portal for information and news about various R&D efforts as well as new projects and policies.[21] The official Biofuels Commission, established by the government, is also committed to investigating the viability of existing biofuels processes and the development of new technology.[22]

F) CONCLUSION

Uruguay is in the early stages of establishing a domestic biofuels industry. The national government has made some progress in promoting the industry, including the establishment of the National Biofuels Commission and National Program of Bioethanol (Pronabio-E), but much remains to be done. Uruguay's agricultural capacity, particularly in starch crops, and its need to reduce its dependency on oil imports and create rural jobs make the nation a good candidate for investment in this emerging sector.

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Source: World Factbook

A) INTRODUCTION

Venezuela is one of the world's top oil producers and one of the few oil-rich countries that also has the potential to grow large volumes of crops for the production of biofuels. The country could develop significant production capacity for biofuels thanks to its size, climate, topography, and cultivated crops.

However, there is no official government policy for biofuels yet in place and the country is likely to remain a net importer of ethanol for several years. The lack of a clear legal framework has been a stumbling block to the development of the industry. In addition, the deficit in sugar supply raises concerns about that industry's potential to support the production of ethanol.

B) GOVERNMENT POLICIES

Venezuela has no policies established for the biofuels industry, but the government has indicated an interest in expanding sugarcane cultivation for ethanol production for use as both an MTBE-replacement additive at a 10% blend and as a tool of rural development.

In March 2006, Hugo Chavez announced Plan 474 to plant sugarcane and build the distilleries necessary for the production of ethanol. According to the statement, the government intends to allocate $900 million over five years to the production of ethanol.[1] The funding will contribute to the development of 17 ethanol production plants

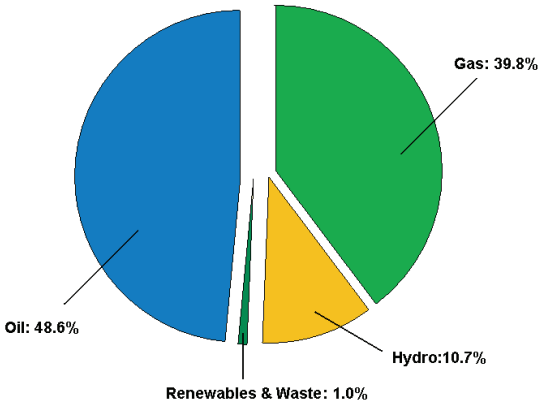
and could provide 600,000 new jobs by 2009.[2]

Relations with Brazil
In February 2005, the Venezuelan Ministry of Energy and Oil, the Brazilian Ministry of Mines and Energy, and the presidents of PDVSA (Petroleos de Venezuela), Venezuela's state owned company, and Petrobras signed an agreement. All sides pledged to share knowledge on the production of ethanol based on sugarcane and to integrate their industrial and technological sectors. They also agreed to work together to revise and amend Venezuela's regulatory framework to include ethanol in the energy matrix.[3]

C) CURRENT SITUATION

Energy Matrix
In 2004, oil and natural gas made up 48.6% and 39.8% of Venezuela's energy consumption, respectively.[4] The country is a founding member of the Organization of Petroleum Exporting Countries (OPEC) and the world's eighth largest net exporter of oil.

Chart 1.9a: Venezuela's Energy Matrix (2004)



Source: International Energy Agency

Venezuela possesses the second largest proven reserves in the Western Hemisphere, with 79.7 billion barrels of proven conventional oil reserves, not including substantial extra-heavy and bitumen deposits that could total as much as 270 billion barrels. Venezuela contends that it produces 3.3 million barrels per day of crude oil; however, some industry analysts believe that number is closer to 2.8 - 2.9 million.[5] Also a major gas producer in the Americas, Venezuela's proven natural gas reserves are an estimated 4.276 trillion cubic meters, the second largest in the Western Hemisphere behind the US. In 2004, the country produced 27.2 billion cubic meters of natural gas, consuming the same quantity that year. Crude oil production restricts that of natural gas, as roughly 90% of gas resources are associated.[6]

In January 2007, Venezuela began the process of exerting national sovereignty over its natural energy reserves, taking control of 32 oil fields. PDVSA's current production is difficult to approximate, with average output estimated to be 1.6 million barrels/ day; the company projects that it will achieve a production capacity of 5.847 million barrels per day 2012.[7]

Biofuels Production
Venezuela's abundant gas and oil is a major factor discouraging the development of a biofuels industry. Although Venezuela cultivates significant quantities of sugarcane (8.81 million tons annually[8]) and palm kernel (315,000 tons annually[9]), there is currently no ethanol or biodiesel production in Venezuela.

Venezuela currently imports 159,000 liters (1000 barrels) per day of ethanol from Brazil; and Petrobras announced that further investments on ethanol pipelines to Venezuela

will be made by 2010.[10] The two countries are negotiating a contract that would send 380 million liters of ethanol a year to Venezuela.

Ethanol Capacity Expansion
Venezuela's sugar deficit is a major impediment. In 2005-2006, the demand for sugar in Venezuela was 960,000 tons, but production only reached 630,000 tons, forcing Venezuela to import. The nation's sugarcane industry does not currently have excess for use in the production of ethanol.[11] In addition, there is no infrastructure (production or supply chain) in place yet.

According to analysts, this gap could be closed by increasing the amount of cultivated land from 125,000 to 180,000 hectares of sugarcane, and the government has indicated interest in this approach.[12] PDVSA recently announced that it would seed 276,000 hectares of sugarcane in order to produce 4 million liters (25,000 barrels) of ethanol per day.[13] The western regions of Trujillo and Yaracuy are likely to receive major investments from PDVSA.[14] The state oil company also has plans to create a joint venture for the domestic production of sugarcane-based ethanol that would include the construction of at least 17 ethanol plants.[15]

In 2006, the oil industry indicated that between 2007 and 2009 additional sugar crops would be planted and harvested in the states of Zulia, Barinas, Trujillo, and Portuguesa (2007); Cojedes, Anzoatequi, Guarico and Monagas (2008); and in other states in 2009. Further, Alejandro Granado, the Refining Vice President of PDVSA, announced a pilot plant at Pio Tamayo Central where a distillery would be installed to process 25,000 liters of ethanol per day, and another in Yaracuy to process 500,000 liters of ethanol per day.[16] In December 2006, representatives from PDVSA and the government of Yaracuy met to discuss moving forward with the development of the plants.[17]

In addition, Venezuelan oil company Suelopetrol plans to launch a subsidiary, Ethapetrol, that will produce ethanol for premium gasoline manufacturing. Suelopetrol, a joint venture with PDVSA, is in negotiations with PDVSA for the entire supply of the 100,000 – 120,000 liter per day production.[18]

Biodiesel
While Venezuela does not currently produce biodiesel on a commercial scale, the Government has solicited assistance from Malaysia's Golden Hope Plantations Bhd to help manage their palm oil industry. Golden Hope seeks to expand Venezuela's palm oil production from its current 45,000 acres to 165,000 hectares.[19]

D) PRIVATE SECTOR

Venezuela's energy sector is highly politicized, and there is no significant private sector involvement in biofuels. Petrobras and PDVSA remain the only players with any significant investments in the sector.

E) RESEARCH & DEVELOPMENT

There is very little R&D activity related to biofuels. The agreement signed with Brazil includes a commitment to joint ethanol research through universities, research centers, and companies, but it does not appear that any initiative is underway.[20]

As part of its agreement to assist in the management of Venezuela's palm industry, the Golden Hope Academy will train 20 Venezuelan palm oil planters and the Malaysian Palm Oil Council will conduct joint research and development activities with Venezuelan scientists.[21]

F) CONCLUSION

Despite a cooperation agreement between the respective ministries and state oil companies of Brazil and Venezuela, there is little indication of any near term progress in developing a significant biofuels sector in Venezuela. Government policies setting a

framework for the industry are lacking, and no R&D initiatives are underway. Venezuela is a significant net importer of sugar, so there is no surplus feedstock. Private investors show no signs of interest in the sector. Although PDVSA has plans to construct 17 ethanol plants in the country, it is not at all clear how the necessary cane feedstock will be produced. With its enormous petroleum reserves, and current high oil prices, Venezuela lacks incentives for a serious drive for energy diversification.

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2. CENTRAL AMERICA & THE CARIBBEAN

Source: World Factbook

A) INTRODUCTION

The interests of Central American and Caribbean countries in biofuels are multi-faceted and include:

- Energy Security – many countries expend a great deal on imports of petroleum fuel;
- Environmental Preservation – cutting carbon emissions to improve air quality and overall quality of life; and
- Socio-Economic Improvement – biofuels production has the potential to enhance and advance the agroindustrial sector of a given economy, providing jobs and boosting income in rural communities as well as adding value to the production chain of agricultural goods.[1]

Costa Rica, El Salvador, and Guatemala are considered the best equipped for expansion in biofuels production, based on their current production capabilities, the organization of their agroindustrial sectors, and the aptitude of their governments in recognizing the importance of the biofuels sector and in legislating accordingly. Some estimates show that these countries have industry indicators comparable to those found in Brazil.[2] While Guatemala shows a great deal of promise, there are special interests within the country which could impede further development of its biofuels industry.

Other countries in Central America are also seen as having potential, such as Honduras, Nicaragua, and Panamá, due to their climate, dependence on foreign sources of oil, and existing sugarcane industries. These countries, however, have slightly less advanced physical and political infrastructure for biofuels development, which includes processing plants for production and the regulatory frameworks to promote biofuels use on a large scale. Of this group, Nicaragua has shown particular promise and continues to move forward in the development of its biofuels sector.

In the Caribbean, Jamaica is developing into a player in the ethanol market, and a number of other islands including Grenada and the Dominican Republic have been identified as having potential. The United Nations has targeted the production of biodiesel as a potential development tool in Haiti, and is working with Brazil to transfer technology and know-how as part of a comprehensive development project through the UN

Food and Agriculture Organization (FAO).[3]

B) GOVERNMENT POLICIES

In the 1980s, Costa Rica, Guatemala, and El Salvador all tried, unsuccessfully, to introduce ethanol blends into their consumer markets.[4] More recently, regional alliances have made the prospect of introducing biofuels into the energy matrix more realistic. In a show of regional cohesion on the issue, the Subgroup on Methods and Normalization and the Subgroup on Hydrocarbons in the Central America Region created technical regulation RTCA 75.02.43:06 on biodiesel and blend mixtures (with combustible diesel oil) for Central America. In November 2006, this regulation was ratified by the Ministerial Council of Economic Integration (COMIECO) for the region.[5]

Caribbean Basin Initiative
The goal of the Caribbean Basin Initiative (CBI), initially launched in 1983 through the Caribbean Basin Economic Recovery Act (CBERA), is to facilitate economic development and export diversification within Central America and the Caribbean. This initiative was expanded in 2000 through the US-Caribbean Basin Trade Partnership Action, and currently offers 24 countries duty-free access to the US market for most goods, including ethanol.[6] CBI countries have had access to US ethanol markets since 1989.[7]

Members of the CBI in the Caribbean are: Antigua, Aruba, the Bahamas, Barbados, British Virgin Islands, Dominica, Dominican Republic, Grenada, Haiti, Jamaica, Montserrat, Netherlands Antilles, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, and Trinidad & Tobago. Central American members are: Belize, Costa Rica, El Salvador, Guatemala, Guyana, Honduras, Nicaragua, and Panama.

Under the CBI, member countries are allowed to export ethanol to the US, duty free, in the following stages:

1) Up to 7% of total US ethanol production;
2) An additional 132.48 million liters (35 million gallons) beyond that if 30% of the ethanol is derived from local feedstocks; and
3) Additional liters on top of that if they are derived from 50% local feedstock.[8]

For fiscal year 2005, the US International Trade Commission determined that the 7% CBI cap on duty-free ethanol exports to the United States would have amounted to more than 910 million liters (240.4 million gallons), which would equal or even exceed the amount produced by some of the largest producing US states. CBI countries, however, were unable to reach that level.[9]

Once CAFTA comes into effect, it will supersede the CBI and make permanent the allowances for ethanol exports to the US.

Central America-Dominican Republic-US Free Trade Agreement
The Central America-Dominican Republic-United States Free Trade Agreement (CAFTA) is designed to eliminate tariffs and non-tariff barriers to trade, expanding opportunities for laborers, producers, consumers, and service providers of the signatory countries. Specifically, CAFTA features a reciprocal-access agreement to eliminate tariffs on more than 80% of US exports to the Central American and the Caribbean signatories, with a phase-out of remaining tariffs over 10 years. According to the US government, these provisions balance the fact that 80% of imports from CAFTA countries already enter the US duty-free through the CBI and under the WTO's Most Favored Nation provisions.[10]

The signatories are Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, and the US. CAFTA was approved by the US Congress in July 2005 and signed into law by the President the next month. Since then, CAFTA has been ratified by the legislatures of all signatories save Costa Rica, where approval is pending.[11]

Under CAFTA, signatories may continue to share the 7% quota established by the CBI,

but with specific shares established for two countries:

- Costa Rica - 117.3 million liters (31 million gallons) annually; and
- El Salvador - 19.7 million liters (5.2 million gallons) the first year and annual increases of 4.92 million liters (1.3 million gallons) per year not exceeding 10% of the quota.

There are also strict rules of origin in place to prevent transshipment from other nations through CAFTA signatory countries.

Some view CAFTA as a "gateway accord" to a grander Free Trade Area of the Americas (FTAA), under which signatory countries in North America, South America, Central America, and the Caribbean would receive freer access to one another's markets. Agricultural subsidies, including those for sugar, have been one of the sticking points in FTAA negotiations. For Brazil to sign such an agreement, some concession on sugar products, including ethanol, would likely be necessary. Some fear that this would allow Brazil to flood the US market with ethanol. In 2005, Brazil exported 114.31 million liters (30.2 million gallons) to the US.[12]

Caribbean Community and Common Market[13]
The Caribbean Community and Common Market (CARICOM) is another regional trade block, consisting of the Caribbean nations of Antigua and Barbuda, the Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Haiti, Jamaica, Montserrat, Saint Lucia, St. Kitts and Nevis, St. Vincent and the Grenadines, Suriname, and Trinidad & Tobago. Associate members are: Anguilla, Bermuda, the British Virgin Islands, the Cayman Islands and the Turks & Caicos Islands.

CARICOM's Single Market and Economy (CSME) provides for a common external tariff; the free movement of goods, capital, and labor; and a common trade policy. CSME also calls for the harmonization of trade related laws, such as intellectual property, as well as economic, fiscal, and monetary policy coordination.

CARICOM, in conjunction with the Caribbean Development Bank (CDB) and the Inter-American Development Bank (IDB), has also taken steps to promote biofuels development in the Caribbean, including a technical cooperation program to expand biofuels prospects through carbon finance in Barbados, Guyana, and Jamaica,[14] and a workshop in Guyana scheduled for December 2006.

Plan Puebla Panamá[15]
Plan Puebla Panamá (PPP) is a regional development and integration plan aimed at connecting the Central American nations from the south-southeastern region of Mexico to Panamá. The plan has eight initiatives aimed at turning the region's comparative advantages into competitive opportunities and focusing on traditionally marginalized stakeholders such as indigenous peoples, rural dwellers, and Afro-Caribbean communities. Of particular relevance to biofuels initiatives are the aspects of the plan which encourage the social inclusion of underrepresented groups, particularly in the areas of environmental management and sustainable natural resource use, and the creation of incentives to promote productive investment in the region.

The official guidelines of the plan were presented in Mexico City in March 2006. The members of PPP are Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, and Panama.

Of the PPP's eight initiatives, the following have some bearing on the biofuels industry:

- Roadway and Transport Integration, for which Costa Rica is responsible – the goal of this initiative is to minimize the cost of overland transportation by connecting and improving highways along the Pacific and Atlantic coasts. The improvement of port facilities along the highways is also part of this initiative.
- Electric-Energy Interconnection, for which Guatemala is responsible – this initiative

aims to create a unified regional market in order to attract investment and reduce the cost of electricity through economies of scale. Projects within this initiative include the conservation of non-renewable energy sources and the promotion of renewable energy use.
- Trade Facilitation, for which Honduras is responsible – this initiative aims to eliminate non-tariff and other trade barriers, although most will now dissolve under CAFTA. It will also promote cooperation among small and medium enterprises to boost exports.
- Sustainable Development, for which Nicaragua is responsible – this initiative will help encourage a culture of sustainable development, conservation, and preservation of natural resources with the ultimate goal of optimizing ecological as well as economic value. Projects under this initiative will include a Natural Resources Sustainable Development Program and the promotion of agroindustrial activities.

PPP provides an efficient coordinating mechanism through which multinational projects may be realized. It provides a dynamic institutional framework, which can adapt to the changing policy landscape while keeping the original goals of the plan in view. Finally, it provides a forum for consensus building on important strategic issues.[16] The promotion of biofuels development falls in line with the goal and initiatives of the plan, as outlined above, and the plan should be an asset to biofuels projects promoted under its umbrella.

Mesoamerican Biofuels Group
The recently created Mesoamerican Biofuels Group, comprised of Mexico, Guatemala, Beliz, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, the Dominican Republic and Colombia, has developed action plans to introduce biofuels in the region. The group had its first meeting in August 2006 in San Jose, Costa Rica and its second in Washington, DC in November. It receives support from, among others, the Inter-American Development Bank, in the areas of technical cooperation and funding for biofuels feasibility studies.

Energy and Environment Partnership with Central America
The Energy and Environment Partnership with Central America (EEP), was created in 2002 at the United Nations World Summit on Sustainable Development in Johannesburg, South Africa.[17] The program seeks to develop accessible energy services for marginalized groups in rural areas to promote the sustainable use of renewable energy sources and clean technologies. One of the renewable energy sources being considered by the project is biomass for fuel in homes and industry. There are projects underway covering various stages of biofuels production development, from biomass fuel feasibility studies in Belize, Costa Rica, Nicaragua, Panamá and Honduras, to jatropha plantation in Honduras, to biodiesel production in Guatemala and El Salvador. There are also regional feasibility studies for bioenergy and biodiesel plants as well as projects focusing on the dissemination of information on biomass and biofuels and public policy formulation.[18]

Petrocaribe Venezolano, S.A.
Petrocaribe is a regional initiative sponsored by the state petroleum company of Venezuela, Petróleos de Venezuela (PDVSA). The program provides discounts to Petrocaribe signatories through the elimination of third-party intermediaries and the provision of financing options, including trade in goods and services. The initiative also entails the building or revitalization of related infrastructure, especially refining capacity, and assistance from the Venezuelan government in financing activities. Such activities include the refurbishment of refineries in Kingston, Jamaica and Cienfuegos, Cuba, and potentially the development of storage facilities on various strategic islands for rapid mobilization of petroleum stockpiles.[19] The only two Caribbean nations which have not signed on to the project are Trinidad & Tobago and Barbados. Following the election of Réne Préval, Haiti was brought into the negotiation process for Petrocaribe.

For countries such as those in the Caribbean which have minimal domestic petroleum resources, these integration projects offer more affordable petroleum products on an established timetable, vastly preferable to purchasing products on the spot market at

higher prices. In this way, Petrocaribe could potentially reduce the energy bills of participant countries and weaken energy security as driver for biofuels production. According to the Venezuelan Embassy in Washington, however, countries in the Caribbean region should continue to consider biofuels production a social and economic benefit. Regular discussions are planned on the economic and social development projects that Petrocaribe should pursue, and biofuels will likely surface in this context.[20]

Relationship with Brazil

There has been mutual interest and cooperation on the part of the governments of Brazil and several Central American and Caribbean countries. Since 2005, Brazil has made an effort to establish a series of protocols for cooperation on biofuels production with several countries. One of the more prominent, the *Protocol of Intention for Technical Cooperation in the Area of Production Techniques and the Use of Ethanol*, was extended to a number of countries in September 2005, including Costa Rica, Belize, Haiti (which signed in May 2006), El Salvador, and Panama (which signed in September 2006). According to the cooperation agreements, the partnerships would aim to enhance the parties' efforts to meet the Kyoto protocol requirements.[21]

In May 2006, Luis Fernando, the Brazilian Minister of Development, Industry, and Trade, and Silas Rondeau, Brazil's Minister of Mines and Energy, led a business mission trip to Central America, visiting Costa Rica, El Salvador, Guatemala, Honduras, and Panama.[22] In a reciprocal visit, equivalent officials from those countries traveled to Brazil for a five-day summit in August 2005 to discuss the many facets of ethanol production.[23] Brazil has also taken an interest in working with Caribbean nations and signed a biofuels and bioenergy cooperation pact with France to promote biofuels development in the Caribbean and Africa.[24]

C) CURRENT SITUATION

Production

Ethanol production occurs in the region on a significant scale, but biodiesel production is less common. The cultivation and harvest period for sugarcane in Central America is typically 120 days, significantly less than Brazil's 200-day season.[25] There is a concentration of production units in Guatemala, representing 44% of the region's total processing capacity. The top 13 processing plants in Central America represent half the region's capacity, but smaller processing plants tend to be more common; the bottom 20 represent only 10% of capacity.

Table 2a: Largest Ethanol Factories in Central America

	Plant	Ton/Day
Guatemala	Pantaleón	17,507
Guatemala	Magdalena	16,571
Nicaragua	San Antonio	14,515
Guatemala	Santa Ana	13,717
Guatemala	El Pilar	13,600
Guatemala	La Unión	10,803
El Salvador	Central Izalco	9,200
Guatemala	Concepción	7,674
El Salvador	El Ángel	7,500
Guatemala	Madre Tierra	7,024
Costa Rica	Toboga	6,500
Nicaragua	Monte Rosa	6,350
Guatemala	Tierra Buena	6,009

Source: Nogueira[26]

It is estimated that the further development of the biofuels industry in Central America could generate 14,000 jobs through the production of E10 fuel.[27] Among Caribbean

countries analyzed in this report, refineries in the Dominican Republic and Jamaica have the largest capacities, some of which rival the larger refineries in Central America.

Table 2b: Largest Ethanol Factories in the Caribbean

	Plant	Ton/ Day
Dominican Republic	Central Romana	15,426
Dominican Republic	Cristobal Colon	10,889
Jamaica	Frome	6,000
Dominican Republic	Consuelo	4,537
Jamaica	Monymusk	4,333
Jamaica	Appleton	3,333
Jamaica	Monymusk	3,333

Players
Governments and international organizations are playing an important role in project development and investment in the biofuels sector in the region. CARICOM is active in a number of projects in the Caribbean. The private sector and industry unions and producer associations are also involved, though greater investment is always needed.

Brazil is developing ties in Central America and the Caribbean to promote biofuels production, and the country is poised to act as a technical expert as well as production partner on projects across the region. Brazil is likely to involve itself in production for domestic consumption as well as for export.

Internal Consumption
Within the region, the consumption of biofuels is not widespread, but internal demand may develop quickly through consumer education campaigns and legislation mandating biofuel blends. The graph below [Table 2c] shows that in 2002, the region required 153 million liters for E5; 306 million for E10; and 764 million for E25. It also shows that demand could surge to 229 million, 459 million, and nearly 1.5 billion liters for those same blends respectively in 2010.

Table 2c: Potential of the Ethanol Fuel Market in Central America

	Blend	Guatemala	El Salvador	Honduras	Nicaragua	Costa Rica	2002 Total	2005 Est.	2010 Est.
Gasoline Consumption									
Thousands of Barrels		6,981	3,073	2,781	1,410	4,981	19,226	22,929	28,858
Million Liters		1,110	489	442	224	792	3,057	3,645	4,588
Ethanol Required									
Million Liters	5%	55	24	22	11	40	153	182	229
	10%	111	49	44	22	79	306	365	459
	25%	277	122	111	56	198	764	911	1,147
Molasses Required									
Thousand MT	5%	213	94	85	43	152	588	701	882
	10%	427	188	170	86	305	1,176	1,402	1,765
	25%	1,067	470	425	216	761	2,939	3,505	4,412
Sugar Required									
Thousand MT	5%	101	44	40	20	72	278	331	417
	10%	202	89	80	41	144	556	663	834
	25%	504	222	201	102	360	1,389	1,657	2,085

Source: Asociación de Combustibles Renovables de Centroamérica, documento Programas de Combustibles[28]

This type of projection for the Caribbean is not yet available, but consumption will likely rise as programs are put into place to promote domestic biofuels use and supplies are made widely available for public consumption. The same is true for biodiesel use in both Central America and the Caribbean.

Exportation
While Central American and Caribbean countries may not be consuming large amounts of biofuels, they are exporting it, especially to the United States. Before 2005, Costa Rica, El Salvador, and Jamaica were the only countries in this group to have exported

ethanol to the United States, and those exports were less than 50% of the permitted amount.[29] Trinidad & Tobago began exporting ethanol to the United States in 2005, bringing total US imports from that group to 391.37 million liters (103.4 million gallons) [Table 2d].

Table 2d: Ethanol Fuel Exports to the United States (millions of liters)[30]

	2002	2003	2004	2005
Costa Rica	45.4	55.6	96.1	126.4
El Salvador	17.0	26.1	21.6	89.7
Jamaica	109.8	148.8	138.5	137.4
Trinidad & Tobago	0.0	0.0	0.0	37.9
Total	172.2	230.5	256.2	391.4

Source: Renewable Fuels Association[31]

D) PRIVATE SECTOR

CAFTA quota allowances for ethanol exports to the US should help promote ethanol market stability in the region and incentivize increased investment in the sector. Countries and companies interested in supplying the US market have a strong interest in investing in the other CAFTA countries to take advantage of this opportunity. Brazil possesses the experience and know-how to successfully produce ethanol, as well as biodiesel, and has begun to export this expertise to countries in the region through partnerships in production ventures. For example, Brazilian ethanol producer Coimex teamed with Jamaican petroleum company Petrojam to acquire the nation's two largest sugar factories, which together account for 65% of Jamaica's production, investing $100 million.[32] China, a new biofuels exporter, sends some of its product to the Caribbean for processing to take advantage of the region's relationship with the United States, its ultimate export destination.[33]

There are several funds aimed at sustainable development and renewable fuels programs, particularly bioenergy and biofuels development in Central America:[34]

- The Inter-American development bank has supported a number of initiatives in Central America and the Caribbean, including:
  - o The Central American Renewable Energy and Cleaner Production (CAREC) facility, to which the IDB gave $5.5 million to support SMEs in the areas of proven renewable energy, cleaner production and energy efficiency in the region;
  - o Supporting PPP countries in expanding the pipeline of energy-related Carbon Credit projects in the Mesoamerican region by proving $546,847 in funding; and
  - o The IDB-GTZ Program fund, which is to provide $63,000, as well as technical cooperation, to the Hydrocarbons Cooperation Committee of Central America (CCHAC) to evaluate ethanol production from sugarcane in Central American countries. The Mesoamerican Biofuels Group is also a collaborator in this effort.

- A delegation from the Overseas Private Investment Corporation (OPIC) visited Central America in October 2006 and announced that it would offer a new round of financing to El Salvador, Guatemala, Honduras, and Nicaragua totaling at least $212 million. This figure includes $149 million from three new OPIC-supported investment funds, one of which focuses on renewable energy use in the power sector, and $7.5 million for a microfinance project in the four countries, as well as Peru and Mexico.[35]

- From April 2000 to April 2005, the US Agency for International Development (USAID) gave $5.31 million to E+Co, a clean energy investment firm, to focus on renewable energy ventures in the region through its Financing of Energy Companies

in Central America (FENERCA) program for the increased use of renewable energy resources.

- Along with operating support of $1.1 million from UNDP (Development Program) and UN Foundation programs, USAID-funded activities that resulted in the direct investment of $37.5 million in private capital from local financial institutions in the sector, with another $17 million under consideration.
- Partners in the program were the Biomass Users Network-Central America (BUN-CA), a non-profit based in Costa Rica, and the Environmental Enterprises Assistance Fund (EEAF), which also operates out of Costa Rica. Several other financial institutions have shown interest in the creation of a Central America Fund for Renewable Energy Projects. As of 2003, tentative fund totals were $22-25 million.[36]

USAID has also provided technical assistance and funding in the amount of $140,000 to help identify and prepare alternative energies, including biofuels, in PPP countries beginning in August 2004.[37]

- The World Bank (the Bank), through its Carbon Finance Unit (CFU), also uses money contributed by OECD countries to finance projects promoting greenhouse gas reductions through various funds and facilities. The Bank does not lend money, but rather contracts for the purchase of emissions reductions within the framework of the Kyoto Protocol's Clean Development Mechanism (CDM) or Joint Implementation (JI).
  - The Community Development Carbon Fund (CDCF), capitalized at $128.6 million, provides financing to poorer regions of the developing world and supports programs combining community development with emissions reductions.
  - The Bank's Umbrella Carbon Facility (UCF) is an aggregate pool of resources taken from the various Bank carbon funds for the purchase of Certified Emission Reductions, and has a total capitalization of $719 million. There are currently biomass-related projects under development, such as a sugar factory modernization project in Guyana and biomass cogeneration projects in Brazil; there are also non-renewable fuel projects in the works for Central America.[38]

- The German renewable energy and energy efficiency program finances energy efficiency, non-conventional renewable energy applications (e.g. biomass) and clean and efficient urban transportation; the program has three proposals totaling $262,000, two of which are focused on Central America: a diagnostic of agricultural issues related the production of ethanol from sugarcane and the design of programs for efficient use of power in public services. The fund will also finance a Technical Committee being prepared by EN3 to assess production opportunities for sugarcane-derived biofuels in Barbados, Guyana, Jamaica and Trinidad & Tobago.[39]

While not all these funds and initiatives directly target biofuels development, they encompass them and offer the opportunity of financing for such projects.

E) RESEARCH & DEVELOPMENT

Research and development focused specifically on biofuels is still needed throughout the region. There are a number of universities with departments that conduct biofuels research, but information on R&D projects is limited. Moving forward, technical cooperation and collaboration with Brazil, including within the R&D sector, will be important, as will collaboration among neighboring countries or countries with similar interests, resources, and industry conditions.

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A) INTRODUCTION

Costa Rica is one of the more politically and economically stable countries in the region, which is reflected in the regulatory framework for and organization of its sugar and ethanol industries. The country relies heavily on imported petroleum, which has created a strain on its budget in light of recent high prices. The country will also need to increase its productive capacity to continue to supply ethanol to the US as well as to meet its domestic demand.

B) GOVERNMENT POLICIES

Costa Rica's regulatory framework for biofuels production is one of the more advanced in the region. Renewable energy is not a new subject in Costa Rica. Following the ethanol production projects of the late 1970s, the country began to explore the possibility of sustainable and efficient energy use, including the production and consumption of biofuels, through legislative efforts. In 1994, Law No. 7447 for the *Regulation of the Rational Use of Energy* was established to consolidate the participation of the government in promoting efficient, environmentally-conscious uses of energy.[1]

In February 2003, Presidential Decree 31818-MAG-MINAE created a technical commission to design strategies for the development of biodiesel and committed the administration to promoting the program if the results of the commission's studies were positive.[2] In April 2003, Guideline No. 22 was created to promote the exploration of

renewable sources of energy, including the elaboration of development plans and the incorporation of a mechanism which would allow for the integration of such sources into the National Interconnected System.[3]

In February 2004, Presidential Decree 31807-MAG-MINAE established a Technical Work Commission to design strategies for the production of ethanol as a substitute for MTBE and to create a regulatory framework for the program. Its main goals were the development of Costa Rica's agro-industrial sector and the improvement of environmental standards through the substitution of biofuels. It also put forward blend targets for both biodiesel and ethanol by January 2005.[4] This measure is contested and has not been fully implemented; however, a commission continues to work on the details of the decree, and a pilot project is underway.[5]

In April 2005, Costa Rica's government passed Expedient 15.853, a biofuels promotion law to support the research, development, generation, and use of biofuels and petrochemical derivatives. The law was a major attempt at establishing a legal framework for the development of a biofuels market in Costa Rica. It outlined general policies to augment scientific research and development, technology transfer, investment in human capital, commercialization of biofuels and private-sector participation in the industry. The objectives of this effort are to define norms, qualify projects, determine quotas, set blend percentages, and regulate the bodies involved in the process to ensure the success of the sector at a national level. The Regulatory Authority for Public Services will set the commercial price of biofuels according to the law establishing its creation in 1996, Law 7593.[6] Under the Ministry of Environment and Energy, the law created the National Biofuels Office (ONABI) to define those products which can be called biofuels (ethanol, biodiesel, biomethanol, biodimetileter, synthetic biofuels, biohydrogen and pure vegetable oils) as well as to formulate and guide public policy on biofuels promotion. It also created the National Biofuels Council to act as a coordinating link between the Executive, the decentralized state institutions involved in the sector, and civil society, as well as to devise recommendations for national strategies and policies.

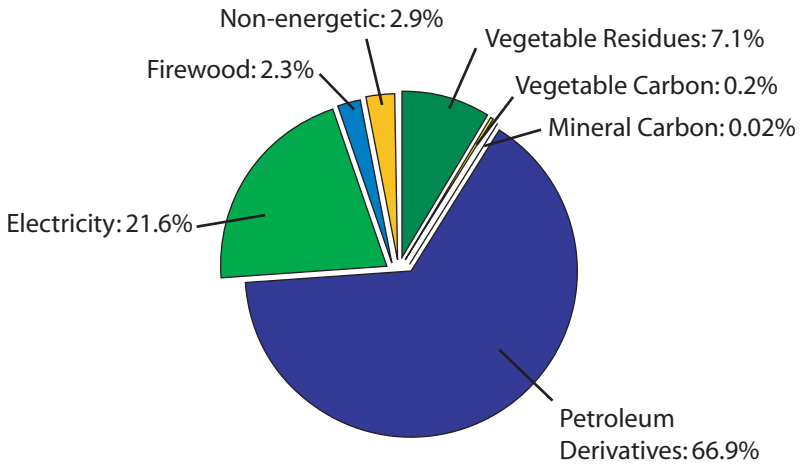
CAFTA and Regional Trade Initiatives
As outlined in the overview for this region, under CAFTA, Central American countries will continue to enjoy tariff-free access to the US market almost identical to that allowed under the expanded Caribbean Basin Initiative. A specific export share has been established for Costa Rica under CAFTA: 117.3 million liters (31 million gallons) of ethanol annually. This should continue to push the development of biofuels capabilities and production in the country.

Relations with Brazil
Brazil's *Protocol of Intention for Technical Cooperation in the Area of Production Techniques and the Use of Ethanol* was extended to Costa Rica in September 2005, along with a number of other countries.[7] The day after his inauguration in May 2006, Costa Rican president Oscar Arias met with Brazilian Vice-President José Alencar, who promised to support the improvement of Costa Rica's ethanol industry as a means to ameliorate the impact of higher oil prices.[8] Brazil's majority state-owned petroleum company, Petrobras, is also participating in Costa Rica's biofuels sector (see *Private Sector* for more detail).

C) CURRENT SITUATION

Energy Matrix
Costa Rica's total energy consumption in 2003 was 3.42 billion liters (21.5 million barrels) of oil equivalent, with 50.65% of that going to transportation.[9] Petroleum is also the country's major source of energy, making up nearly 67% [Chart 2.1a]. By 2015, with a total energy consumption of 5.56 billion liters (35 million barrels of oil equivalent), Costa Rica expects to have 15% of its energy come from biomass and 63% from petroleum derivatives, with 53% of that going to the transport sector.[10] Biofuels production and consumption is already being targeted for development to achieve this end; Costa Rica has set a target of replacing 7% of its gasoline with ethanol by the end of 2008.[11]

Chart 2.1a: Costa Rica's Energy Matrix (2003)



Source: Ministry of Environment and Energy[12]

History

Costa Rica's first biofuels project began in 1974 with the creation of its *Program of Renewable Energies;* the goal of the program was to reduce the country's dependence on foreign energy sources. A distillery was installed at the end of 1978, and within four years, the sugar refinery in charge of production, CATSA, produced 24.6 million liters of ethanol.[13] Legislation has since followed to promote greater production and consumption of biofuels in Costa Rica (outlined in the *Government Policy* section).

Current Production

Costa Rica has a land area of 5.06 million hectares, 108,000 of which are irrigated. 222,640 hectares (4.4%) are arable, and 297,022 hectares (5.87%) are used for permanent crops.[14] The country currently produces a considerable amount of sugar cane and sorghum, both of which can be used to produce ethanol [Table 2.1a]. Sugarcane cultivation takes up more than 40,000 hectares, and the regions of Guanacaste and Puntarenas along the country's Pacific coast are the most important.[15]

Table 2.1a Yield per hectare of Sugar cane and Sugar crops (tons/ha)

	2000	2001	2002	2003	2004
Costa Rica	76.27	76.46	73.67	80.80	77.31
Dominican Republic	37.89	37.88	38.81	37.18	40.79
El Salvador	74.93	82.84	76.92	76.97	92.45
Guatemala	90.95	93.05	93.86	90.63	96.77
Honduras	84.67	99.37	55.22	71.64	40.75
Nicaragua	69.08	77.44	75.90	93.67	88.91
Panama	51.92	44.40	49.35	54.48	47.14

Source: FAO STAT[16]

2.1 COSTA RICA

Map 2.1a: Location of Guanacaste and Puntarenas in Costa Rica

Guanacaste

Puntarenas

Source: Wikipedia

Ethanol Production

Costa Rica is a producer and exporter of ethanol but has not incorporated ethanol into its domestic energy matrix. This is likely to change in the short term as the country enacts further legislation to mandate biofuels blends and provides incentives for biofuels use. Costa Rica's ethanol production has been estimated at 40 - 42 million liters per year between 2003 and 2006.[17] As outlined below, ethanol demand is projected to increase, both domestically and on a global scale, and there will likely be a need for an increase in the country's production capabilities.

Costa Rica's production has mostly focused on the dehydration of imported hydrous ethanol, often from the EU; for the 2001-2002 harvest period, Costa Rica imported just under 1.28 million liters of hydrous ethanol form Europe and exported an almost identical volume to the United States in anhydrous form. This volume was four times lower than that imported by Costa Rica during the 1999-2000 season, and imports since have been drastically reduced due to EU regulations.[18]

There are currently three major facilities in place for ethanol production: Central Azucarera del Tempisque, S.A. (CATSA), which is a sugar refinery and subsidiary of CODESA, an economic development body of the state, produces 200,000 liters of ethanol per day. Ingenio Taboga produces 150,000 liters of ethanol per day from sugar. Combined, Costa Rica has a production capacity of 350,000 liters of ethanol per day or 42 million liters during a 120-day season. The Liga Agrícola Industrial de la Caña (LAICA) has dehydration processing capacity of 110 million liters per season.[19] The blending of ethanol with gasoline is executed primarily through RECOPE, or the Petroleum Refining Company of Costa Rica.

Structure of the Sugar Industry

Costa Rica's sugar industry is made up of nine major processing facilities.

Table 2.1b: Crushing Capacity of Costa Rican Sugarcane Facilities

Facility	Capacity (ton/ day)
Tobota	6,500
Catsa	6,000
El Viejo	6,000
El Palmar	4,500
El General	4,000
Quebrada Azul	3,000
Victoria	2,700
Atirro	2,200
Juan Viñas	1,700
Curtis	1,400
Costa Rica	1,200
Argentina	1,000
Providencia	800
Santa Fe	720
Porvenir	700
San Ramón	680
Total	43,100

Source: UN/CEPAL[20]

In May 2005, the country's sugar production was estimated at 412,000 tons per annum.[21]

Table 2.1c: Indicators for the Sugarcane Industry in Costa Rica

Harvest Period	Area Harvested (thousand hectares)	Crushed Cane (thousand tons)	Sugar Production (thousand tons)	Productivity (tons of cane/hectare)	(kilograms of sugar/ ton of cane)
1996-1997	42.9	3,153.3	333.1	73.5	105.6
1997-1998	44.2	3,681.9	380.5	83.3	103.2
1998-1999	46.0	3,670.0	375.5	79.8	102.2
1999-2000	46.0	3,362.9	367.0	73.1	108.8
2000-2001	47.2	3,398.3	380.0	72.0	111.8
2001-2002	48.0 3	472.1	376.2	72.3	108.3

Source: UN/CEPAL[22]

Biodiesel Production

The country's installed capacity for biodiesel production has the potential to achieve a 1% blend, given the total consumption of diesel in the transportation sector.[23] Palm oil is the crop best suited for the production of biodiesel; however, it is currently used almost exclusively for cooking oil. In 2005, the nation had 50,000 hectares of palm-oil yielding crop.[24] Table 2.1d illustrates Costa Rica's Palm kernel yield per hectare.

Table 2.1d: Yield per hectare (tons/ ha) of palm kernel equivalents

	2000	2001	2002	2003	2004
Costa Rica	18.50	18.60	18.30	22.63	18.62
Dominican Republic	15.30	15.30	15.35	15.35	15.34
El Salvador	0.00	0.00	0.00	0.00	0.00
Guatemala	22.76	20.29	23.88	23.60	30.37
Honduras	18.75	19.67	16.64	23.33	25.22
Nicaragua	26.50	26.50	26.50	24.32	24.35
Panama	10.36	10.17	10.09	10.17	10.12

Source: FAO STAT[25]

The Technical Work Commission created by Decree No. 31087-MAG-MINAE is currently conducting studies to evaluate the economics of blending biodiesel with regular petroleum diesel. The construction of a test plant capable of producing 20,000 tons of biodiesel annually was planned for 2005. The project's anticipated cost was $8 million, and cultivation of 2,500 to 4,000 hectares, yielding 5 to 8 tons of oil per hectare, was also incorporated into the project.[26]

Competitiveness

The Tropical Agriculture Center of Research and Science, in cooperation with the University of Finland, carried out a research project to analyze the potential for developing biofuels in Costa Rica. The study concluded that there is interest in the industry, but that information is limited and key players are still dispersed. Costa Rica has not been able to consolidate a technological approach in bioenergy, and the characteristics of the market and the regulatory framework in place are significant barriers to the industry's growth. Despite this, the report concluded that Costa Rica has significant potential for further development of the industry.[27] Costa Rica is a competitive ethanol exporter, selling at international prices without government support.

Domestic consumption

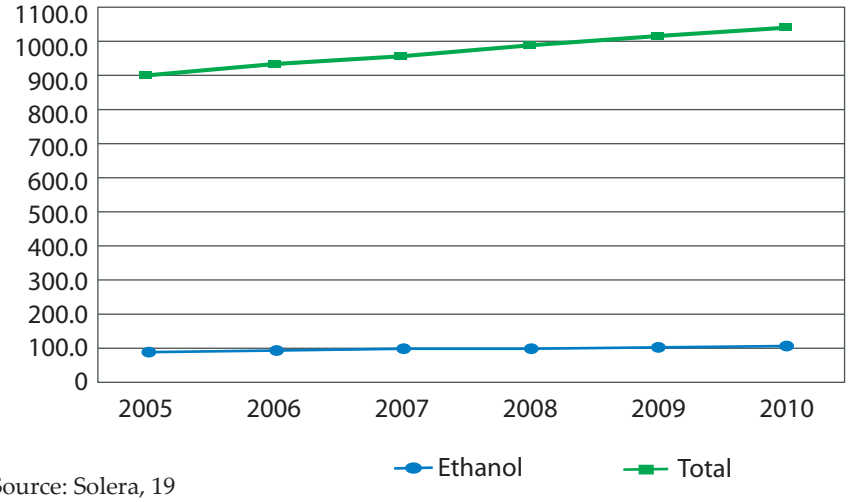
Consumption of fuel in Costa Rica is increasing [Table 2.1e], due mainly to the expansion of the automobile sector. Costa Rica consumes between 90 and 94 million liters of ethanol, and that number is projected to increase to 104.6 million liters by 2010. Currently, total gasoline demand is projected to rise at a steeper rate than ethanol demand [Chart 2.1b]. In February 2006, as part of a joint pilot project between RECOPE and Petrobras, 64 gas stations in Guanacaste and the Central Pacific region began offering E5 and E10 blended fuel. The logistical feasibility of a nation-wide offering of ethanol blends, from blending by RECOPE to commercial sale to individual customers, will be evaluated through this trial program. The project, which also aims to boost consumer confidence in ethanol through exposure to the fuel, will be completed in June 2007, with tabulation and analysis of results to follow.[28]

Table 2.1e: Estimated Gasoline & Ethanol Consumption in Costa Rica (Million liters)

	Regular	Super	Total	Ethanol
2005	498.8	403.6	902.4	90.2
2006	518.5	417.7	935.8	93.6
2007	538.6	423.3	961.9	96.2
2008	559.8	432.1	991.8	99.2
2009	581.8	435.9	1,017.6	101.8
2010	604.5	441.5	1,046.0	104.6

Source: FAO STAT[23]

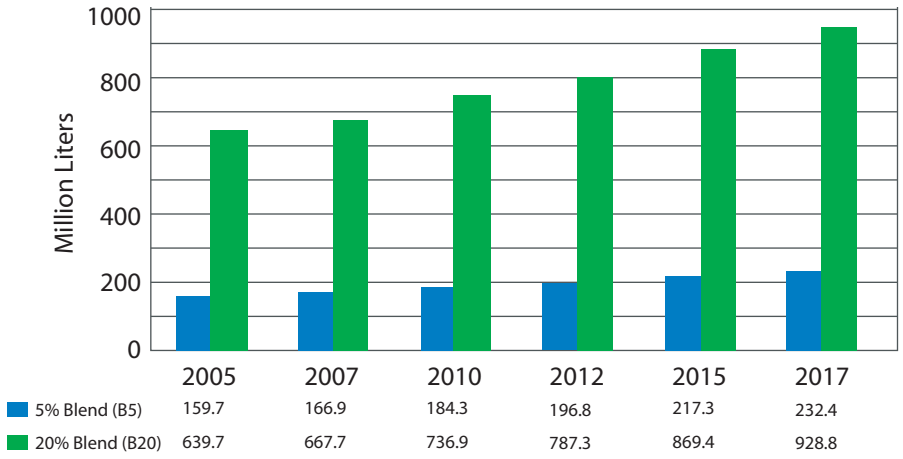
Chart 2.1b: Projected Demand for Gasoline & Ethanol



Source: Solera, 19

Demand for biodiesel is also projected to increase based on the anticipated proliferation of biodiesel blending with petroleum diesel at the 5% and 20% levels. By 2017, it is forecasted that Costa Rica will require over 930 million liters to meet demand created by a 20% diesel blend.

Chart 2.1c: Projected Demand for Biodiesel



Source: RECOPE 2004/ Cruz and Charpentier[29]

Exportation

Costa Rica exported over 121 million liters of ethanol in 2005, up from nearly 116 million in 2004 and 65.6 million in 2003. Costa Rica also imported nearly 150 million liters of ethanol in 2005, up from 95 million in 2004.[30] Under CAFTA, Costa Rica's allowance of duty-free ethanol exports is 117.3 million liters. According to the US government, Costa Rica exceeded that limit in 2005, the year the agreement was signed, and the effects of the CAFTA quota remain to be seen.[31]

D) PRIVATE SECTOR

As discussed, Petrobras and RECOPE are involved in the promotion of ethanol blend use in more than 60 gas stations in the Pacific region of Costa Rica. Petrobras is also interested in building an ethanol plant in the country and is awaiting the necessary permits.

E) RESEARCH & DEVELOPMENT[32]

Specialists from the School of Electrical Engineering and the Department of Engineering at the University of Costa Rica have commenced work on an initiative, the Biodiesel Project, which aims to discover more efficient ways of extracting biodiesel from vegetable oil. The project targets the development of production methods, classifies the raw materials to be used, and assesses the profitability of biodiesel production given the country's characteristics. In addition, researchers in the university's Organic Chemistry Laboratory in the School of Chemistry are looking at the characteristics of palm oil, its potential alternative uses, and the microbial degradation of biodiesel made from palm. According to the university's Vice-Rector for Research, 10 projects have been completed. All but one are in the field of biofuels. They include:

- Fuel Oil from African Palm;
- Biomass Fuel;
- Synthetic Fuel with a base of Agroindustrial Products; and
- Agroindustrial Modules of Mini Ethanol Distilleries as a Base for Petroleum Substitution.

F) CONCLUSION

Costa Rica, like a number of other countries in the region, has developed mainly as an exporter of ethanol, and domestic consumption still lags significantly. The development and implementation of a thorough biofuels law, with the addition of significant incentives and public education campaigns, will allow for the development of a robust domestic market. Costa Rica has huge potential for the development of a biofuels industry, and lessons learned from past attempts at biofuels production, coupled with above-average infrastructure and private sector know-how, will be advantageous in achieving this goal. The legal framework is positive, although clarification and successful implementation will be required to assure success.

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[31] Brent D. Yacobucci, CRS Report for Congress Ethanol Imports and the Caribbean Basin Initiative (Washington: Congressional Research Service (CRS), 10 Mar. 2006), 4-5.
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Source: World Factbook

A) INTRODUCTION

Historically, Cuba's sugar industry has been a primary contributor to the nation's economy. However, economic isolation, industrial inefficiencies, and fluctuations in the international sugar market have hurt its competitiveness. The industry has downsized drastically in order to survive. Increasing global demand for ethanol may be the catalyst capable of reviving Cuba's faltering industry. While Castro's government has declared interest in biofuels development, the country has yet to draft the legal or regulatory framework to support it. In order for a biofuels industry to be viable, the country will need to invest heavily in production facilities and allow foreign entities to participate in the sector's development.

B) GOVERNMENT POLICIES

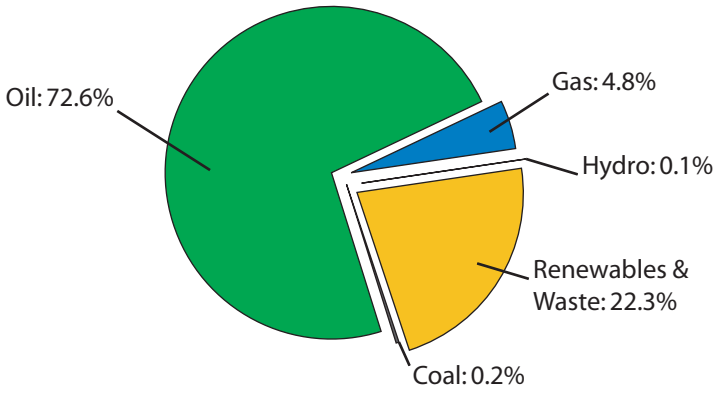
Once one of the world's most prolific sugar producers, Cuba has struggled to overcome a series of geopolitical setbacks. U.S. President Eisenhower reduced Cuba's sugar import quota by 7 million tons in 1960, a Cold war maneuver that led to the nationalization of $850 million in US assets.[1] Throughout the subsequent decades and the US embargo, Cuba and Cuba's sugar industry relied overwhelmingly on economic and energy assistance from the Soviet Union. After the Soviet collapse, Cuba's oil imports declined from 13 million to 5-6 million tons per year, forcing Cuba to acquire energy resources on the international market.[2] Lacking the necessary financial and technical resources to sustain the inefficient sugar industry, Cuba was forced to close 71 of its 156 factories by 2003.[3] While significant investments in tourism and oil have helped to diversify Cuba's economy, the sugar industry still employs thousands of laborers, and government officials are investigating ethanol production as a means of revitalizing the industry.

While Cuba does not yet have enabling legislation, the nation has political momentum to develop domestic biofuels. According to Ulises Rosales del Toro, Cuba's sugar minister, the country plans to increase production by at least 25% this year and will triple production to 3 million tons within the next few years.[4] However, in order to achieve such a goal, the industry will require substantial investment to upgrade outdated and inefficient facilities, requiring relaxation of Cuban investment laws that have prohibited foreign investment in the country's sugar industry since 1959.

C) CURRENT SITUATION

Energy Matrix
Oil constitutes more than 70% of Cuba's primary energy supply, rendering the country vulnerable to fluctuations in international oil prices and supply shocks.

Chart 2.2a: Cuba's Energy Matrix



Source: International Energy Agency[6]

Recent discoveries of Cuban oil fields have, however, sparked the interest of international investors and reduced pressure to diversify the energy supply. European, Brazilian, Chinese, and Vietnamese companies are exploring the oil fields and are co-producing 60% of the Cuban output along with Cubapetroleo (CUPET).[6] In addition, Cuba purchases approximately 100,000 barrels of oil a day from Venezuela at highly discounted prices and is able to resell what it does not use.[7] The improved oil picture notwithstanding, the government appears to recognize the need to diversify and the degree to which ethanol can enhance Cuba's energy independence and contribute to the nation's struggling economy.

Sugar Industry

At the turn of the century, 1,720,791 hectares of land were dedicated to sugar production, approximately half of all agricultural land.[8] However, lack of financing and inefficiency has forced Cuba to close almost half of its sugar mills, drastically reducing total production capacity. By 2003, total land for sugarcane production was reduced to 1.5 million hectares.[9] Production levels have declined accordingly. In 2006, Cuba only produced 1.2 million tons of raw sugar, its lowest output since 1908.[10]

Nonetheless, according to Luis Galvez of the Cuban Research Institute for Sugarcane Derivatives, Cuba has 17 distilleries with combined capacity of up to 180 million liters of ethanol annually.[11] The government has vowed to invest further in the industry and increase capacity by at least 15% in the next year. By 2010, Cuba hopes to produce 500 million liters of ethanol annually, a fivefold increase.[12]

D) PRIVATE SECTOR

In order for Cuba to attain these ambitious goals, the country will need to open itself to foreign investment. Local authorities have recognized the need to transform the domestic sugar sector into a modern, diversified industry that possesses greater added value. Modernizing the industry will allow for the production of fuel ethanol as well as increase electricity generation from sugarcane bagasse. Currently, the government is investigating various financing options to invest in sugarcane byproducts. As of 2003, almost a dozen joint ventures were underway with investors from Spain, Mexico, Canada, Italy, and France working on sugarcane byproducts, which comprise 8% of the total industry.[13] Efforts were being made to upgrade the country's distilleries and construct facilities for ethanol production.

E) RESEARCH & DEVELOPMENT

Currently, research is being conducted to treat the effluents produced by sugar refineries and distilleries. Researchers from Mexico and Cuba have devised a small-scale biofiltration system able to eliminate ethanol emitted by distilleries, using sugarcane

bagasse as support.[14] If successful at treating effluents, the process could be applied on a larger, industrial scale in countries producing substantial quantities of ethanol, such as Brazil and the US.

While Cuban officials have primarily focused on ethanol as a means of revitalizing the sugar industry, the Guantánamo province possesses conditions favorable for the production of grass feedstock for biodiesel production. The United Nations Development Program is conducting a reforestation project to improve the production of jatropha curcas, a forest species commonly used as a biodiesel feedstock. While the biodiesel industry has not yet matured, increased production of jatropha curcas could eventually contribute to the diversification of Cuba's energy portfolio.

F) CONCLUSION

While Cuba's intentions to dramatically increase ethanol production are ambitious, the country requires significant investment in order to achieve its stated goals. The decline of Cuba's sugar industry has coincided with deterioration of the industry's milling and refining facilities. Cuba will need to relax current restrictions on foreign investment and provide the appropriate incentives in order to attract the resources necessary to develop a viable industry.

Endnotes

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Source: World Factbook

A) INTRODUCTION

The Dominican Republic, which shares the island of Hispañola with Haiti, has the potential for larger-scale production and consumption of both ethanol and biodiesel. The country's once-thriving sugar industry has slowed, but sugarcane production remains constant, and the political will exists to promote biofuels for increased energy independence and rural development. The Dominican Republic imports all the petroleum it consumes, creating a large financial burden. Additionally, adding to the nation's sugar-industry value chain will help support rural development and potentially help improve the conditions under which Haitian migrants work and live on sugar plantations and their surrounding bateys, or living communities. Barriers to the development of a biofuels sector include outdated sugar mills, inadequate investment, and limited public awareness of the benefits of renewable fuels. Once pending biofuels legislation is passed, the opportunities for expansion of the sector will likely surge.

B) GOVERNMENT POLICIES[1]

Renewable fuels legislation in not new to the Dominican Republic. The country passed ethanol legislation in 1948 (though it produced few results). In 2000 and 2001, Law 112-00 for Hydrocarbons and Law 125-01 for Electricity created incentives for renewable energy development. In 2002, Decree 557-02 addressed electricity generation in sugar plants.

Decree 732-02, also released in 2002, was the most specific and expansive in laying out incentives for ethanol. It sought to implement a wide-reaching plan to promote the development of the biofuels agroindustry and other forms of alternative energy. Officially submitted to the Dominican congress as the *Law of Incentives for the Development of Renewable Energy Sources and their Special Regimens* in 2005, the decree:

- Guarantees a 100% tax exemption for imported machinery, equipment, and accessories;
- Grants a 10-year income tax holiday for businesses in the sector;
- Permits the transfer of 50% of investments made in internal consumption with renewable energies to income tax; and
- Guarantees market share to renewable energies.

In addition to this large step in promoting renewable energy production, on November 8, 2005, Dominican President Leonel Fernandez signed an agreement with Colombian President Alvaro Uribe through which Colombia would provide energy assistance and transfer technology for ethanol production to the Dominican Republic.[2]

CAFTA/ Caribbean Basin Initiative
Under the Caribbean Basin Initiative (CBI), Dominican exports of ethanol are permitted duty-free to the United States up to 7% of US production, with additional rules-of-origin stipulations which allow for additional export volumes. The Dominican Republic, along with other members of the accord, are prime targets for foreign investment by investors wishing to tap into the US ethanol import market. The CAFTA stipulations are essentially the same as those of the CBI and will supersede them.

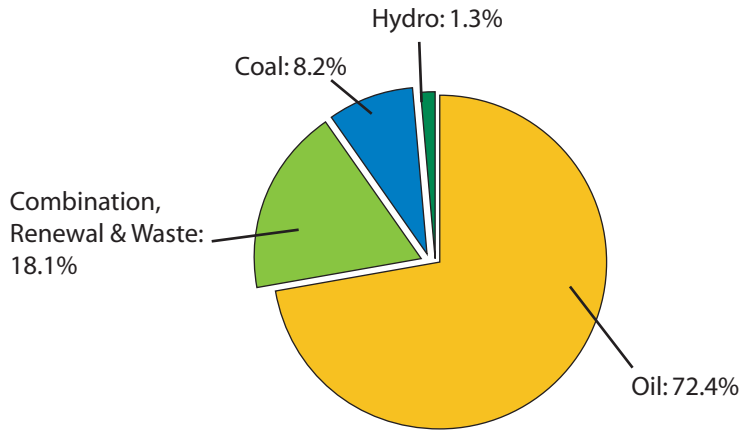
Relations with Brazil
In June 2005, Brazilian Foreign Minister Celso Amorin went to Santo Domingo to meet with President Fernandez. Leading a delegation of 20 businessmen, Amorin discussed with Fernandez the possibility of a partnership between the two countries for the production of ethanol. The objectives of collaboration would be to assist the island nation in improving the genetic make-up of sugarcane crops.[3]

C) CURRENT SITUATION[4]

History
Sugarcane has historically been an important crop for the Dominican Republic, accounting for 85% of the country's export revenue in the mid-1980s. However, production and seeded-land peaked in the 1980s and 1990s, and waning international prices and US quotas, coupled with underinvestment in the sector, have resulted in a decline of the nation's sugar industry.

Energy Matrix
The Dominican Republic uses a great deal of oil, which constituted 72.4% of its energy matrix in 2003 [Chart 2.2a]. The country imports all the fossil fuels it consumes, including 7.475 billion liters of petroleum in 2003. The country spends $2.5 billion, or 35% of its total annual revenues, on fuel imports,[5] and has suffered through occasional petroleum shortages. The Dominican Republic also has well known gaps in power generation and electricity coverage. Increased production and consumption of biofuels could alleviate some of these problems.

Chart 2.3a: Dominican Republic's Energy Matrix (2003)



Source: International Energy Agency[6]

Production

The DR's total land area is 4.84 million hectares, of which 275,000 hectares are irrigated. The country boasts 1.088 million hectares (22.49%) of arable land and 496,584 hectares (10.26%) devoted to permanent crops.[7] The Dominican Republic has up to 350,000 hectares of traditional sugarcane land, 200,000 of which could be used for biofuels production without diverting land from food crops. In 2004, the country produced 5.55 million metric tons of cane from 136,000 hectares,[8] which is down from its peaks of 11.8 million metric tons of cane production (1982) and 234,000 hectares of cultivated land (1993).[9]

Table 2.3a: Yield per hectare of Sugarcane and Sugar crops (tons/ha)

	2000	2001	2002	2003	2004
Costa Rica	76.27	76.46	73.67	80.80	77.31
Dominican Republic	37.89	37.88	38.81	37.18	40.79
El Salvador	74.93	82.84	76.92	76.97	92.45
Guatemala	90.95	93.05	93.86	90.63	96.77
Honduras	84.67	99.37	55.22	71.64	40.75
Nicaragua	69.08	77.44	75.90	93.67	88.91
Panama	51.92	44.40	49.35	54.48	47.14

Source: FAO STAT[10]

Ethanol Production

Little information is available on the DR's ethanol production, although it is likely that some small-scale production takes place due to the sheer size of its sugarcane crop and the country's history of ethanol legislation. The country is projected to consume some 61.2 million liters (385,000 barrels) of ethanol through a 5% gasoline blend in 2006 [Table 2.2e], which will either come from small-scale domestic production or imports.

Structure of the Sugar Industry

The DR's sugar market, once flourishing, is now in decline. Much of the milling infrastructure is old, and more than half of the plants were built in the 19th century. Only seven plants are still operating [Table 2.2b].

Table 2.3b: Capacity of the Dominican Republic's Sugar Refineries

Facility	Date of Construction	Status*	Capacity	Cultivated Land
Porvenir	1874	Closed	2,949	11,138
Angelina	1876	Closed	1,815	6,603
Consuelo	1881		4,537	16,375
Cristobal Colon	1883		10,889	13,237
Santa Fe	1885	Closed	2,711	9,951
Quisqueya	1890	Closed	2,541	13,382
CAEI	1893		2,269	4,921
OZAMA	1895	Closed	3,630	20,820
Amistad	1899	Closed	545	1,593
Boca Chica	1916		3,630	12,001
Central Romana	1918		15,426	71,253
Montellano	1918		2,507	6,630
Barahona	1920		4,537	11,516
Catarey	1948	Closed	2,000	6,615
Rio Haina	1950	Closed	11,340	49,183
Esperanza	1957	Closed	1,361	2,224
Totals			72,698	257,442

Source: Industria Azucarera Dominicana[11], * Blanks are operational plants

Total sugar production in 2005 was nearly 464,000 metric tons, 40.22% of which was exported. Production declined in the late 1990s but has recovered recently [Table 2.2c]. The decline and recovery at the turn of the decade was due, in part, to the transfer of public sugar mills to private investors between 1999 and 2000 for the purpose of recapitalization, legislation for which was approved by Congress in 1997.[12]

Table 2.3c: Sugar Production, Exportation and Consumption[13]

	Production					
	CEA	Romana	Vicini	**Total**	**Exportation**	**Consumption**
1980	651,685	293,081	67,838	1,042,853	-	202,462
1990	273,444	263,744	19,114	584,827	460,997	195,104
Subtotal	925,129	558,825	86,952	1,627,680	460,997	397,566
1995	222,447	245,526	40,341	533,277	238,058	290,779
1996	189,594	324,508	57,580	571,682	350,940	253,910
1997	225,766	400,152	69,686	695,604	357,060	265,975
1998	157,134	272,580	65,116	494,830	268,350	289,386
1999	53,912	214,602	79,236	347,750	190,657	210,760
2000	109,777	289,247	65,636	465,660	185,346	299,440
2001	62,109	304,795	68,631	435,535	185,346	341,432
2002	116,958	272,272	59,408	448,638	185,335	348,507
2003	98,423	317,810	80,372	496,605	185,335	300,764
2004	96,414	364,348	68,372	529,134	185,335	334,984
2005	69,568	327,800	66,488	463,856	186,555	278,850*
Subtotal	1,357,497	3,333,640	720,866	5,482,571	2,518,317	3,214,787
TOTAL	2,282,626	3,890,465	807,818	7,110,251	2,979,314	3,612,353

Source: Industria Azucarera Dominicana[14], * January - October

Biodiesel Production

There is currently no large-scale biodiesel production in the DR, but the country has 8,000 planted hectares of African palm, and an additional 10,000 available hectares. The Dominican Republic produces 15.34 tons of palm kernel per hectare [Table 2.2d]. Jatropha is also indigenous to the region.

Table 2.3d: Yield per hectare (tons/ ha) of Palm kernel equivalents

	2000	2001	2002	2003	2004
Costa Rica	18.50	18.60	18.30	22.63	18.62
Dominican Republic	15.30	15.30	15.35	15.35	15.34
El Salvador	0.00	0.00	0.00	0.00	0.00
Guatemala	22.76	20.29	23.88	23.60	30.37
Honduras	18.75	19.67	16.64	23.33	25.22
Nicaragua	26.50	26.50	26.50	24.32	24.35
Panama	10.36	10.17	10.09	10.17	10.12

Source: FAO STAT[15]

Competitiveness
A study touting the capability of the Dominican Republic to produce biofuels was presented to the country's National Competitiveness Center in October 2006. The report recommends creating biodiesel plants in the nation's capital, Santo Domingo, in Puerto Plata in the north, and in La Altagracia. The report estimated that the country has the capacity to produce 31.75 to 34.6 million liters of feedstock from which to produce biodiesel.[16]

Level of domestic consumption
Currently, the DR consumes a small amount of ethanol. With a 22% blend, however, consumption could reach 259 million liters [Table 2.2e].

Table 2.3e: Ethanol Consumption Projection

	Gasoline Consumption (L)	**Blend** %	**Ethanol Consumption** (L)
2006	1,226,156,826.14	5	61,307,734
2007	1,178,230,132.45	12	141,387,600
2008	1,177,994,486.45	16	188,478,965
2009	1,177,758,888.14	19	223,774,121
2010	1,177,523,335.93	22	259,019,995

Source: CNE, 11

The country's biodiesel consumption is also projected to rise, reaching 265.5 million liters (1.67 million barrels) per year, assuming the country institutes a 20% blend and develops the proper regulatory, legislative, and public-education measures to accompany it [Table 2.2f].

Table 2.3f: Biodiesel Consumption Projection

	Diesel Consumption (L)	**Blend** %	**Biodiesel Consumption** (L)
2006	1,325,082,529.74	2	26,501,650.25
2007	1,325,745,070.60	5	66,277,708.81
2008	1,326,407,943.70	10	132,640,784.51
2009	1,327,071,147.47	15	199,060,676.09
2010	1,327,734,681.89	20	265,546,937.65

Source: CNE, 12

Exportation
The Dominican Republic does not currently export biofuels; however, based on its participation in both CAFTA and the CBI, it will have guaranteed access to the US ethanol import market. The DR could also export supplies to Haiti, which currently lacks the infrastructure or crops to produce ethanol internally.

D) PRIVATE SECTOR

Investments in the DR's biofuels industry are not as robust as in other countries. In September 2002, Hong Kong-based Cavendish International announced that it would invest $250 million to refurbish the Haina River sugar mill, once the largest mill in the world, and construct a second mill for ethanol production in San Pedro de Macoris.[17] Additionally, a consortium led by Belgium-based Alcogroup announced plans to build an ethanol plant in Monte Plata in 2006, and the Dominican sugar cooperative says that it is in talks with other partners to convert at least one sugar refinery into an ethanol plant.[18] Investments are likely to continue to materialize, both internally and from foreign sources such as Brazil and Colombia, countries with which the DR has technical cooperation agreements. Investors may come from as far away as Russia, which is currently the case with an ethanol project in Jamaica (see Jamaica chapter). To promote internal investment, the government will likely need to embark upon a promotion campaign among sugar producers and domestic investors.

E) RESEARCH & DEVELOPMENT

There is likely some research taking place in the DR with respect to biofuels production, but detailed information in limited. The capital's Autonomous University of Santo Domingo (UASD) has a variety of offerings in chemistry, microbiology, agroindustry, and engineering. INTEC, the University Institute of Technology, also located in Santo Domingo, is investigating the potential for generating energy from seaweed.[19] As the sector develops, R&D for improvements in crop yield and processing will likely materialize. There will also be potential for collaboration with Brazil, Colombia, and other Caribbean nations.

F) CONCLUSION

The Dominican Republic has the potential to produce both ethanol and biodiesel, and the need for energy independence and rural development will propel renewable fuels programs in the country. The country still lacks a comprehensive legal framework and investment for the sector, but will be able to address these issues through legislation and technical cooperation with countries expert in biofuels production. Additionally, the nation's participation in the CAFTA agreement makes it a prime destination for foreign investment.

Endnotes

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Source: World Factbook

A) INTRODUCTION

El Salvador has been identified as one of the potential biofuels success stories in Central America. Though not yet as advanced as Costa Rica or Guatemala in terms of public-policy support for biofuels production, the country's sugar industry has exhibited the productivity and organization needed to serve as a foundation for a viable biofuels industry. Ethanol production in El Salvador is currently relatively small; however, the country is exporting biofuels to several countries, including the US. Additionally, biodiesel production is in the trial stage. For both of these market segments, regulatory reform is still needed to promote production, use, and export on a greater scale. Feedstock production and investment in processing facilities are two principal challenges to El Salvador's biofuels development.

B) GOVERNMENT POLICIES

The Salvadoran government is preparing a law to promote and regulate the production of ethanol, as well as biodiesel, according to Economic Minister Yolanda de Gavidia. An Executive Decree has been written and will soon be debated by the Legislative Assembly. The law establishes that, beginning September 1, 2007, all gasoline distributed in El Salvador must contain ethanol as an oxygenating agent. The minimum blend will be between 8% and 10% ethanol. By that same date, the import of fuels that contain MTBE or MMT will be forbidden, as will any other oxygenating agent that is not derived from renewable sources. The Executive Decree places the Director of Hydrocarbons and Mines in charge of managing production quotas. Those entities engaged in the production of ethanol will enjoy tariff-free import of machinery and other goods used to produce ethanol for two years. During that time, revenues derived from ethanol sales will be tax exempt.[1]

The Promotion System for Renewable Energy (SIFER), under the country's Ministry of Economy, makes available a Rotating Fund for Renewable Energy Promotion (FOFER), which provides low interest loans to cover payments due to lending banks for renewable energy projects.[2] The ministry has also partnered with the Austrian Technical Cooperation Trust Fund to provide information to decision makers on the implementation of a biodiesel program. The goal of the project, which will include a $73,360 contribution from the fund and $15,000 form the ministry, is to incorporate the private sector and elaborate domestic and international opportunities.[3]

CAFTA
As outlined in the regional overview, Central American countries will continue to en-

joy tariff-free access to the U.S. market under CAFTA almost identical to that allowed under the expanded Caribbean Basin Initiative. For ethanol, a specific share has been established for El Salvador under CAFTA: 19.7 million liters (5.2 million gallons) for the first year with annual increases of 4.92 million liters (1.3 million gallons) per year not exceeding 10% of the quota. This should continue to encourage the development of biofuels capabilities and production in the country.

Relations with Brazil

Gina de Hernandez, the Director of Hydrocarbons and Mines in El Salvador's Ministry of Economy, visited Brazil along with representatives of other Central American countries in 2005. The goal of the trip was to learn from the successful Brazilian experience in the production of ethanol.[4] Brazilian firm Crystalsev is also involved in a project in El Salvador [see Business Sector].

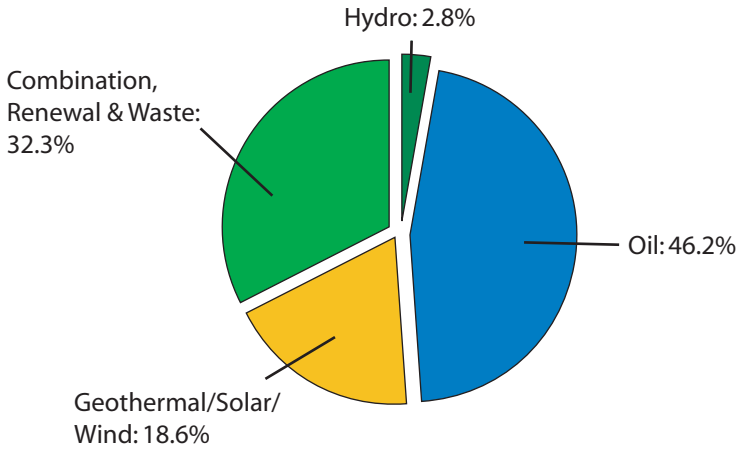
In June 2006, El Salvador signed a technical, scientific and technological cooperation agreement with Brazil for a project to develop the processing of castor oil (mamona). El Salvador was also one of the countries to sign the Protocol of Intention for Technical Cooperation in the Area of Production Techniques and the Use of Ethanol in September 2005.[5]

C) CURRENT SITUATION

Energy Matrix

Oil accounts for 46.2% of El Salvador's energy supply [Chart 2.3a]. In 2005, El Salvador spent $900.7 million on nearly 2.54 billion liters (16 million barrels) of petroleum products, up from $671.5 million the year before.[6] There is a consumer market for renewable and waste energy derived from biomass, particularly for rural power generation and electrification, but the figure for renewable energy use includes the burning of wood saplings to light homes at night; firewood is by far the country's most common cooking fuel.[7] In 2002, the Salvadoran Sugar Company (CASSA) began to produce electricity from bagasse, which is fed into the national energy grid. Electricity continues to be generated in this way during the harvest period.[8]

Chart 2.4a: El Salvador's Energy Matrix (2003)



Source: International Energy Agency[9]

History

In the late 1980s, El Salvador bought four distilling plants from Venezuela: two with production capacity of 120,000 liters/day, and two of 60,000 liters/day. The two larger plants were installed and produced a gasoline-ethanol blend until 1991, when production was discontinued. The two smaller plants were never installed. Lack of effective planning and a dearth of information to consumers (who were reluctant to use the alternative fuels despite their economic advantages) doomed the projects.[10]

Current Production
El Salvador has a land area of 2.07 million hectares, 45,000 hectares of which are irrigated. The nation has 649,359 hectares (31.37%) of arable land, a notable percentage, and 245,916 hectares (11.88%) devoted to permanent crops.[11] Sugarcane is the main feedstock crop for ethanol production, and the country has the greatest percentage of land in Central America devoted to sugarcane: roughly 3.9%.[12] In 2004, El Salvador's sugarcane and sugar crop yield was 92.45 tons per hectare [Table 2.3a], which, multiplied by the country's estimated 60,000[13] hectares of devoted land, gives the country a sugarcane and sugar crop production of more than 5.5 million tons of cane and sugar crop cultivation. This yield, as illustrated in Table 2.3a, is the second highest for the region and more than double that of Panamá, Honduras, and the Dominican Republic.

Table 2.4a: Yield per hectare of Sugar cane and Sugar crops (tons/ha)

	2000	2001	2002	2003	2004
Costa Rica	76.27	76.46	73.67	80.80	77.31
Dominican Republic	37.89	37.88	38.81	37.18	40.79
El Salvador	74.93	82.84	76.92	76.97	92.45
Guatemala	90.95	93.05	93.86	90.63	96.77
Honduras	84.67	99.37	55.22	71.64	40.75
Nicaragua	69.08	77.44	75.90	93.67	88.91
Panama	51.92	44.40	49.35	54.48	47.14

Source: FAO STAT[14]

Ethanol Production
Data on El Salvador's ethanol production is limited, but the country exported nearly 84 million liters in 2005, and as investments and demand increase, production is expected to rise. Much of the country's production is centered on dehydration of hydrous ethanol imported from countries like Brazil. The Inter-American Development Bank is currently providing technical cooperation to help determine the feasibility of developing ethanol plants which utilize sugarcane as well as to identify and evaluate the sites in-country with the most potential.

Structure of the Sugar Industry
El Salvador's sugar industry is primarily overseen by the Sugar Association of El Salvador, a non-profit organization. The association monitors and analyzes the activities and productivity of the sector, and establishes linkages between sugar producers in El Salvador and international organizations and coordinating bodies. All of the plants listed in Table 2.3b, with the exception of Colima, are part of the association. According to the association, those eight facilities account for 100% of the nation's sugar production, which in turn accounts for nearly 20% of the nation's agricultural GDP.

Currently, 59% of sugarcane producers are independent cultivators. The remaining 41% belong to over 470 different agricultural cooperatives or associations. The majority of production is carried out by small operations; the average landholding is 50 hectares.[15] According to the association, the sector generates nearly 48,000 direct and more than 187,000 indirect jobs and benefits more than 224,000 dependents (a separate estimate puts the total number of jobs directly and indirectly associated with the sugarcane sector in 2004 at 375,000[16]). Although there are more than 7,000 sugarcane farmers working the roughly 60,000 hectares of sugarcane planted in El Salvador, the sugar processing industry is highly concentrated, with more than 60% of total production occurring in the four largest companies: Central Izalco, El Angel, Chaparrastique, and La Cabaña.[17]

As of 2005, eight of El Salvador's ten sugar facilities were active. The refineries in Colima and El Carmen were listed as inactive, but as late as 2004, Colima was operating with a crushing capacity of 2,000 tons per day [Table 2.3b]. The Chanmico, Chaparrastique, El Carmen, La Cabaña, La Magdalena, Jiboa and San Francisco facilities were

once state property. Today they are controlled by the Corporación Salvadoreña de Inversiones (CORSAIN). The Central Izalco (of CASSA), Colima and El Ángel facilities are completely private. Central Izalco belongs to the Regalado Dueñas and Mathies Hill families; the Colima refinery belongs to Calderón Sol and Cristiani; and El Ángel is owned by three families, the most important of which is the Borja Nathan family, which serves as facility administrator.[18]

Table 2.4b: Crushing Capacity of Salvadoran Sugarcane Facilities

Facility	**Capacity** (ton/ day)
Central Izalco	9,200
El Ángel	7,500
Chaparrastique	6,000
La Cabaña	5,750
Jiboa	5,000
Chanmico	4,000
San Francisco	3,500
La Magdalena	3,500
Colima	2,000
Total	46,450

Source: UN/CEPAL[19]

The sugar industry is in El Salvador is one of the most efficient in the region, even though there has been a marked trend towards the reduction of seeded land. In 2004, the country's sugar sector generated 2.4% of GDP and brought in $37 million in revenue, $10 million less than in 2003, according to the Salvadoran Central Reserve Bank.[20] In 2006, El Salvador produced 5.27 million tons of sugar.[21] According to the sugar association, El Salvador exports 50% of its sugar production.

Table 2.4c: Indicators for the Sugarcane Industry in El Salvador

Harvest Period	**Area Harvested** (thousand hectares)	**Crushed Cane** (thousand tons)	**Sugar Production** (thousand tons)	**Productivity** (tons of cane/hectare)	(kilograms of sugar/ ton of cane)
1996-1997	61.2	3,939	393.5	64.3	99.9
1997-1998	83.6	5,043.8	466.6	60.3	92.5
1998-1999	83.6	4,815.5	449.8	57.6	93.4
1999-2000	69.2	4,750.7	499.6	68.7	105.2
2000-2001	63.1	4,619.5	488.3	73.2	105.7
2001-2002	63.1	4,473.8	468.3	70.9	104.7
2002-2003	59.4	4,466.4	480.6	75.2	107.6
2003-2004*	64.1	4,678	544.8	73.0	105.7

Source: UN/CEPAL[22]

Biodiesel

El Salvador currently produces soy, jatropha, castor bean (higuerillo), and cottonseed, which can be used as feedstock for biodiesel. Biodiesel production, however, has only reached the experimental level in the Central American Technological Institute (ITCA); test programs have had good results using biodiesel to power buses.[23] The British firm D1 Oils has also launched a pilot program to produce biodiesel from jatropha in El Salvador.

Competitiveness

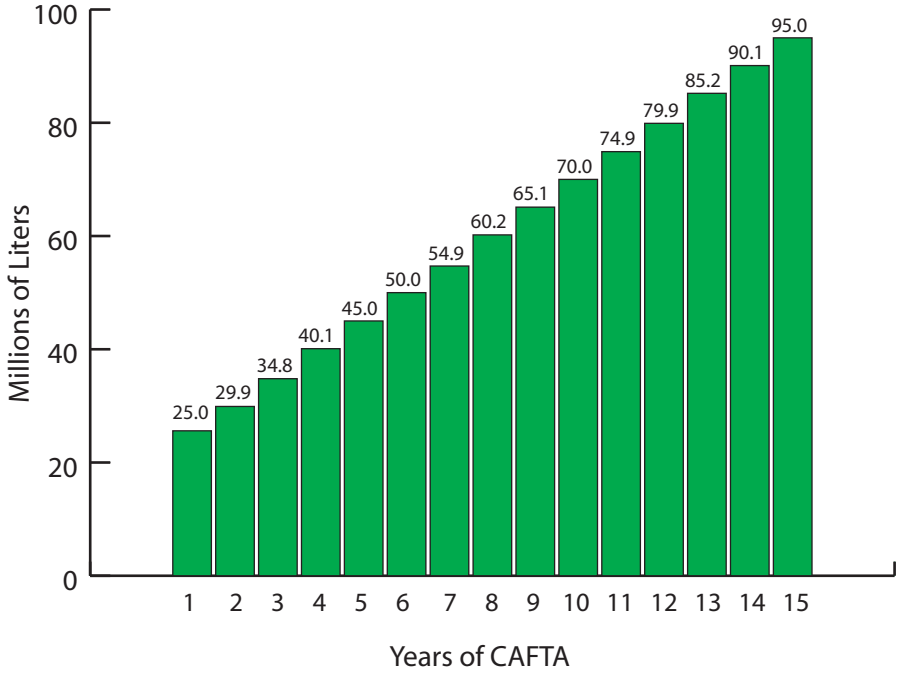
El Salvador, along with Costa Rica and Guatemala, has been identified as having the potential for growth within the ethanol sector. It has an efficient sugar industry, solid

productivity, good organization, and government participation, and is believed to have industry indicators comparable to those found in Brazil.[24]

Domestic Consumption
There are currently no figures available for domestic consumption. The government has not actively promoted biofuels use domestically, a practice which is likely to change with the introduction of a biofuels promotion and commercialization law [see Government Policy]. According to the Sugar Association of El Salvador, the country should be able to meet a projected demand of 56.7 million liters of ethanol per year.[25]

Exports
El Salvador's ethanol exports in 2005 were between 83.8 and 89.7 million liters, up from nearly 26.1 million in 2004 and 30.7 million in 2003. The country also imported nearly 130 million liters of ethanol in 2005, up from roughly 40.5 million in 2004.[26] According to the Salvadoran Ministry of Economy, El Salvador's export quota to the United States is projected to increase under the CAFTA agreement, and with these increases, revenues are likely to nearly quadruple over 15 years [Chart 2.3b].[27]

Chart 2.4b: Ethanol Export Quotas to the United States



Source: Ministry of Mines and Energy

D) PRIVATE SECTOR

Investment in the Salvadoran biofuels industry is steadily improving. In September 2004, US agricultural giant Cargill decided to build an $8 million dehydration unit in El Salvador as a cooperative venture with Brazilian firm Crystalsev and CASSA of El Salvador. Production for the 238.7 million liter-capacity plant (63 million gallons) was to begin in 2005.[28] The goal of this plant was to bring ethanol from Brazil into the US, taking advantage of tax incentives under the Caribbean Basin Initiative.[29] The plant began exporting in 2006.[30] The La Cabana distillery in Agolares, operating 120 days a year, produces fuel ethanol at 60,000 liters per day and hopes to double its capacity by 2006-07.[31] The company has already invested $800,000 to expand its production capabilities.[32]

On the biodiesel front, British firm D1 Oils has launched a pilot program to produce

biodiesel from jatropha in El Salvador. The project intends to plant 2,500 trees on five plots of 1,000 hectares each. The firm has stated that if the results fulfill their expectations, they should be producing biodiesel by 2007.[33]

Overall, Salvadorans interested in producing renewable fuels believe that the biofuels law currently under legislative review should contain incentives to promote the production and use of these fuels and to facilitate the entrance of new players through tax breaks and low-interest loans.[34]

E) RESEARCH & DEVELOPMENT

Information on research and development activities in El Salvador is not easily accessible, which suggests that R&D in the biofuels sector is not as prevalent as it could be. There will be a forum on alternative energy in El Salvador during the second week of November in which they will try to identify the entities developing projects and research in this area.[35]

Sun Energy Corp., a renewable energy company based in Santa Ana, El Salvador is currently engaged in research and development activities related to biodiesel production. The company aims to produce biodiesel from waste vegetable oils and oils it will produce itself from jatropha or castor bean. It also intends to investigate the feasibility of biodiesel production from waste animal fats produced by the nation's meat industry.[36]

F) CONCLUSION

El Salvador has great potential in the ethanol industry, given the productivity of its sugar industry and its privileged position in relation to the US market. To be able to introduce biofuels into the country's energy matrix, however, El Salvador's government needs to provide incentives for investors and guarantee a market through blending requirements and public awareness campaigns. Raw material must be produced on a greater scale to expand the potential of El Salvador's biofuels industry. This will require investment in more efficient technology as well as partnership with countries like Brazil, which possess the expertise in both R&D and production to assist the country in developing its biofuels sector. On a positive note, the investment climate in El Salvador inspires confidence in the country's ability to attract needed investment.

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Source: World Factbook

A) INTRODUCTION

Guatemala has become a central focus for the development of alternative energy sources, and particularly ethanol and biodiesel. The maturity and competitiveness of the sugar sector coupled with previous investment in ethanol technologies make the development of a viable biofuels market in Guatemala increasingly feasible. Further, Guatemala's ranking as the world's largest producer of palm and palm kernel equivalents illustrates the country's vast potential for the development of a competitive biodiesel industry. Opportune economic and political conditions exist in Guatemala to develop the nascent industry and thereby diversify the country's agro-industrial base, reduce its dependence on foreign oil, generate employment, and reduce domestic and global environmental degradation. Guatemala is well positioned to become a model for sustainable biofuels development for the region and for the world.

B) GOVERNMENT POLICIES

Beginning in the 1980s, industrial organizations began focused discussions with government, the sugar sector, and the Ministry of Energy and Mining on including ethanol in the fuel mix. Guatemala began promoting the use of ethanol through fuel standards in 1985, with the enforcement of Decree 17/85. The law allowed for a blend of up to 25% ethanol, but due to poor planning, a lack of technical capability, and scant interest from key players, the standards have thus far had little effect.[1] Insufficient planning, lack of information to consumers, conflicts of interest, and difficulties in pricing, among others factors, have inhibited the growth of a domestic ethanol market. The absence of a clear institutional and regulatory framework, coupled with opposition from oil importers, continue to thwart the maturation of ethanol and biodiesel industries. After years of frustration, organizing finally began to make progress in formalizing government and industry cooperation in biofuels.

In 2003, the Guatemalan government passed the Law of Incentives for the Development of Projects in Renewable Energy ("Ley de Incentivos para el Desarrollo de Proyectos de Energia Renovable"). It created fiscal, economic, and administrative incentives for such projects. Incentives included exemption from import duties, VAT, taxes on machinery imports for the stages of pre-investment and execution, and income taxes for 10 years during commercial operation. Despite the incentives created by the 2003 law, opposition led by the country's oil establishment remains strong.[2] Getting oil importers to "buy in" will be critical to enable the development of a renewable energy industry.

Exhaustive studies were conducted by the government's Economic Cabinet to identify the benefits of a Guatemalan biofuel program. According to UN-CEPAL, a 10% ethanol blend would produce the following benefits:[3]

- Generate 10,000 direct jobs;
- Diminish pollution due to the elimination of MTBE;
- Save $56 million annually from the reduction of petroleum imports;
- Contribute to the stability of fuel prices;
- Enable Guatemala to access credit from international financial institutions for reducing atmospheric contaminants.

Total estimated savings from reduction of petroleum consumption were estimated at approximately $20 million, based on 2002 values.[4]

Further, the proposal called for $60 million for the installation of six distilleries, each with a capacity of 120,000 liters per day, with an additional $9 million investment in expanded cultivation. The following three years would require an investment of $40 million for the installation of four additional distilleries and $6 million for the acquisition of new land for cane cultivation.[5]

The law would require a minimum percentage of all fuel to be derived from renewable sources and would prohibit the importation of MTBE-containing fuels. Distilleries would be previously authorized by the government to produce ethanol and the Ministry would define annual quotas for each producer along with the required minimum fuel mix of at least 5%. Under this proposal, biofuel exports would only be permitted if the domestic market was fully supplied. A flexible price for biofuel would be established taking into account the last twenty years of sugar prices on the international market.

A more recent analysis conducted by the Guatemalan Association for Renewable Fuels suggests that a 10% ethanol fuel blend would require $80 million in investment in eight distilleries with an annual ethanol production of 145 million liters. Balance of payments savings would be on the order of $54 million.[6]

While the imposition of renewable energy requirements will continue to meet opposition by domestic petroleum importers, the biofuel proposal illustrates an entrepreneurial and progressive vision on the part of the government and the sugar industry. Establishing incentives for other stakeholders and establishing multi-sector 'buy-in' will be necessary to establish legitimate and lasting biofuel legislation.

CAFTA

As mentioned previously in this report, under the Central America Free Trade Agreement (CAFTA), Central American countries will continue to benefit from the 1989 expansion of the Caribbean Basin Initiative that granted access to US ethanol markets. However, incentives for the development of a domestic ethanol market may diminish if the international price of sugar increases due to further trade liberalization. Sugar producers in Guatemala and other Central American countries have expressed concerns that a conversion to ethanol production may have a detrimental impact on quotas allowed under present trade arrangements.

According to UN COMTRADE,[7] Guatemala's exports to the United States for 2002 for cane or beet sugar and pure sucrose in solid form were 114.5 million metric tons at a

value of $30 million. CAFTA would allow additional sugar imports into the United States above the current 127,000 tons under the tariff rate quota. Additional exports could eventually exceed 100,000 tons as second-tier tariffs are reduced one cent per year over 15 years, eventually eliminating tariff protection.

Relations with Brazil

In 2005, Guatemala and Brazil signed the Protocol of Intention for Technical Cooperation in the Area of Production Techniques and the Use of Ethanol. It encourages cooperation between the two countries on ethanol technology, research and development.[8] The same year, high-ranking officials from the Guatemalan Ministry visited Brazil, along with representatives of other Central American countries, to learn about Brazil's successful efforts in ethanol production.[9]

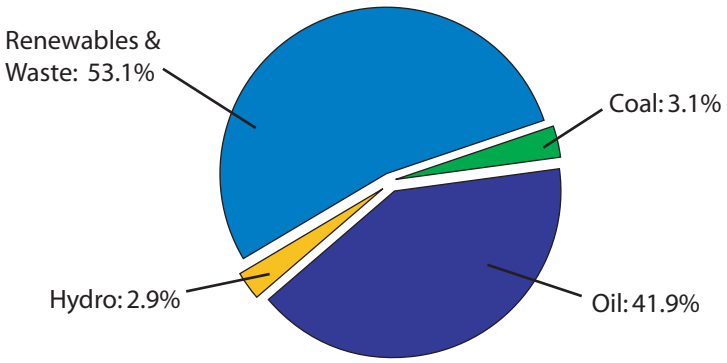
In 2006, the Brazilian Secretary of Industry and Commerce, Luciano Tavares, offered assistance to Guatemala in constructing policies on the development and use of ethanol. In addition, Brazil's Vice President, José Alencar, met with Guatemala's Governor of Operations, Eduardo Stein in May 2006 and offered support for the promotion of alternative fuel production in Guatemala. Businessmen along with representatives from Brazil's Energy and Mining industry expressed interest in formalizing a commercial exchange with Guatemala in the form of a free trade agreement.[10] Technology investments and environmental conservation were also discussed. With respect to biofuels, Brazil committed to advise Guatemala on the construction of biodiesel and ethanol plants.[11] While financial and technical support from Brazilian counterparts could bolster Guatemala's nascent industry, a number of NGOs have expressed concern over the use of Guatemala and other small sugar-producing countries as a channel for Brazilian ethanol into US markets.[12] Small farmers from the global south have also voiced concerns that multinational corporations investing in ethanol production will absorb large tracts of land and ultimately undermine the ability of small farmers to compete.[13]

C) CURRENT SITUATION

Energy Matrix

Guatemala derives more than half of its energy from renewable sources, including ethanol and biodiesel. Given the country's developed agroindustrial base and strength in sugar and palm oil production, Guatemala exhibits significant potential for the development of a domestic biofuel industry.

Chart 2.5a: Guatemala's Energy Matrix



Source: IEA

Production

Guatemala ranks as the largest sugar producer in the region and the fifth-largest sugar exporter in the world. At present, there do not seem to be significant price differences between sugarcane producers or land restrictions on cane cultivation. Independent cane producers account for nearly 20% of supply. Cane plantations occupy only 4% of

cultivated land.[14] Given its natural resource endowment and its industrial and technological capability, Guatemala is well positioned to develop its ethanol industry for both domestic consumption and for export.

Table 2.5a: Yield per hectare (tons/ha), Sugar cane and Sugar crops[15]

	2000	2001	2002	2003	2004
Costa Rica	76.27	76.46	73.67	80.80	77.31
Dominican Republic	37.89	37.88	38.81	37.18	40.79
El Salvador	74.93	82.84	76.92	76.97	92.45
Guatemala	90.95	93.05	93.86	90.63	96.77
Honduras	84.67	99.37	55.22	71.64	40.75
Nicaragua	69.08	77.44	75.90	93.67	88.91
Panama	51.92	44.40	49.35	54.48	47.14

Source: FAO STAT

Table 2.5b: Indicators for the Guatemalan Sugarcane Industry:

Harvest Period	Area Harvested (thousand hectares)	Crushed Cane (thousand tons)	Sugar Production (thousand tons)	Productivity (tons of cane/hectare)	(kilograms of sugar/ ton of cane)
1996-1997	170	14,793	1517	87.0	102.6
1997-1998	180	17,666	1,792	98.1	101.4
1998-1999	180	15,645	1,583	86.9	101.2
1999-2000	180	14,339	1,655	79.7	115.4
2000-2001	180	15,174	1,712	84.3	112.8
2001-2002	188	16,900	1,912	91.4	113.1

Source: Asociación de Azucareros de Guatemala

Ethanol Production

Several major distilleries account for much of Guatemala's current ethanol production. Destileria Bioetanol, associated with Ingenio Pantaleon, is the largest distillery in the country. It will use modern technology to produce 150,000 liters per day of ethanol and is in the final stages of construction. Investments in the project total $15 million. The distillery at Ingenio Palo Gordo produces 120,000 liters per day, and has been operational continuously since 1985.[16] Octagon is the only company in Guatemala currently producing biodiesel; its biodiesel project is partly financed by the government of Finland.[17]

Structure of the Sugar Industry

Sugar is the nation's largest export, with over 197,000 hectares of Guatemalan land seeded for sugar cane production and 72% of Guatemala's sugar production exported. Guatemala's sugar industry represents 23.82% of the total value of Guatemalan agricultural production and 13.65% of the total exports. Sugar is the second largest contributor to foreign exchange. During 2005, sugar and molasses production generated revenue of $497.5 million and has generated 300,000 direct and indirect jobs.[18] The sugar industry is one of the largest and most economically competitive in the region and is a primary engine for economic growth in Guatemala.

The Guatemala sugar industry is comprised of 15 sugar mills located in 5 departments along the Pacific Coast and has grown enormously over the last forty years. In 1960, 12,534 hectares were dedicated to sugar compared with 197,000 hectares in 2004-2005. Production has increased from 65,163 tons in 1965 to 17.8 million tons in 2004-2005.[19] While a number of facilities are currently in operation, the majority of production stems from the following refineries:[20]

Table 2.5c: Guatemala Sugar Refineries

Refinery	Ton/Day
Pantaleón	17.507
Magdalena	16.751
Santa Ana	13.717
El Pilar	13.600
La Union	10.803
Concepción	7.674
Madre Tierra	7.024
Tierra Buena	6.009

Source: Asociación de Azucareros de Guatemala

Pantaleón, the largest of the refineries, processes 16% of the total capacity with the largest six refineries producing 72% of total capacity.[21]

The total growth and production concentration is illustrated below by the total tons of sugarcane processed by the six refineries over a seven-year period:

Table 2.5d: Total Sugarcane Processed by Largest Guatemalan Refineries (tons)

Refinery	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Concepción	1,550,396	1,298,703	1,032,278	915,673	1,322,885	1,255,032	1,305,620
La Unión		1,681,207	1,442,903	1,596,044	1,820,487	1,673,789	2,989,914
Magdalena	1,745,096	1,507.854	1,817,646	1,845,232	2,376,617	2,684,394	3,360,909
Pantaleón	3,204,239	2,761,042	20,608,535	2,683,024	2,933,956	2,907,590	1,912,714
Santa Ana	1,548,971	1,671,961	1,638,105	1,761,019	1,793,255	1,743,987	1,912,714
MadreTierra	1,404,209	1,287,386	1,129,393	1,295,616	1,395,331	1,265,242	1,347,209
Tululá	0	0	0	0	596,055	544,883	593,344
Total	9,452,911	10,208,153	9,669,310	10,096,608	12,238,586	1,2074,917	1,342,242

Source: CENGICAN[22]

The sugar industry in Guatemala, while booming, is concentrated among a few select families that have received financing and funding from international development groups such as the International Finance Corporation and the World Bank. Pantaleon and Concepcion are the two primary sugar factories and have been in operation since the late 1800s and early 1900s, respectively. According to the IFC, Pantaleon is owned and controlled by the Herrera family. Concepcion's shareholders are as follows: Herrera family (37%), Pantaleon (17%), Nottebohm family (28%), and Widmann family (18%). Because the Herrera family owns 100% of Pantaleon, they control 54% of Concepcion as well.

The primary entity within the Guatemalan sugar industry is ASAZGUA, the Guatemalan Sugar Association, which is an umbrella organization for sugar producers and exporters. ASAZGUA was formed in 1957 as an independent, apolitical, non-profit organization integrating parties active in the industry. From that time, the Guatemalan sugar industry has become increasingly cohesive and has developed policies, programs and projects of communal interest. Unlike other regional sugar producers, the Guatemalan sugar industry has operated relatively autonomously from the state.[23] All exporters are members of ASAZGUA, which is supported by the following:

- Guatemalan Sugar Cane Research and Training Center (CENGICANA)

- Guatemalan Society of Sugar Cane Technologists (ATAGUA)
- Shipping Terminal of Sugar (EXPOGRANEL)
- Sugar Foundation (FUNDAZUCAR)
- Sugar mills and Canegrowers Association.

Under the leadership of ASAZGUA, Guatemalan sugar producers organized and developed proposals to include biofuels in the domestic energy regulations. The 1985 decree 17/85 allowed for the use of biofuel up to a 25% alcohol blend.[24] However, insufficient planning, lack of interest by fuel distributors, and difficulties in pricing limited the potential return of the pioneering legislation.

Biodiesel

While sugar is Guatemala's primary material for ethanol production, the country possesses significant jatropha, palm oil, and avocados that are being sourced for the production of biodiesel.

The potential for biodiesel production is substantial considering the country's vast production of palm and other oil seeds. According to the FAO, Guatemala is the world's largest producer of palm kernel equivalents, yielding 30.37 tons/hectare in 2004.[25]

Table 2.5e: Yield per hectare (tons/ ha) of Palm kernel equivalents[26]

	2000	2001	2002	2003	2004
Costa Rica	18.50	18.60	18.30	22.63	18.62
Dominican Republic	15.30	15.30	15.35	15.35	15.34
El Salvador	0.00	0.00	0.00	0.00	0.00
Guatemala	22.76	20.29	23.88	23.60	30.37
Honduras	18.75	19.67	16.64	23.33	25.22
Nicaragua	26.50	26.50	26.50	24.32	24.35
Panama	10.36	10.17	10.09	10.17	10.12

Source: FAO STAT FAO Statistics Division

If Guatemala is able to secure adequate and sustained financing for production facilities, the country could become a center for regional biodiesel production.

Competitiveness

The sugar sector has the capacity to produce enough ethanol for domestic consumption at a 10% ethanol blend without much difficulty, putting Guatemala in an extremely positive position to develop a viable ethanol market and enhance domestic energy security. Four of the nation's distilleries have a combined productive capacity of 490,000 liters per day. Utilizing 27% of the available molasses, Guatemala would be able to meet the projected domestic demand for ethanol.[27] Paradoxically, there is no domestic ethanol market in Guatemala; nearly all production is exported, mainly to the US and the European Union. Given this situation, action must be taken to promote the use of ethanol in Guatemala and create a domestic market, including through the expansion of existing facilities. As discussed previously, Guatemala could save over $50 million a year by replacing oil imports with domestically produced biofuels.

D) PRIVATE SECTOR

According to the Association of Renewable Fuels of Guatemala, $80 million in investments is needed to produce enough ethanol to supply the domestic market.[28] The Guatemalan government signed the United Nations Convention on Climate Change in 1992, and it was ratified by the Congress of the Republic in 1995. Guatemala may take advantage of its status as a signatory to attract foreign investment for ethanol and biofuel production under the Clean Development Mechanism.

Since 2002, the company OCTAGON has been researching the production of biodiesel through the use of oilseeds, specifically jatropha curcas, with plans for developing plantations along with construction of facilities for the production of biodiesel. In 2004-2005, OCTAGON initiated jatropha curcas studies in ten geographic zones and has plans to expand the project commercially in 2006.[29] The project would expand the country's biodiesel base and refine the technological and mechanical procedures required for biodiesel production from oilseeds.

In 2005, OCTAGON designed an industrial plant for biodiesel capable of processing the enhanced volume of harvested jatropha curcas and other varieties of oilseeds. Through the development of the pilot plant, the company seeks to perfect the industrial processes for extracting and retaining the byproducts of oilseeds. The plant would define the processes for purification of biodiesel and glycerin and seeks to produce 3,000 gallons of biodiesel per day. Simultaneously, the company is conducting significant research into the use of varying types of oilseeds for biodiesel production in an effort to enhance overall yield and efficiency. According to OCTAGON, the project will require a 130 million euro ($166 million) investment.[30]

E) RESEARCH & DEVELOPMENT

The Guatemalan Sugarcane Research and Training Center (CENGICAÑA), was created by ASAZGUA in 1992 to support the technological advance of the sugar agro industry, with the aim of improving production and productivity of sugarcane and its derivatives. It is financed by the sugar mills that comprise Guatemala's sugar agro industry, whose contribution to the Center's budget is proportional to sugar production.[31] Among its many projects, CENGICAÑA fosters a Sugarcane Varietals Development Program which seeks to improve Guatemala's sugar productivity through the breeding and selection of better-yielding, disease and pest resistant varietals suited to the various climates of the region. The center's research and development also focuses on agronomy and pest control management, but does little with respect to the technological processes necessary to enhance the industrial processing of ethanol or biofuel derivatives.

Guatemala is currently carrying out a study of the potential of jatropha for the production of biodiesel. The companies AGROCYT, OCTAGON, FAUSAC, ICTA and AGEXPRONT are all participating in the project. The goal of the study is to determine the genetic viability of the plant and to assess the possibility of altering its genetic composition in order to improve its potential.

F) CONCLUSION

Despite institutional and industrial barriers, the sugar industry in Guatemala is already mature and producing on a competitive basis. However, obstacles to viable ethanol development remain, due to the lack of a clear regulatory framework for the production of ethanol and biodiesel and the need for clear rules and goals for the domestic market (with regard to blend, consumption, etc.). One major hurdle is the opposition posed by oil importers, which have been successful in preventing the implementation of biofuels in the domestic markets. Promoters of ethanol production must target incentives to varying stakeholders and establish 'buy-in' among conflicting parties. The potential for ethanol is immense, given the size and competitiveness of the sugar industry and the country's successful exporting experience. Once the framework for domestic consumption is designed and implemented and sources of financing are developed, Guatemala will become a significant player not only regionally, but globally.

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A) INTRODUCTION

Haiti does not produce biofuels, but it has potential for biodiesel development through technology and information transfer from Brazil. The United Nations Food and Agriculture Organization (FAO) has included biodiesel production as part of a comprehensive development package for the country. If such a program is implemented, the socioeconomic and environmental benefits to the country will be significant, including rural economic development, power generation, air-quality improvement, and a reduction in the country's petroleum import expenses.

Haiti's once booming sugarcane industry is near defunct due to deforestation and soil erosion, which has resulted in the desertification of large expanses of the nation's countryside. While sugarcane is still grown in pockets of the country, the short- and even medium-term prospects of a revival are dim. Biodiesel therefore is seen as a better choice for the country. Biodiesel feedstocks such as castor bean and jatropha are better suited for the country's terrain than sugarcane. Moreover, Haiti's reliance on diesel fuel for transport and power generation makes biodiesel particularly attractive. Much of Haiti's transport sector relies on diesel fuel, and the use of biodiesel as an additive or substitute could have a significant impact on the nation's air quality. Biodiesel might also help replace biomass-derived charcoal (which fosters deforestation) as fuel for cooking and other activities. In terms of power generation, biodiesel derived from oilseed plants, waste vegetable oils, or animal fats could help reduce environmental damage and create a more consistent supply of energy, improving overall quality of life.

B) GOVERNMENT POLICIES

There are no biofuels laws in Haiti, and this type of legislation is likely not a high priority for the administration of recently elected president René Préval. The poorest country in the Western Hemisphere faces a myriad of political and economic problems, many of which are intertwined. It has had a tumultuous political history marred by numerous coups d'état and corruption and must reestablish political stability and security and improve economic and social development.

An improvement of the country's political and economic climate might make possible the development of a stable biofuels industry and attract investment by reducing investor risk. Infrastructure will also be a key issue: the country will need equipment and plants to produce biofuels as well as transport infrastructure to make the fuels widely available. Préval aims to address the poor state of Haiti's roads, but short-term improvement is unlikely. Public information campaigns will also be important to promote the production and use of biofuels on a national scale.

Petrocaribe
Following the election of Préval in February 2006, Haiti was brought into the fold of Petrocaribe negotiations (Venezuelan president Hugo Chávez did not recognize the U.S.-backed interim government of Haiti, established after the ouster of Jean Bertrand Aristide in 2004, and blocked its entrance into negotiations). The Petrocaribe initiative should offer some relief on the purchase of crude products, but the socio-economic benefits of biofuels use should still be a strong incentive. Additionally, the environmental benefits of biofuels use both for the transportation sector and for power generation could be significant.

Relations with Brazil
Since 2005, Brazil has sought to establish cooperation agreements on biofuels production with several countries, including Haiti. In May 2006, Haiti signed on to Brazil's Protocol of Intention for Technical Cooperation in the Area of Production Techniques and the Use of Ethanol, which aims to enhance both countries' efforts to meet their Kyoto requirements.[1]

In September 2006, Haiti's agriculture minister, Joanas Gué, accompanied Édna Carmélio, head of biofuels in the Brazilian Ministry of Agrarian Development, on a visit to the biofuels production plant at the University of Brasília. The visit was part of a nine-day trip led by Gué to secure assistance from Brazil in developing a Haitian biodiesel industry. According to Carmélio, Haiti will likely be able to utilize certain aspects of the Brazilian model, including financial incentives to encourage the purchase of biofuels from small holdings and technical assistance for feedstock cultivation.[2] Brazil has pledged to provide technical know-how and equipment to support Haiti in its effort.

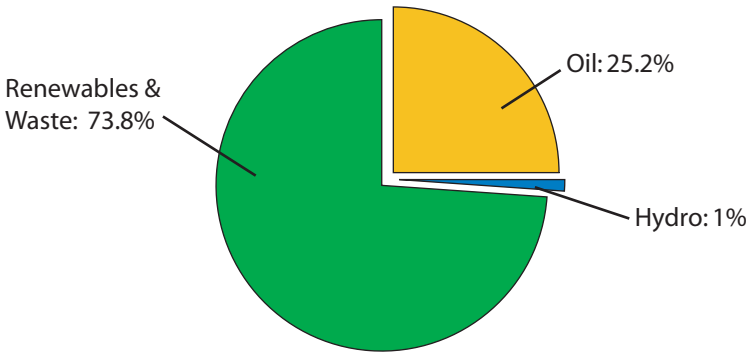
The UN Food & Agriculture Organization (FAO) is promoting the adoption of several Brazilian social programs, including its national biodiesel program, in Haiti. Vegetation similar to that used successfully in biodiesel production in Brazil is prevalent in Haiti, according to José Graziano, FAO Director General for Latin America and the Caribbean. The organization will provide technical support to Haiti's central bank in managing the funds dedicated to the program, much of which will come from the European Union. The FAO will also promote a program similar to Brazil's National Financing Program, designed to provide low-interest credit to support individual agricultural production for use as biodiesel feedstock. Graziano is a former minister of Lula's government and one of the creators of the Zero Hunger program, which is also part of this initiative.[3]

C) CURRENT SITUATION

Energy Matrix
Haiti uses a signficant amount of renewable energy, particularly from biomass such as firewood and plant-based charcoal [Chart 2.5a]. Haiti also consumes significant oil, but the 25.2% figure listed in Chart 2.5a is comprised, in large part, of diesel. Haiti's

domestic supply of oil in 2003 was 569,800 tons, all of which was imported; 59% of that total was diesel oil [Table 2.5a]. For this reason, biodiesel will be the focus of any biofuels programs implemented in Haiti.

Chart 2.6a: Haiti's Energy Matrix (2003)



Source: International Energy Agency[4]

Table 2.6a: Oil Figures for Haiti (2003)* (,000 tons)

	Liquefied Petroleum	Motor Gasoline	Kerosene	Residual Gas/Diesel	Fuel Oil
Production	0	0	0	0	0
Imports	14.3	116.6	78.1	334.4	26.4
Exports	0	0	0	0	0
Total Domestic Supply	14.3	116.6	78.1	334.4	26.4
Electricity Plants	0	0	0	53.9	5.5
Petroleum Refineries	0	0	0	0	0
Total Transformation	0	0	0	53.9	5.5
Industry	0	0	17.6	111.1	20.9
Transport	0	116.6	0	159.5	0
Agriculture	0	0	0	0	0
Commercial and Public Services	0	0	0	0	0
Residential	14.3	0	60.5	9.9	0
Total Final Consumption	14.3	116.6	78.1	280.5	20.9

Source: International Energy Agency[5,] * The indicators for crude oil , natural gas liquids and refinery feedstocks were all zero.

Production

Haiti does not currently produce biofuels, but there are programs in the pipeline to promote the development of a biodiesel industry. Both castor beans and jatropha are found in Haiti, though cultivation is limited.

While ethanol production is not a likely for Haiti in the medium-term, an analysis of its sugarcane industry is included as a basis for comparison with other countries and to examine the potential for a revitalization of the sector.

Structure of the Sugar Industry

The country's Ministry of Commerce and Industry does not publish information on Haiti's sugar industry, or any industry for that matter. It is known that Haiti no longer has an export market for sugar, but produces some sugarcane for domestic consumption, importing most of its sugar from the Dominican Republic. The sugar that is produced domestically is primarily cultivated by small-scale farming operations. According to the nation's Ministry of Agriculture, roughly 44,500 hectares are employed in domestic sugarcane production.[6] The country does export rum, and its largest export-

ing company, Barbancourt, primarily uses its own domestically-grown feedstock.

In recent years, Cuban experts have traveled to Haiti to provide technical assistance in the reconstruction and reopening of the sugar mill in Darbonne. In March 2004, the mill was in its fourth sugar harvest, employing 2,000 people and providing electricity during the harvest period to 5,000 families in the area.[7] Other mills operating in the country were:[8]

- The Dessalines Center of Les Cayes
- Sugar mill of the North (Citadelle)
- Haitian American Sugar Corporation (HASCO)

HASCO, the country's largest and oldest mill, closed last, in April 1987.[9] There was talk of reopening the plant in 1996,[10] and it is possible it has been functioning intermittently since then. Some of the remaining former refineries now produce small amounts of low-quality rum for domestic consumption.[11]

Competitiveness
Haiti has 2.76 million hectares of land, of which 92,000 hectares are irrigated. 775,836 hectares (28.11%) are arable and 318,228 hectares (11.53%) are dedicated to permanent crops.[12] Barriers to biofuels production include poor infrastructure, particularly roads for distribution and access to storage capacity. Haiti also suffers from extensive deforestation (97% of total land)[13] and soil erosion. The climate is a mix of tropical and semi-arid, and the terrain is rugged and mountainous, which has promoted soil erosion and a lowering of the country's water table. This in turn contributes to Haiti's water shortages, which hamper any effort to rejuvenate the sugarcane industry. For these reasons, the government is more focused on biodiesel production from oils and fats.

D) PRIVATE SECTOR

There is little official information on Haiti's employment rate. Unemployment and underemployment are high, with unemployment rates for the formal sector reaching 60-80%.[14] The informal sector makes up the overwhelming percentage of the country's economic activity. The development of a biodiesel industry supported by the government could help bring additional workers and activity into the formal sector.

Because of Haiti's political, economic and security issues, domestic investment capital is scarce and attracting foreign investment, other than development aid, will be an arduous task. As with many countries in the region, the state of the nation's infrastructure, particularly roads, will be a significant obstacle to the development of any national biofuel industry, as road transport is the primary means of distributing the fuel.

In September 2005, the IDB approved a $12.6 million concessional loan, in addition to a $50 million loan granted earlier in the year, to support repair of the country's transport infrastructure. Port repairs are to include dredging of the main channel, the repair of piers, and the construction of a perimeter fence. There are also additional IDB loans of $50 and $70 million respectively to improve rural roads and to fund small-and-medium size infrastructure projects.[15] The World Bank also approved a $16 million loan for a rural roads and territorial development project in fiscal year 2006.[16] In the medium-to-long term, these activities could have a positive effect on Haiti's ability to develop a biofuels industry.

E) RESEARCH & DEVELOPMENT

Information on Haiti's R&D sector related to biofuels is unavailable. It is likely that any future endeavors will include technical cooperation with Brazil.

F) CONCLUSION

Biofuels development in Haiti should focus on biodiesel, due to the weakness of the sugarcane sector and the availability of certain biodiesel feedstocks in the country. Hai-

ti's frequent and sweeping blackouts also highlight the need to redesign or reformat equipment for power generation so that it can employ biodiesel as a fuel source.

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Source: World Factbook

A) INTRODUCTION

Research suggests that biodiesel derived from palm is the most feasible and promising alternative to conventional fuels in Honduras. The country's natural resource endowment and industrial base provide a solid foundation on which to build a renewable energy strategy. As of 2006, the government has announced an aggressive initiative to invest significant political and public resources into the development of biofuels. This political will, coupled with substantial international investment from Nicaragua and Brazil, will help to reduce Honduras' severe dependence on international fuel and enhance the country's global competitive position.

B) GOVERNMENT POLICIES

In April 2006, the President of Honduras, Manuel Zalaya, predicted that in five years 30% of domestic energy consumption would be from biodiesel.[1] While no legislation has yet been passed, the Honduran government has drafted a legal framework for the promotion of biofuels. The Biofuels Production and Consumption Law, which was submitted to the National Congress for discussion and approval on September 2006, contains provisions for bioethanol, biodiesel, biogas and synthetic biofuels, defines registration procedures, controls and assigns benefits, and sets out penalties for failing to comply with the regulations.[2] The draft demonstrates the government's determination to engage in serious dialogue regarding the development of biofuels. The implementation of a sound legal and regulatory framework is essential in order for Honduras to attract the necessary investment to transform its biofuel ambitions into reality.

CAFTA

Although many small farmers are demanding protection from increased US agricultural imports, the outlook for sugarcane growers is positive. Sugarcane growers are

already benefiting as high oil prices increase demand for sugar as an ethanol input (which has also helped to increase sugar prices).[3] Under CAFTA, Honduran sugar exports will benefit further from increased access to the US market. Coupled with the Zelaya government's recent initiative to promote the use of alternative fuels, including ethanol, the prospects for cane growers appear positive.

Relations with Brazil
In April 2006, President Zelaya of Honduras met with President Lula of Brazil to deepen bilateral relations and intensify cooperation in various areas. Among other issues, the leaders reiterated their support for the *Protocol of Intention for Technical Cooperation in the Area of Production Techniques and the Use of Ethanol*, which had been signed by both parties the previous September. Once Honduras solidifies a legal and regulatory framework for biofuels, the countries can begin cooperating to develop specific, concrete biofuels projects.[4]

C) CURRENT SITUATION

Energy Matrix
Importing approximately 13 million barrels of oil a year, Honduras depends heavily on external petroleum producers and remains vulnerable to international price fluctuations.

Table: 2.7a: Fuel Consumption in Honduras (millions of liters)

Fuel	2000	2001	2002	2003
Auto gasoline	110.4	116.5	116.8	57.1
Diesel	173.1	221.5	241.7	132.7
Other derivatives	149.9	175.2	181.3	95.3
Total	433.5	513.3	539.8	285.2

Source: UN CEPAL

According to UN CEPAL, the value of fuel imports to Honduras in 2002 was $395 million (25% gasoline and 45% diesel). The price of fuel in Honduras is regulated and follows the prevailing international price. During that same period, the government collected a fuel tax of 18%, down from 25%.[5] Measures to reduce fuel prices were part of the Zelaya presidential campaign. Now in power, the Zelaya administration is seeking to reform energy policy by reducing taxes and purchasing all imported fuel from a single supplier, a measure they project will save $66 million annually. Regarding domestic energy policy, the Zelaya government intends to construct several hydroelectric dams and aggressively pursue alternative energy initiatives for ethanol and biodiesel.

Biofuels Production
Despite the fact that Honduras' agroindustry is one of the least developed in the region, nascent ethanol and biodiesel projects demonstrate the country's capacity for larger- scale production. Refineries such as CATV have installations suitable for distillation units to produce fuel ethanol.[6] Pursuing higher earnings, refineries are seeking to introduce flexibility into their processing by including ethanol and electricity from cogeneration. Further, they are cognizant of the potential environmental impact of ethanol production and are currently investigating means to compost and utilize by-products as fertilizers.

Structure of the Sugar Industry[7]
Honduran sugarcane production was 4.50 million metric tons per year in 2006, almost reaching 2004's level of 4.59 million. The yield per hectare was 79.6 metric tons, the second-highest in the Central America region behind Guatemala. At present, the Honduras sugarcane industry is comprised of eight sugar refineries, seven of which had a combined installed capacity of 42,000 tons per hour in 2006; those seven produced 8 million quintales (800,000 metric tons) of sugar annually, 49% of which came from the sugar refineries and 51% from independent sugarcane farmers. Honduras exported 28% of the total to international markets.[8]

Table: 2.7b: Processing Capacity of Honduras Sugar Refineries

Refinery	Capacity (ton/day)
Santa Matilde	12,000
La Grecia	9,000
AZUNOSA	6,500
AYSA	4,500
ACHSA	4,000
Chumbagua	3,000
CATV	3,000
TOTAL	42,000

Source: APAH[9]

Production is relatively well dispersed among the sugar refineries, and the industry does not exhibit the same degree of concentration that exists elsewhere in Central America.

Honduras is poised to commence ethanol production. The Chumbagua, La Grecia and Tres Valles plants have initiated studies to produce ethanol, and are waiting on the passage of the biofuels law to install at least two ethanol distillation plants. These Producers have also initiated action to install new refineries in the Olancho region.

African Palm and the Production of Biodiesel[9]

While somewhat limited in its ethanol capacity, Honduras possesses significant experience growing and cultivating African palm for the production of biodiesel. African palm is cultivated on approximately 89,100 hectares of land producing 1.28 million tons of palm fruit; Honduras ranks sixth in the world in terms of area cultivated, behind Asian and Andean producers. Production of palm oil has more than doubled over the last decade to reach 246,350 metric tons in 2006, 58% of which (142,360 metric tons) was exported. There are 11 oil refining plants, which, in 2006, had a refining capacity of 456 metric tons of oil per hour. These processing units employ 120,000 people.

Table 2.7c: Installed Capacity for Palm Oil Processing

Company	Location	Capacity (metric tons/ hour)
Cressida Aguán	Tocoa, Colón	90
Agrotor	Tela, Atlántida	60
Aceydesa	Trujillo, Colón	45
Cressida León	Arizona, Atlántida	45
Coapalma	Trujillo, Colón	45
Hondupalma	Guaymas, Yoro	45
Caicesa	San Francisco, Atlántida	40
Agropalma	Trujillo, Colón	36
Palcasa	El Progreso, Yoro	30
Salamá	Trujillo, Colón	12
Imdisa	Jutiapa, Atlántida	8
Total		**456**

Source: Empresas Procesadoras 2005

In early 2006, the Honduran Government proposed that the country commence a massive agroindustrial program for the production of biodiesel that would require $626 million of public and private investment and would help generate 100,000 direct and 200,000 indirect jobs. The goal is to seed more than 200,000 hectares with African palm and ultimately produce more than 757.1 million liters (200 million gallons) of biodiesel, with funding coming from the Central American Bank for Economic Integration (BCIE), the IDB, the IFC and local banks. The program seeks to incorporate 60,000 hectares of land in 2006 and increase production steadily over the coming years.[10]

In a separate project with BCIE, Honduras plans to import 1.5 million seeds from Malaysia to plant and harvest African palm. As early as April 2006, the country began to import 50,000 seeds per month; however, there is currently talk of augmenting that figure to 100,000 per month. They will be used by growers to re-seed 4,000 existing hectares and seed an additional 3,000 hectares of newly-dedicated land.

Various government research studies indicate that Honduras possesses 500,000 to one million hectares of unutilized land suitable for palm production in the regions of Atlántida, Cortés, Colón, Yoro, and Gracias a Dios.[11]

The country produces approximately 56,800 – 75,700 liters (15,000 - 20,000 gallons) of biodiesel per day, and that production will be increased to 113, 600 (30,000 gallons daily), more than 37.85 million liters (10 million gallons) per year, under the expansion plans for this year. Of the current amount, 45,400 - 56,800 liters (12-15,000 gallons) of biodiesel are produced from palm oil, with DINANT producing 22,700 liters (6,000 gallons) daily and Haremar Group of San Pedro Sula producing 11,350 (3,000) per day. The remaining biodiesel production comes from fish oil, particularly from tilapia. Aquafinca Saint Peter Fish produced 16,300 tons of tilapia or 12,300 pounds of fresh filet for export. Its biodiesel production capacity is 22,700 liters (6,000 gallons) per day.

Honduras initiated a pilot project, to be completed in December 2007, with the objective of testing 620 buses with different mixtures of biodiesel produced by Hondupalma, Dinant and Aquafinca. There are additional pilot projects in the pipeline for biodiesel testing in buses. For biodiesel, the government provides technical assistance through the Agro Science and Technology Directorate (DICTA) and the National Agrofood program (PRONAGRO). The private sector, however, has complete control over productive activities.

Current production provides a foundation from which the country can begin to reduce its dependence on foreign petroleum. According to Moisés Starkman, National Biodiesel Coordinator, Honduras imported 5.7 million barrels (239.4 million gallons) of diesel in 2005 at a cost of $442.8 million.[12] The government program has the potential to significantly enhance the country's energy security, save millions in foreign exchange, and ultimately enhance Honduras' competitiveness. With the support of the government and backing of progressive business leaders, the project may solidify Honduras' place among the global leaders in biodiesel production.

D) PRIVATE SECTOR

Honduras is experiencing sustained growth in terms of foreign investment. The government has strengthened its judicial structure, worked hard to offer stable conditions for investment, and emphasized having highly trained professionals in different industrial sectors. The new regulations imposed by CAFTA to protect investors are attracting substantial investment as the country grows, as protection for intellectual property rights solidifies, and as working conditions improve.[13]

In October 2006, the president of the Association of Independent Banana Producers, Arturo Castillo, announced that a group of Chinese investors would finance a $30 million project over a 20-year period to produce ethanol from yucca. The investors formed an association with Honduran agricultural producers for the ambitious project, which will commence operations within two years and will require 20,000 hectares of land. According to studies conducted by the group, the investment in production and refin-

ing capacity should ultimately yield 20 million liters of ethanol.[14]

In addition, Grupo Pellas, the Nicaraguan agroindustrial conglomerate, announced that it will invest $150 million in Honduras, including the development of 31,000 hectares of sugarcane specifically for ethanol production.[15] Along with Canadian and American investors, Grupo Pellas is conducting feasibility studies for the project that they anticipate will produce more than 100 million liters of ethanol and create 10,000 jobs in the region of Olancha.[16]

E) RESEARCH & DEVELOPMENT

The limited biofuels research being done today in Honduras is all sponsored by foreign entities. International organizations are sponsoring two agricultural studies for biofuels feedstocks, one in the south with jatropha plants brought from Guatemala and the other in Olancho, but neither has reached completion. Additionally, the Honduran Foundation for Agricultural Research (FIHA) is working on a contract from a Dutch company to test jatropha planted from seeds in the central zone of the country. This project is also in the early stages, with an initial harvest due in the spring of 2007. There is currently no funding available from the federal government for biofuels research and universities have thus far not engaged.[17]

F) CONCLUSION

The government of President Zalaya appears determined to aggressively develop the biofuels sector. Comprehensive legislation has been drafted, and the government is focusing on palm oil and sugar. Exports of palm oil in 2004 reached $53.1 million and sugar $13.8 million.[18] Output is increasing and local producers appear to appreciate the opportunities presented by biofuel. Further, the current investment climate in the country is positive. Honduras is working with Brazil on ethanol technology cooperation and some limited, foreign-financed R&D is occurring domestically. Although projections of potential cultivated acreage seem optimistic in the medium term, a sustained public/private effort, with outside support, could make Honduras a regional leader in the efficient production of biofuels.

Endnotes

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Source: World Factbook

A) INTRODUCTION

Jamaica is the largest English-speaking island in the Caribbean and one of the most energy-intensive countries in the region. It relies heavily on petroleum imports and has not taken full advantage of its renewable energy capabilities. However, there has been recent activity in the biofuels sector, including partnerships with Brazil and new legislation to replace MTBE with ethanol as a gasoline additive. Jamaica's state oil company, Petrojam, is active in both international petroleum and biofuels ventures and will likely be a key player in the development of the country's renewable fuels sector.

B) GOVERNMENT POLICIES

Jamaica's 1995 Energy Plan aimed to ensure stable, sufficient supplies of energy; to diversify its energy matrix; to minimize the environmental impact of its energy sector; and to develop a regulatory framework that was beneficial to all stakeholders. Many of these objectives were achieved, but weaknesses remain in the areas of diversified sources of energy and the promotion of renewable fuels production and use.[1] New energy policies will need to focus on these issues to address the country's dependence on foreign sources of energy and the resulting financial burden.

According to the Jamaican Ministry of Industry, Technology, Energy and Commerce, some of the top priorities for Petrojam in fiscal year 2005/2006 were to bring cleaner energy and energy technology to Jamaica to support energy diversification, conservation and environmental impact policies, and to help achieve a redistribution of the nation's energy matrix to include more renewable energy sources. The government's efforts will include accelerating the Jamaica Energy Sector Policy, developing a strategy for cogeneration, and promoting the development of a domestic and export-oriented ethanol market. The government also plans to create an Energy Fund, which could potentially support biofuels development projects, and to embark upon a consumer education campaign to promote the use of renewable energy as well as conservation.[2]

The government is planning to phase out MTBE as an oxygenate additive and replace it with 10% ethanol beginning in the third quarter of 2006.[3] It also plans to introduce a biodiesel and petroleum diesel blend, beginning with 2% for the first three years and increasing to 5% over six years.[4] A green paper written about Jamaica's energy policies for 2006-2020 recommends the gradual increase of ethanol in the blend to 15% within a five-year period. It also suggests that the government promote hybrid and flex-fuel vehicles.[5] As an overarching measure, the government will establish a Center of Excellence to facilitate the development of a thriving renewable energy sector.[6]

Caribbean Basin Initiative
Under the Caribbean Basin Initiative (CBI), Jamaican exports of ethanol are permitted duty-free access to the United States up to 7% of US production, with rules-of-origin stipulations that allow for additional exports. This means that Jamaica, along with other members of the accord, would be prime destinations for external countries wishing to tap into the US ethanol import market. Brazil has been one of the countries to take advantage of this opportunity.

Relations with Brazil
In May 2005, Jamaica signed a letter of intent with the Government of Brazil for technical cooperation in sugar and ethanol production. According to the document, the two countries have committed to providing mutual support for the development of Jamaica's sugar and ethanol sector with the goal of increased production.[7] The Jamaican government is also cooperating with the Coimex Trading Co. of Brazil to produce ethanol for export to the United States (see Private Sector for more information).

C) CURRENT SITUATION

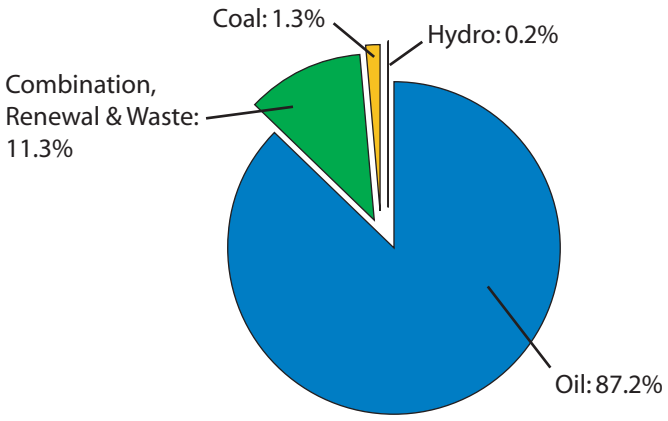
History
Jamaica first began producing ethanol from sugarcane in the 1980s, but its attempts had failed by the 1990s. Petrojam, however, continued to produce ethanol from surplus European wine alcohol in cooperation with ED&F Man, a London-based commodities distributor, until Europe launched its own biofuels programs.[8]

Tropicana, a subsidiary of the California-based firm, established Jamaica's first ethanol plant in the early 1980s. The plant constituted an investment of roughly $23 million, and it was by far the largest investment for Jamaica, or the Caribbean, under the auspices of the CBI. Within a year, the plant's output reached roughly 75 million liters, which were to be exported entirely to the US. In 1987, the Jamaican government arranged for Belize to supply sugarcane for its ethanol processing.[9]

After wine exports from Europe ceased, Jamaica turned to Brazil for the feedstock needed to produce ethanol. In 2004, Petrojam Ethanol Limited, a wholly owned subsidiary of Petrojam, arranged a corporate partnership with the Brazilian firm Coimex which resulted in the resumption of ethanol production.

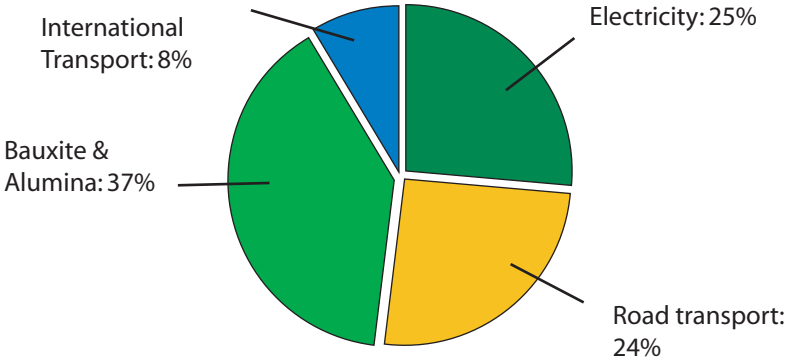
Energy Matrix
Jamaica's bauxite and aluminum sectors use large amounts of energy and make the Caribbean island one of the most energy-intensive countries in the region. Jamaica has a very limited domestic energy supply and does not use significant amounts of renewable energy, such as wind, solar, or biomass. The country is therefore heavily dependent on primary energy imports. Oil makes up an overwhelming percentage of the island's energy use [Chart 2.7a], and 37% of that oil goes to the aforementioned sectors. Transportation makes up another 24% of oil consumption [Chart 2.8b]. In 2004, the Jamaican government spent roughly $1 billion importing petroleum.[10]

Chart 2.8a: Jamaica's Energy Matrix (2003)



Source: International Energy Agency[11]

Chart 2.8b: Breakdown of Oil Consumption, 2004



Source: Green Paper, 2006-2020

An investment analysis of the Jamaican energy sector shows that more than $1.5 billon will be needed over the next six years to implement the government's overall energy strategy, including the development plan for biofuels. This total is in addition to the roughly $250 million needed to replace aging electricity plants.[12]

Production

Jamaica currently produces considerable crops of sugar and castor oil, both of which can be used for the production of biofuels. In 2004, Jamaica produced 2.1 million tons of sugarcane and sugar crop from 48,000 hectares.[13] Jamaica's castor-oil crop grows wild, so exact land use is not available.[14]

Ethanol Production

Jamaica's ethanol production rather than relying on domestic feedstock, is today exclusively focused on the dehydration of Brazilian ethanol for sale to the US market. The country processed 22 million liters in 2005, down from 25 million the year prior. There are two production facilities owned by ED&F Mann which have a combined output of 197 million liters. The third plant, under refurbishment by Coimex and Petrojam, will have a capacity of 150 million liters, to be expanded to 300 million and then 370 million liters in the short- to medium-term.[15]

Structure of the Sugar Industry

Jamaica's sugar industry, which has been in a state of decline for a long period, is cur-

rently undergoing a process of restructuring.[16] The industry depends almost entirely on protected and guaranteed markets through preferential agreements with the EU; indeed, the price received for its raw sugar is more than twice that prevailing on world markets. Not surprisingly, production costs are far from competitive on the world market or even against Jamaica's direct co-producers from other ACP (African, Caribbean and Pacific) countries. Part of the industry upgrade will include systems for cogeneration, both to power the plant and to sell any excess to the national power grid, an upgrade that should improve the sector's production efficiency.

There are seven sugar refineries of varying sizes in Jamaica. The industry's daily processing capacity is 22,400 tons [Table 2.7a]. With its current capacity, the sugar industry can process 2.1 million tons of sugarcane in almost 94 days. If 19,000 hectares are added, as has been suggested, at a yield of 60 tons of cane per hectare,[17] the total additional sugarcane crop yield would equal 1.14 million tons, a 54.3% increase over current crop outputs. This would take over 144 days to process, a very tight schedule when maintenance, vacation, and repair time is considered. Additional capacity expansion will undoubtedly be necessary, particularly if sugar is to be made a feedstock for ethanol production.

Table 2.8a: Capacity of Jamaica's Sugar Refineries

Facility	Rated Capacity (tonnes of sugar)	Rated Capacity (tonnes of cane)	Tonnes of Cane/Day
Frome	90,000	1,080,000	6,000
Monymusk	65,000	780,000	4,333
Bernard Lodge	50,000	600,000	3,333
Trelawny	30,000	360,000	2,000
St. Thomas	25,000	300,000	1,667
Appleton (private)	50,000	600,000	3,333
Worthy Park (private)	26,000	312,000	1,733
Total	336,000	4,032,000	22,400

Source: Loy and Coviello[18]

Table 2.8b: Sugarcane and Derivative-Product Production Statistics

	Unit	1999	2000	2001	2002	2003
Cane Milled	1,000 tonnes					
Total		2,313.0	2,025.0	2,231.0	1,965.5	1,775.7
Farmers		1,127.0	920.0	949.0	852.0	748.5
Estates		1,186.0	1,105.0	1,282.0	1,114.0	1,027.3
Sugar Production	1,000 tonnes					
Calendar Year		207.0	203.0	199.0	170.0	124.6
Crop Year (Dec.– April)		204.0	216.0	204.0	174.6	152.5
Acreage Reaped (Industry)	1,000 hectares	37.6	39.4	36.0	34.2	30.6
Tonnes Cane per Hectare	1,000 tonnes	60.8	51.8	52.2	57.4	58.5
Tonnes Cane per 96 Sugar		11.3	9.4	10.9	11.3	11.6
Tonnes Sugar per Hectare		5.4	5.5	5.7	5.1	5.0
Molasses Production	1,000 tonnes	86.1	76.3	85.9	79.8	68.5

Source: Loy and Coviello[19]

Biodiesel Production

Information on Jamaica's biodiesel production capacity is not readily available. As the government is planning to introduce biodiesel in the near future, it seems likely that any production would be on a small scale, possibly through a pilot program.

Competitiveness
Jamaica is comprised of 1.08 million hectares of land, of which 25,000 hectares are irrigated, 15.83% is arable, and 10% is dedicated to permanent crops.[20] The competitiveness of a Jamaican biofuels industry will depend, in part, on the restructuring of the sector, and also on the ability of the government to attract investment and participation in the sector. In addition to expanding the necessary infrastructure for production, the government must urgently address the country's dense road network, which frequently falls into disrepair during and after the rainy season.[21] An adequate road network is essential to the transport of biofuels from production facilities to ports for export as well as domestic distribution.

Level of domestic consumption
According to a report by the United Nations Economic Commission for Latin American and the Caribbean (ECLAC), gasoline consumption in Jamaica's transport sector reached an estimated 715.4 million liters (4.5 million barrels) in 2004. With an annual gasoline consumption growth rate of 4%, demand for ethanol could reach 90.6 million liters (0.57 million barrels) in 2010. Based on current industry yields of roughly 60 tons of sugar cane per hectare, the farming of an additional 19,000 hectares (more than 50% above the 2003 level of 30,600 hectares [Table 2.7b]) would be required to cover future domestic ethanol demands based on a 10% blend. This would also save the Jamaican government $20 million on MTBE imports.[22]

Exportation
In total, Jamaica exported 137.4 million liters to the United States.[23] Since the refurbishment of its ethanol processing plants, Petrojam Ethanol has exported 70 million liters of the renewable fuel to the US.[24] Information on the percentage of exports that are transshipment is not readily accessible.

D) PRIVATE SECTOR

The government has put forth a number of projects to jump start its ethanol industry. A particularly significant one is a $7.5 million joint venture between Petrojam and the Brazilian firm Coimex, which operates as the supplier and imports hydrous ethanol feedstock from Brazil. Petrojam processes the feedstock into ethanol, which is then exported duty-free to the US.[25] The joint project is slated to produce more than 151.4 million liters (40 million gallons) of ethanol annually. Another $10 million ethanol plant was commissioned in 2005 to produce fuel, using Brazilian feedstock, for export to the US. Petrojam also anticipates the 2006/2007 construction of a pilot plant for the introduction of ethanol into gasoline, with investments of just over $300,000 (J$ 20 million).

Outside of the government, the Jamaica Broilers Company has said it will begin construction on an ethanol dehydration plant in the country's central region. The company, Jamaica's leading poultry supplier, anticipates an initial capital expenditure of $17 million and hopes to be operational by May 2007. Dedini, a Brazilian ethanol technology company, will provide construction expertise and equipment for the plant, which will produce 227.1 million liters (60 million gallons) of fuel-grade ethanol per year. Jamaica Broilers also recently commissioned a cogeneration facility, which provides electricity for the company's manufacturing projects and for sale to the Jamaica Public Service Company. The anticipated revenue for the ethanol plant is $74 million (J $4.5 billion), nearly half of the company's reported revenue for 2005.[26]

The Jamaican government has decided to establish an Energy Fund as a limited liability company to function as a wholesaler for energy projects without getting directly involved in lending. The Fund will seek to raise $25 million over the next five years for energy efficiency and small-scale renewable energy projects. In addition to $300,000 (J$20 million) in local start-up financing, a $10 million loan will be acquired from the Petrocaribe Development Fund.[27] The Fund seeks to develop a market for the financing of these types of projects, including through private investment, and its operations will be outsourced to the Development Bank of Jamaica.

E) RESEARCH & DEVELOPMENT

Petrojam began a pilot project in May 2006 which researches the most suitable ethanol-gasoline blend to be used in Jamaica's transportation fleet. The project employs motor vehicles from the Petrojam Group and the Ministry of Industry, Technology, Energy and Commerce.[28]

There are also other entities which conduct research in the field of agriculture, particularly sugarcane and associated processes:

- Jamaica's Department of Science, Technology and Research, under the Ministry of Agriculture, conducts research on crops through its Agricultural Research and Development Division.
- The Sugar Industry Authority of the Sugar Industry Research Institute, a non-profit, specifically focuses on research for sugarcane and sugar processing.
- The University of the West Indies, Mona has several departments that conduct agricultural research, including its Centre for Environment and Development and its Biotechnology Centre. The university also offers a course entitled "Biotechnology of Industrial Ethanol Production."

F) CONCLUSION

The revitalization of the Jamaican sugar industry will likely go a long way towards boosting its ethanol production capabilities. The country has also developed an ideal relationship with Brazil in terms of partnership in production ventures and technology transfers. Jamaica is a good model of how to develop an ethanol industry in the Caribbean.

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Source: World Factbook[1]

A) INTRODUCTION

According to the World Economic Forum Global Competitiveness Report, Nicaragua ranked 95th out of 125 countries in economic competitiveness in 2006.[2] While the country advanced slightly from its 96th ranking in 2005, Nicaragua continues to struggle to integrate itself in the global economy. One of the Western Hemisphere's poorest countries, Nicaragua suffers from severe income inequality, underemployment, slow growth, and inflation. As a result of the recent spike in international oil prices, Nicaragua's oil import bill increased to more than twice the amount the country received in debt relief. Consequently, there is a strong impetus in the country to identify and develop alternative fuel sources to reduce its vulnerability to external oil shocks and improve the country's economic performance.

In an effort to enhance its competitive position, Nicaragua has made concerted efforts to integrate itself commercially with its Central American neighbors and capitalize on regional export markets for primary exports, including coffee and sugar.

While Nicaragua's sugar industry ranks third in the region, the country has allocated few of these resources to the production of ethanol. Rather, the industry has historically dedicated its sugar refineries and distilleries to the production of alcohol for human consumption, primarily rum and other alcoholic beverages. Initiatives for the production of fuel alcohol have not been directly integrated into industrial sugar production. Diverting productive resources away from liquor toward fuel alcohol would require adequate legislation and incentives specifically designed to foster the development of biofuels. According to estimates by UN CEPAL, the imposition of a 10% alcohol fuel blend for gasoline would require a $15 million investment.[3] At present, there is no domestic consumption, and incentives for production are few.

While limited, a foundation for both ethanol and biodiesel does exist, and the development of ethanol and biodiesel would contribute to the diversification of Nicaragua's economy, diminish vulnerability to international sugar price volatility, and potentially create a sustainable industry capable of contributing significantly to national income

over the medium to long term. However, the country requires a sound regulatory and institutional framework to attract substantial investment and sustained international support.

B) GOVERNMENT POLICIES

Despite the fact that Nicaragua utilizes ethanol for the production of liquor and alternative fuels, no legislation is currently in place to regulate ethanol. However, in July 2006, the President of Nicaragua issued Decree No 42-2006, which declared that the production of biofuels and bioenergy is in the nation's strategic interest. The decree charged the Ministry of Agriculture and Forestry with formulating a "National Biofuels and Bioenergy Plan" to promote a more positive investment climate. This plan lays out arrangements for an initial cultivation of 200,000 hectares of African palm, and commits additional land for the planting of castor, jatropha, and corn. The expansion of these crops will promote the establishment of extractive, refining, and distilling industries. The program will be designed in order to incorporate small-and-medium size producers to create alliances with processing plants and develop quality standards.[4] Further, the decree provides for the creation of a special commission comprised of the Agriculture and Forestry ministry to develop and articulate a national plan for biofuels and bioenergy.[5]

The Instituto Interamericano de Cooperación para la Agricultura (IICA) took steps to assist in the implementation of the Presidential Decree. The IICA has helped identify areas with potential for cultivating the African palm, and made contacts with investors, producers, and businessmen to discuss the plan. In addition, the IICA brought representatives of the Honduran company DINANT (which has significant biodiesel experience) to Nicaragua to interact with local officials. According to IICA estimates, there are more than two million hectares ready for the seeding of African palm. Based on 2005 consumption, substituting for all diesel imports would require 167,000 hectares.[6]

Challenges

According to an IICA report[7], Nicaragua faces three challenges with respect to the development of a competitive ethanol industry. The primary obstacle is a significant lack of political will; while the government recently released the aforementioned decree for biofuels, the state must become more actively engaged in promoting and developing the industry. Second, Nicaragua suffers from a chronic shortage of resources available for ethanol production. In order for a biofuel industry to be viable, the country would require significant investment in industrial processing plants and would need to guarantee investors the availability of primary materials and a lucrative market for their product. The third challenge enumerated by IICA is the significant bargaining power of large oil companies that strongly oppose the introduction of ethanol into commercial fuels.

While these challenges are significant, they are not insurmountable. The effort requires a clear legal and regulatory framework for biofuel investments as well as incentives to producers, investors, and relevant stakeholders. Also fundamental is active engagement by public and private entities to facilitate private investment. The IICA asserts that the conditions for biofuel success in Nicaragua include: cooperation among entities along the production chain; the creation of economies of scale; a sound strategy for marketing and sales; the formalization of markets; observance of regulations within the market; and identification and integration of commercial contacts.

Relations with Brazil

In 2005, Brazil signed an agreement with a number of Central American countries, including Nicaragua, entitled *Protocol of Intentions on Cooperation in Technical Areas for the Production and Use of Ethanol*.[8]

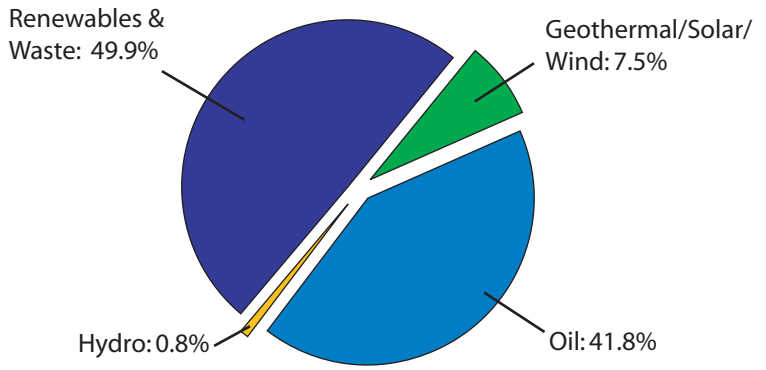
C) CURRENT SITUATION

Energy Matrix

Although nearly half of Nicaragua's energy supply is derived from renewable sources,

the country remains extremely dependent on oil imports and vulnerable to volatile oil prices. The cost of Nicaragua's oil imports has risen steadily over the last three years, from $141 million in 2002, to $196 million in 2003, and then to $236 million in 2004.[9] High oil prices helped drive inflation to 9.6% in 2005, leading to a fall in real GDP growth to 4% from more than 5% in 2004.[10] Nicaragua's vulnerability to oil prices creates a natural incentive for government and industry officials to investigate alternative sources of fuel for domestic consumption.

Chart 2.9a: Nicaragua's Energy Matrix



Source: IEA[11]

Nicaragua is the third-largest sugar producer in Central America, after Guatemala and El Salvador. The sugar industry in Nicaragua is dominated by four large processing companies, which processed a total of 4.98 million tons of sugarcane in the 2003-2004 season, producing 468,700 tons of sugar. While the country ranks third in total sugar production for Central America, data from the National Committee of Nicaraguan Sugar Producers indicates that production is actually declining.

Table 2.9a: Indicators of the Sugarcane Industry in Nicaragua

Harvest Period	Area Harvested (thousand hectares)	Crushed Cane (thousand tons)	Sugar Production (thousand tons)	Productivity (tons of cane/hectare)	(kilograms of sugar/ ton of cane)
1997-1998	52.8	3,720.2	360.4	70.4	96.9
1998-1999	52.3	3,409.7	335.1	65.1	98.3
1999-2000	54.9	3,773.8	406.8	68.7	107.8
2000-2001	52.0	3,458.2	388.4	67.1	111.5
2001-2002	40.2	3,137.7	334.0	78.0	106.5
2002-2003	41.2	3,112.2	333.4	75.5	107.1

Source: UN CEPAL[12]

From available sugar, the industry is able to produce 50 million liters of alcohol per year. In 2003, Nicaragua exported 11.2 million liters of alcohol, generating revenues of $3.75 million.[13] However, the majority of the alcohol was absorbed by the country's rum industry and not converted to ethanol fuels.

Structure of Agricultural Industry and Limits on Ethanol

Sugar production in Nicaragua is highly concentrated among four major producers, with the largest, Ingenio San Antonio, accounting for 55% of all production.[14]

Table 2.9b: Processing Capacity of Nicaraguan Sugar Refineries

Refinery	Capacity (ton/day)	Production Period 02-03 (thousand tons)
San Antonio	14,515	1,751
Monte Rosa	6,350	1,020
CASUR	3,175	215
Montelimar	2.268	116
TOTAL	26,309	3,102

Source: UN CEPAL[15]

At present, only two alcohol refineries are operational in Nicaragua and both are dedicated to the production of alcohol for alcoholic beverages.

The "Compañia Licorera de Nicaragua", founded in 1890, is the only entity in Nicaragua capable of producing and exporting ethanol. The plant has the installed capacity to produce 55 million liters a year, 20 million of which are exported and 2 million aged. The remaining 33 million liters are utilized in rum production both for domestic consumption and for export.[16]

The Pellas Group owns Compañia Licorera and Ingenio San Antonio and is the most powerful economic entity in Nicaragua. Other firms have had difficulty entering the market due to extremely high barriers to entry including significant investment costs for machinery and equipment. Given the concentration within the industry, the Pellas Group exerts a certain degree of monopoly power, although it does encounter some domestic competition from other regional producers. The industry concentration does, however, put the Pellas Group in an advantageous position to reinvest a percentage of its profits into ethanol production for biofuels. The Group has recognized this opportunity, and Compañia Licorera is currently developing a sustainable energy strategy for 2010.[17]

CAFTA and Regional Trade Initiatives

As discussed previously in this report, under CAFTA, Central American countries will continue to enjoy the tariff-free access to the US market that they currently enjoy under the expanded Caribbean Basin Initiative.

Nicaragua's ethanol exports are primarily directed to the European Union and Holland, where they incur a tariff of 10.2 euros per 100 liters under Most Favored Nation status. However, in 2002 the EU granted tariff-free/value added treatment to the countries of Central America, the Andean Community, Panama, and Pakistan to reward their efforts in fighting drug trafficking.[18] Nicaragua and other Central American countries stand to gain considerably from their preferential trade status with the Europe as the EU's demand for biofuels continues to increase.[19]

Despite the decreases in total sugar production outlined above, Nicaraguan ethanol exports have demonstrated consistent growth over the last four years, increasing in value from $2.6 million in 2000 to $6.0 million in 2003.[20]

Table 2.9c: Nicaragua: Exports of Ethanol Alcohol 2000-2003[21]

Country Exports	2000	2001	2002	2003
Sweden	n/a	n/a	1,575,964.95	2,713,318.40
Dominican Republic	n/a	n/a	n/a	2,642.744.19
El Salvador	n/a	n/a	n/a	337,600.00
Honduras	19,375.00	103,320.00	298,784.00	193,420.00
Panama	49,091.46	21,500.00	38,600.00	75,600.00
Dominica	n/a	n/a	n/a	n/a
Philippines	1,022,038.40	1,833,497.24	337,826.05	n/a
Holland	1,557,228.13	n/a	n/a	n/a
European Union	n/a	n/a	1,096,900.91	n/a
Costa Rica	12,038.40	n/a	n/a	n/a
TOTAL EXPORTS	2,659,771.89	1,958,317.24	3,680,928.42	5,962,682.59
Country Imports				
El Salvador	154,781.78	249,192.91	243,308,74	180,650.20
Guatemala	n/a	2,465.19	11,190.25	179,971.95
Honduras	6.50	n/a	n/a	12,410.00
United States	1,390.36	632.32	1624.14	405.95
China	n/a	n/a	1.67	1.85
Canada	n/a	n/a	n/a	.26
Unknown	533,434.37	n/a	n/a	n/a
Costa Rica	n/a	130.83	n/a	n/a
TOTAL IMPORTS	689,613.01	252,421.25	256,124.80	211,440.20

Source: UN CEPAL[22]

The production and export potential for ethanol is therefore considerable, but it will be driven almost entirely by global demand; at present, there is no domestic consumption and incentives for production are limited. Significant investment in equipment, technology, and resources must come from both national and international sources if ethanol production in Nicaragua is to achieve sustainable scale.

D) PRIVATE SECTOR

Upon taking office in 2002, President Enrique Bolanos placed a high priority on attracting and maintaining international investment. The current administration has made efforts to achieve $5.1 billion in debt relief, signed the CAFTA agreement, and promoted the country overseas through the investment promotion agency ProNicaragua. While Nicaragua's investment climate is steadily improving, factors such as political instability, lack of infrastructure, and corruption continue to discourage investment.[23]

Nonetheless, this year, the Pellas Group, owner of Compañia Licorera de Nicaragua and of Ingenio San Antonio, invested $4 million to launch large-scale production of ethanol. According to the firm, by the end of 2006 they should be able to produce enough ethanol to supply the domestic market with a 10-15% blend.[24] Similar investments coupled with clear and enforceable government policy could meaningfully contribute to the growth of the sector and provide some relief from high oil prices.

E) RESEARCH & DEVELOPMENT

Beginning in 1989, Nicaragua's National University of Engineering and Petronic, the state-owned oil company at that time, conducted research on substitutes for diesel derived from vegetable oil. The Austrian government provided significant financial support for this initiative, including a $1.8 million donation with the firm of Sucher &

Holzer GmbH advising the program. After promising results, a project was launched to cultivate 1,000 hectares of jatropha. In 1993, the Nicaraguan Institute of Energy and Sucher & Holzer GmbH signed an agreement to create "the basis for the industrial processing of the jatropha, obtaining biodiesel." The project was technically detailed and included an economic analysis suggesting that all preconditions for the project were favorable. However, industrial and agricultural processes were not properly integrated, weakening project performance. Despite difficulties and disappointing results in biodiesel production, significant advances were made in terms of human resources and technological know-how.[25]

Further agricultural research is being conducted to enhance agriculture knowledge with particular emphasis on entomology, varietals, plant management, harvesting technology, genetic engineering, management, and processing. Additional research is being conducted by the National Universities of Engineering in Managua and the National Autonomous University in León.[26]

E) CONCLUSION

While limited, a foundation for both ethanol and biodiesel does exist and the development of ethanol and biodiesel industries would contribute to the diversification of Nicaragua's economy, diminish vulnerability to sugar price volatility, and potentially create a sustainable industry capable of contributing significantly to national income over the medium to long term. The government has acknowledged the economic potential of biofuels and recognized that development of this sector is in the country's strategic interest. In order for the nascent industry to take root, producers will need to coalesce to create economies of scale and design viable and integrated business and market strategies for biofuels. Domestic organization will require the establishment of a sound regulatory and institutional framework to attract substantial investment, technology transfer, and sustained international support.

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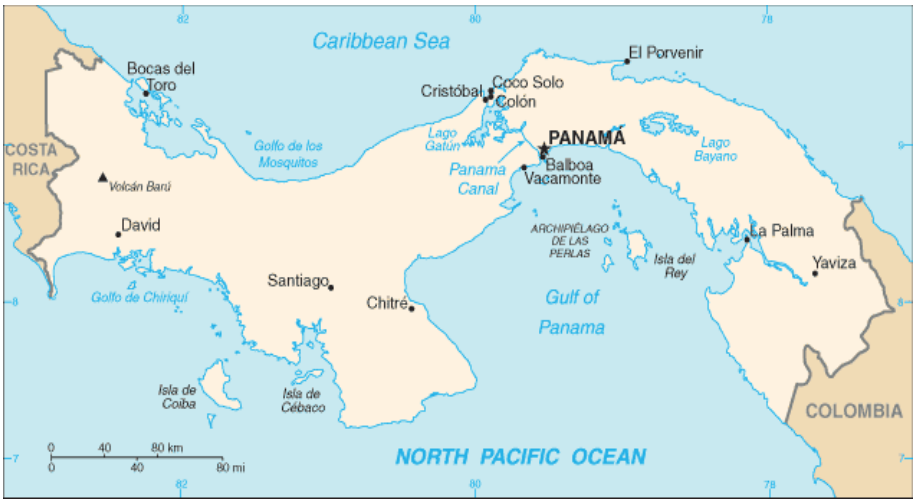


Source: World Factbook

A) INTRODUCTION

Unlike its neighbors, Panama's comparative advantage does not lie in the agricultural sector but rather in its well-developed services sector, which accounts for three-fourths of GDP. Services include operating the Panama Canal, banking, the Colon Free Zone, insurance, container ports, flagship registry, and tourism. The country's limited sugar and palm production severely restrict its ability to efficiently produce significant quantities of ethanol or biodiesel feedstock. As a consequence, the country lags significantly behind other Central American countries in biofuels development.

Before 2002, Panama had not developed, or even entertained, proposals for the development of a domestic biofuels industry. Oil prices in Panama have been among the lowest in Central America, and government officials saw little reason to enact binding biofuels legislation. However, as international oil prices have risen and world attention has turned to renewable energy, Panama has engaged in meaningful dialogue and attracted international organizations, energy companies, and investors to the country to participate in a series of biofuels conferences and workshops. While Panama's low sugar and palm production present significant barriers to the development of a domestic biofuels industry, Panama may capitalize on its strategic geographic location and become a biofuels hub for Brazil and other renewable energy exporters.

B) GOVERNMENT POLICIES

Due to an underdeveloped agroindustry and a lack of political will, Panama has not yet proposed enforceable biofuels legislation. In October 2002, draft legislation was introduced that would have prohibited the use of MTBE and required that all automotive gasoline contain at least a 10% bioethanol blend utilizing ethanol produced from renewable sources in Panama. A provision of the legislation stated that the percentage of bioethanol used in gasoline would not be treated as fuel and, as such, would not be taxed.[1] The Legislative Assembly did not consider the tax exemption feasible and, as a consequence, the project failed. While the Assembly agreed that there should be no restriction on the use of ethanol as an additive, the package was deemed too ambitious.[2]

This setback aside, the country has engaged in serious dialogue with international actors experienced in biofuels, signaling that Panama is seeking to diversify its energy balance. Panama recently hosted a series of international biofuels conferences that brought together experts in biofuels technology and carbon-market development.[3] In this context, the Ministry of Commerce and Industry has debated whether to develop a domestic industry or import ethanol for refining and re-export. Local production of ethanol would generate greater income and employment over the long term than mere ethanol dehydration, but such a course would require a significant increase in sugar-

cane cultivation for the provision of feedstock to refineries.

According to the Ministry of Commerce and Industry, Panama is currently conducting an analysis of the resources available for biofuels production and identifying the appropriate mechanisms and incentives to create consensus among various stakeholders. In addition, the government is drafting a legal and regulatory framework to guide biofuels development and attract foreign investment. Incorporated in this plan is a pilot project for the use of ethanol in gasoline.[4]

Relations with Brazil

Panama and Brazil are combining their strengths to create a center for the global distribution of biofuels. Panama is looking to Brazilian expertise for a technology transfer program that would introduce local biofuels production. More importantly, Panama's strategic location with access to the Atlantic and Pacific Oceans would be particularly valuable for Brazil's global ethanol exports. Panama could become a bioenergy hub, processing and distributing biofuels from Brazil for export to the Far East, Europe, and the west coast of the US. According to the Panamanian Minister of External Relations, Samuel Lewis, the zone is tax free in the Caribbean, and Panamanian ports process a large volume of products for redistribution, especially equipment from Brazil.[5]

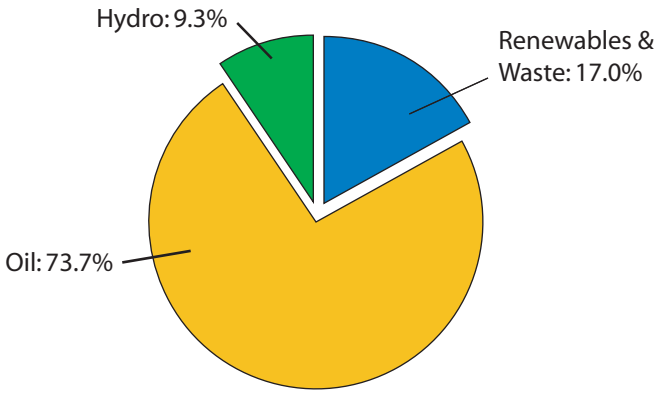
Brazilian businessmen traveling to Panama representing the construction, agroindustry, automotive, aeronautics, food, cosmetics, textiles, telecommunications, renewable energy and petroleum industries met recently with President Martín Torrijos Espino to discuss opportunities for renewable energy and other investments.[6] While Brazil is particularly interested in the establishment of a biofuels exporting zone, various other Brazilian infrastructure companies operate in Panama and have commercial interests in the expansion of the canal.

C) CURRENT SITUATION

Energy Matrix

As evidenced by the graph below, the Panamanian economy depends heavily on imported oil and has yet to significantly incorporate renewable sources into its total energy mix.

Chart 2.10a: Panama's Energy Matrix



Source: Ministry of Environment and Energy[7]

After the closing of the Colón refinery in 2003, Panama's domestic fuel market has been completely supplied by imports, which cost $492 million in 2002.[8] Fuel prices in Panama are regulated and roughly track prices along the US east coast. The sectors utilizing the greatest percentage of oil energy include electrical generation (18%), industry (27%), and transport (43%).[9] The domestic supply of primary sources of energy

has decreased to 10.6% while consumption has steadily increased.[10]

Structure of the Sugar Industry
The Panamanian sugarcane industry is the smallest in Central America. Four sugar refineries processed 2.56 million tons of cane and 153,700 tons of sugar in 2003-2004.[11] According to investigations conducted by UN CEPAL, the Panamanian agroindustry would have difficulty expanding enough to make ethanol production feasible.[12] As illustrated by the data below, Panama sugarcane producers averaged around 50 tons/ hectare from 2000-2004, the lowest yield in Central America.

Table 2.10b: Yield per hectare (tons/ha), Sugar cane and Sugar crops

	2000	2001	2002	2003	2004
Costa Rica	76.27	76.46	73.67	80.80	77.31
Dominican Republic	37.89	37.88	38.81	37.18	40.79
El Salvador	74.93	82.84	76.92	76.97	92.45
Guatemala	90.95	93.05	93.86	90.63	96.77
Honduras	84.67	99.37	55.22	71.64	40.75
Nicaragua	69.08	77.44	75.90	93.67	88.91
Panama	51.92	44.40	49.35	54.48	47.14

Source: FAO STAT[13]

The land area utilized for sugarcane has decreased steadily as has sugar production [Table 2.9c].

Table 2.10c: Indicators for Panama's Sugarcane Industry

Harvest Period	Area Harvested (thousand hectares)	Crushed Cane (thousand tons)	Sugar Production (thousand tons)	Productivity (tons of cane/hectare)	(kilograms of sugar/ ton of cane)
1998-1999	36.4	1,788.5	133.7	49.2	75
1999-2000	34.5	1,789.0	133.7	51.9	75
2000-2001	25.4	1,440.6	133.7	56.8	93
2001-2002	25.4	1440.6	113.4	56.8	79

Source: UN CEPAL[14]

Biodiesel Production
Panama's biodiesel potential is also limited given low production levels of palm and other seed oils.

Table 2.10d: Yield per hectare (tons/ ha) of Palm kernel equivalents

	2000	2001	2002	2003	2004
Costa Rica	18.50	18.60	18.30	22.63	18.62
Dominican Republic	15.30	15.30	15.35	15.35	15.34
El Salvador	0.00	0.00	0.00	0.00	0.00
Guatemala	22.76	20.29	23.88	23.60	30.37
Honduras	18.75	19.67	16.64	23.33	25.22
Nicaragua	26.50	26.50	26.50	24.32	24.35
Panama	10.36	10.17	10.09	10.17	10.12

Source: FAO STAT[15]

Some potential does exist for sugar refineries to utilize bagasse to improve their energy balance and to mechanize the harvesting process. The incorporation of new technologies and innovations could enhance the country's potential for renewable fuels, but Panama has yet to make those improvements a priority.

D) PRIVATE SECTOR

While there has been limited activity in the development of a sustainable domestic biofuels industry, foreign ethanol producers and investors see Panama primarily as an ethanol hub or a redistribution center for renewable fuel exports.

E) RESEARCH & DEVELOPMENT

Currently, the Panamanian government is conducting a number of studies to assess renewable energy potential, including hydro, wind, solar, biomass, ethanol, and biodiesel. A government-sponsored pilot project for ethanol seeks to implement a 10% ethanol blend by 2008. It is anticipated that the project will require one million tons of sugarcane, 16,800 hectares of land, a processing capacity of 24 million gallons, and an investment of US$100 million.[16] In addition, the government seeks to expand palm production, which has been concentrated in the Chiriquí province, to Colón and Darién and has undertaken a substantial public awareness campaign to promote renewable energy initiatives within the country.

F) CONCLUSION

Despite the fact that Panama does not possess the desired preconditions for either ethanol or biodiesel industries, the country has engaged in meaningful dialogue and attracted international organizations, energy companies, and investors to participate in a series of biofuels conferences and workshops. Panama's Ministry of Commerce and Industry continues to promote the economic and strategic importance of renewable energy. However, given the country's limited agricultural production and capacity, a domestic industry appears neither efficient nor sustainable. Various indicators suggest that Panama may instead capitalize on its strategic location and become a biofuels hub, providing final processing and exporting services for Brazil and other renewable energy exporters.

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[16] Ibid.

Source: World Factbook

A) INTRODUCTION

The island nation of Trinidad changed hands between the French, Dutch and British 22 times before 1803, when Britain finally retained control. Trinidad and Tobago were consolidated into a single colony in 1888, gaining full independence in 1962 and joining the British Commonwealth shortly thereafter.[1] During the colonial period, Trinidad's economy thrived on sugarcane and cocoa production; today, the two-island nation's economy rests on oil and gas. The nation's sugar industry has struggled recently, and it remains to be seen whether the country can form strong enough linkages between its energy and sugar industries to support a domestic ethanol industry.

B) GOVERNMENT POLICIES

There is currently no legislation regarding biofuels production or use, and the nation's energy policy focuses on oil and gas. There is, however, recognition of the growing interest in biofuels globally and the country's unique potential as part of the Caribbean Basin Initiative to become a processor and potentially a producer of ethanol for export to the United States. The government views biofuels as as a strategic opportunity, and it has identified the need for research to increase sugarcane production and sugar yield as well as to attract private-sector participation in sugarcane cultivation, which is dominated by the public sector.[2]

Caribbean Basin Initiative
Under the Caribbean Basin Initiative (CBI), Trinidad & Tobago's exports of ethanol are permitted duty-free access to the United States up to 7% of US production, with additional rules-of-origin stipulations that allow for additional export volumes.

Relations with Brazil

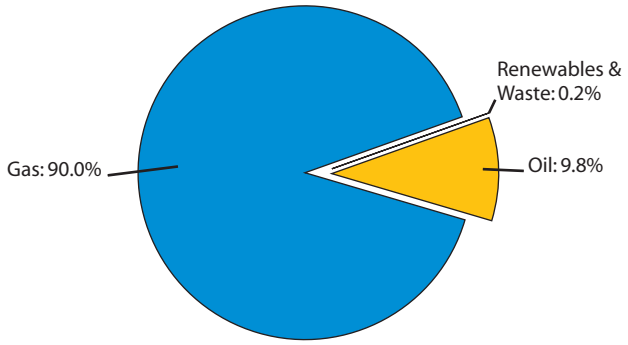
Trinidad & Tobago has not signed any formal cooperation agreements with Brazil since the late 1970s.[3] Brazil has actively engaged countries in the Latin America/Caribbean region, however, and there is no reason why collaboration between the two would not be possible. Trinidad's sole ethanol production plant currently imports sugarcane-based alcohol as feedstock from Brazil (see below).

C) CURRENT SITUATION

Energy Matrix

Trinidad & Tobago has been able to transition from being an oil-based economy to a gas-based economy, although oil production, processing, and export remain important to the nation's economy.

Chart 2.11a: Trinidad & Tobago's Energy Matrix (2003)



Source: International Energy Agency[4]

Trinidad & Tobago's most abundant natural resources are asphalt, natural gas, and petroleum. In 2004, the energy sector contributed roughly 34.1% of GDP and 37.1% of government revenues. It also constituted 85.5% of total merchandise exports. As of January 2004, the nation had 756 million barrels of proven oil reserves and 18.8 trillion cubic feet of proven gas reserves. Production for 2004 averaged 122,902 barrels per day (bbl/d) of oil and 2,934 million cubic feet per day (Mcf/d) of natural gas. Oil production for 2005 was estimated to reach 150,000 bbl/d. Natural gas production was to increase to 3.11 Bcf/d and gas sales were to be 2.99 Bcf/d in 2005 as well.[5] Trinidad is also the fifth largest liquefied natural gas (LNG) producer in the world and the second largest in the Atlantic Basin.[6]

Table 2.11a: Trinidad & Tobago Petroleum Reserves (as of January 2004)

	Proved	Probable	Possible
Crude Oil *(million barrels)*	756	358	1644
Natural Gas *(trillion cubic feet)*	18.8	8.6	5.9

Source:: Ministry of Energy & Energy Industry

Notwithstanding its large reserves, the country must import crude to maintain optimal usage of its sole refinery, located at Pointe-a-Pierre. The refinery is owned by PETROTRIN, the state-owned oil company, and has a capacity of 175,000 bbl/d[7] In 2004, oil imports constituted roughly 60% of refinery throughput, or 22.5 million barrels, the majority of which came from South America (Brazil, Colombia, and Venezuela) and West Africa. Trinidad & Tobago also imports crude from Barbados for refining under a processing agreement.[8]

The country's two main power generation companies are PowerGen and Trinity, both of which are currently trying to expand their generating capacity to meet the demands of the nation's energy-intensive industrial sector.[9]

Current Production
The two islands that comprise Trinidad & Tobago have a total area of 512,800 hectares, 4,000 of which are irrigated. There are also roughly 75,000 hectares of arable land (14.62%) as well as 47,000 hectares devoted to permanent crops (9.16%).[10] It is estimated that there are 4,000 sugarcane farmers in Trinidad & Tobago and over 16,000 hectares (40,000 acres) of private land on which sugarcane is grown.[11]

Ethanol Production
The Trinidad Bulk Traders Limited (TBTL), a subsidiary of liquor company Angostura Holdings Limited (AHL), was created to operate as an ethanol facility in Point Fortin (plans were announced in October 2004). With a capacity of nearly 190 million liters (50 million gallons) per year, the facility required a capital expenditure of $11.3 million (TT $70 million); because the company laid the proper groundwork, the plant's capacity can be doubled with modest additional investment. The plant also has a 15-year lease with PETROTRIN to use its port facility to import sugarcane-derived hydrous ethanol from Brazil as feedstock, and its pipeline infrastructure. Trinidad & Tobago does not currently produce enough alcohol to support ethanol production.[12]

Structure of the Sugar Industry
Until recently, Trinidad & Tobago's largest sugar company was Caroni (1975) Ltd. In 2002, it produced roughly 91,000 tons of sugar from more than 31,000 hectares (77,000 acres) of land. Caroni was established in the early 1970s after the state acquired the assets of the Tate & Lyle company, a major global renewable ingredients (agricultural products) company based in the UK.[13]

The government had sought to restructure the sugar industry, including Caroni, for many years. One proposal called for the closing of one sugar factory; reducing production at the Usine Ste Madeleine factory to 75,000-80,000 tons of sugar; and for Caroni to cease sugar production by 2004, allowing smaller-scale farmers to supply cane to the sugar industry, and to focus on sugar refining instead. Additionally, Caroni's land would go to the government to be managed by a new agency created in 2002, the Estate Management and Business Development Company.[14] Caroni closed in 2003 and was replaced by the state-owned Sugar Manufacturing Company Limited (SMCL), which was to engage in sugar production and refining, but which has had trouble with sugar shortages.[15]

Biodiesel Production
Information on biodiesel in Trinidad & Tobago is limited, but it is thought to be minimal. Trinidad is, however, the world's largest exporter of methane[16] a product that can be used to process biodiesel.

Biofuels Trade
According to the renewable fuels association, Trinidad and Tobago exported 37.85 million liters (10 million gallons) of ethanol to the United States in 2005, its first year of export.[17] It also imported 25,500 liters in 2005.[18]

D) PRIVATE SECTOR

In addition to the TBTL production facility, EthylChem has announced its intention to build a facility in Trinidad and Tobago with a capacity of 190-380 million liters.

As previously mentioned, there is a need for additional private sector participation in the cultivation of sugarcane, and there will likely be a similar need for the production of biofuels. The nation's Ministry of Food Production and Marine Reserves has been identified by the government as the key player in promoting greater private investment in the agricultural sector, as well as in related infrastructure, and in promoting a culture of biotechnology and science with the agricultural sector.[19]

E) RESEARCH & DEVELOPMENT

The Caribbean Agricultural Research and Development Institute (CARDI), which is

linked to CARICOM, is headquartered in Trinidad & Tobago and located on the St. Augustine campus of the University of the West Indies (UWI). CARDI engages in agricultural research and development of crops and livestock, including sugarcane, as does the UWI's Faculty of Agriculture and Natural Sciences and the Research Division of the nation's Ministry of Agriculture Land and Marine Resources. Before its dissolution, Caroni Research was also active in sugarcane research activities.

F) CONCLUSION

Trinidad & Tobago still requires the regulatory and legislative frameworks necessary to promote biofuels production and use. The country's strong petroleum sector could potentially serve as a collaborative partner for a successful ethanol industry, which could in turn rejuvenate the nation's weakened sugar industry. Additionally, the existence of large amounts of methane in Trinidad & Tobago could present an interesting opportunity for biodiesel processing.

Endnotes

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