

Final Report

GEORGIA'S MISSION TO BRAZIL

December, 2007

TABLE OF CONTENTS

RECOMMENDATION.....	3
EXECUTIVE SUMMARY.....	4
A. INTRODUCTION.....	5
B. BIOFUELS INDUSTRY DEVELOPMENT – INCENTIVES AND REGULATION.....	6
C. BIOFUELS RESEARCH.....	8
D. PRODUCTION AND TRADE IN BIOFUELS.....	12
E. DISTRIBUTION AND RETAIL INFRASTRUCTURE.....	15
F. PORT OF SANTOS – LOGISTICS – ETHANOL EXPORTS.....	18
G. THE POTENTIAL FOR COOPERATION AND OTHER ACTIONS.....	21
AUTHORS.....	24
LIST OF CONTACTS MADE DURING BRAZIL MISSION.....	25

RECOMMENDATION

Georgia should vigorously pursue cooperative efforts with Brazilian business, academic and governmental entities with regard to both (i) techniques for production of cellulosic ethanol and (ii) logistics of delivery of ethanol to consumers for use as fuel for vehicles. This emphasis on Brazil should be coordinated with the other efforts in Georgia as to ethanol, but the potential value of cooperation with Brazil in this area is so large that a separately focused effort by a dedicated action team led by the private sector and focused on cooperation with Brazilian entities is merited.

EXECUTIVE SUMMARY

This Ethanol Mission to Brazil by the delegation from Georgia succeeded in establishing in the minds of Brazilian business and academic leaders that Georgia has unique assets with regard to ethanol production and logistics. First, Georgia has existing timber feedstock from which cellulosic ethanol could likely be made in large quantities. Second, Georgia is the distribution center of the Southeast and has the Port of Savannah which can serve as a key entry point for ethanol produced abroad as in Brazil (or ultimately as an exit point for export of ethanol produced in Georgia). The quality of the mission participants cemented in the minds of Brazilian business and academic leaders that Georgia has the intellectual talent and seriousness of purpose necessary for a productive cooperative effort.

It is clear from this mission that Brazil has unique assets of its own to offer in cooperative efforts with Georgia on ethanol. Brazil has decades of experience in utilizing ethanol as a fuel for vehicles, and in those decades of experience Brazil has learned a great deal about the logistics of ethanol transport. In addition, Brazil is pursuing the production of cellulosic ethanol from bagasse (the biomass left after crushing of sugar cane) and sugar cane field residues. There appear to be aspects of the Brazilian effort with bagasse and cane residues that could provide the basis for cooperative research and exchange of information in connection with Georgia's efforts to produce cellulosic ethanol from timber product feedstock.

There are many states (and countries) vying for the chance to form cooperative efforts with Brazil on ethanol, and Brazilian resources are limited. Georgia should move promptly to identify the most productive potential cooperative ventures and to dispatch to Brazil a followup mission to pursue those possibilities.

A. INTRODUCTION

A group of researchers, business leaders, and economic developers conducted a mission to the state of Sao Paulo, Brazil on December 3 – 8, 2007. The purposes of the mission included learning of the status of ethanol production, distribution, use, and planned research and development in Brazil. The delegation participated in eight meetings with Brazilian industry and government organizations with many individual contacts made. Overall, the delegation found the Brazilians to be eager to share their experience concerning the ethanol industry and it was obvious that they expected future cooperation and trade to occur between the Brazilian ethanol companies and the United States.

The ethanol industry development in Brazil began after the energy crisis of the 1970's with government support and mandates of ethanol production and use. The cheap oil of the 1990's reduced ethanol use, and the high petroleum prices of this decade have spawned a resurgence of the industry due to the invention of the full-flex fuel car which has resulted in increased sugarcane cultivation.

The Brazilian federal and state governments provide strong policy and financial support for research in ethanol production. Major research efforts are underway to determine the best locations and methods for increasing sugarcane growth and ethanol production. Increases in ethanol production are being considered from additional areas in cultivation, higher yields of cane and from using bagasse and sugarcane field residues as cellulosic feedstocks. The Brazilian cellulosic ethanol research seems to be in its early stage. However, the possibility of research collaboration between Georgia and Brazilian institutions will likely be universally beneficial.

There are currently 359 sugar plants producing sugar and 17.6 billion liters (4.7 billion gallons) of ethanol annually in Brazil. Additional expansion of up to 89 new sugar plants is expected by 2010 and a target production level of 205 billion liters (54 billion gallons) annual production is projected by 2025. The newer plants will have more efficient boilers burning utilizing the bagasse and field residues and producing excess electricity. The new sugar plants will be arranged in clusters around newly established sugarcane production areas to allow for shipment of ethanol in newly constructed pipelines. The production of cellulosic ethanol from the bagasse and field residues in an industrial plant is likely several years away.

Most ethanol shipments are done by tanker truck in Brazil because of the limited pipeline infrastructure. However, the few existing fuel pipelines are used for both gasoline and ethanol. Several new pipeline projects are planned to move ethanol from interior locations to areas of high demand and to the ports.

All of the 35,000+ retail fuel locations are mandated to sell unblended ethanol. All gasoline is also required to be blended with a minimum of 20% ethanol. Therefore, all vehicles use at least 20% ethanol in the fuel. Fuel prices in Sao Paulo in December 2007 were the US equivalent of \$2.64/gal for ethanol and \$4.81 for the gasoline blend (E25). Ninety percent of all new vehicles sold in Brazil are full-flex vehicles, meaning that they can operate on any blend of ethanol and gasoline.

Environmental benefits realized in Brazil from the use of ethanol have included cleaner air in metropolitan areas and the reduction of hazardous waste spills.

Brazil currently exports 3.4 billion liters (880 million gallons) annually. Several companies involved in the expansion of the industry plan to increase exports substantially.

The sections below describe briefly some of the knowledge gained by the Georgia delegation concerning the Brazilian ethanol industry including: incentives and regulations, research projects, production, distribution and retail infrastructure, and the potential for trade using their ports. The final section of this report suggests future cooperative actions between Georgia and Brazil.

B. BIOFUELS INDUSTRY DEVELOPMENT - INCENTIVES AND REGULATIONS

The production of ethanol in Brazil dates back to 1931. It was used during that time sparingly as a fuel extender and only when there was a sugar surplus. Brazil's strong central government launched the ethanol program in 1975 to reduce its dependency on foreign oil, offering subsidies to sugar cane producers and forcing service stations in most towns to install ethanol pumps. In 1979 the industry introduced the first 100% ethanol car. Other incentives associated with the development of the industry included low interest loans and some tax abatement. Petrobras, the country's main oil company, established distribution centers around the country. By 1990 the military government was no longer in

power, oil prices were dropping and subsidies were eliminated. All these factors led to a decline in ethanol production and use. Unfortunately, many people bought cars in the 1980's that could only be fueled with 100% alcohol; and the reduced supply during the 1990's caused a shortage of ethanol fuel. The industry started to grow again in the current decade with the rising price of oil and the introduction, in 2003, of the full flex-fuel vehicles. These Brazilian full flex-fuel vehicles have the ability to operate using 100% gasoline, 100% ethanol or blended fuel. Presently 90% of new cars sold in Brazil are full flex-fuel vehicles. The sugar industry has also continued to invest in research since the 1970's to make ethanol production much more efficient, thus leading to more rapid growth when oil prices skyrocketed.

No government subsidies for ethanol production exist at the present time in Brazil although government funding for research and development exists and is described later in this report. The only government intervention is the mandate of the blending of at least 20-25% ethanol with all gasoline. Unblended 100% gasoline is not offered for sale. The Brazilians believe that any vehicle, including imports, can use E25 without any problem or risk to the engine. It was pointed out that imported cars may have certain specifications designed for the Brazilian market. Flex fuel vehicles have slightly lower taxation and annual registration fees than standard gasoline powered vehicles.

In addition, a mandatory biodiesel blending of 2% with petroleum diesel exists in Brazil. This mandate will increase to a 5% blend in 2013.

As the industry continues to grow for both the domestic market, as well as exports, the Brazilian government will need to invest in infrastructure such as pipelines, ports and highways; however, there was no discussion about increasing incentives to the private sector.

In comparing the USA and Brazil, one speaker summed up the situation by stating that the USA had the advantage of an army of scientists involved in research and development, while the Brazilians have an integrated ethanol system and the end users of ethanol. The price differential between 100% ethanol and blended gasoline/ethanol in Brazil was surprising and clearly the major factor in demand. While little is offered in the way of incentives today in Brazil, that was not the case 30 years ago. As the ethanol industry

begins in Georgia; low interest loans to industry, credits to end users, tax breaks on flex-fuel vehicles and continuing the matching grant program for pump installations are all tools to help grow the industry in Georgia. However, from this Brazilian mission it became clear that several myths exist in the U. S. that must be overcome at the national level before ethanol becomes a viable product.

C. BIOFUELS RESEARCH

Current Status

It is clear that there are a number of different organizations in Brazil who are participating in, or have interest in research on ethanol from sugar. Brazil's sugar-fuel strategy could not be duplicated in the U.S. because of the acreage and climate needed to produce sugar cane in massive amounts, much less the infrastructure to get it to the pump. Still, some Brazilians told us it was mainly their government's commitment to severely restricting imports and to jump-start homegrown energy industries that were the real keys to Brazil's successes. Farmers planted more sugar cane, investors built distilleries to convert the sugar to ethanol, and automakers designed cars to run on 100% alcohol. All this was a result of past public subsidies, tax breaks, government mandates, and consumer demand. A distribution network to get the fuel to gas stations was financed by the government and fuel prices controlled. Lessons learned from this process will be very useful to the U.S.

Universities are engaged in efforts to increase acreage of sugarcane planted in Brazil and have ambitious goals of increasing ethanol production to the tune of supplying 10% of the world's ethanol demand by 2025. These numbers were generated by researchers at Campinas State University (Universidade Estadual de Campinas--Unicamp) at the request of the Federal Government.

Future Research

Many of the presentations we observed focused on programs to analyze the amount of sugarcane that might be grown without expanding to environmentally sensitive lands and the type of infrastructure that is planned to support this massive growth. Alternate ways of harvesting the cane were also discussed because the environmentally damaging process

of burning the stalks prior to harvest must be stopped within a few years. At one of the largest sugarcane mills we visited, over 80% of the crop is still harvested by hand. Conversion of the bagasse (residue remaining after sucrose extraction) to ethanol was also discussed as a possibility. Mr. Jose Oliverio, with Dedini which is a major producer of equipment for the ethanol industry in Brazil, provided details about the process, hoping to sell their equipment for chemical hydrolysis in the near future. The Dedini rapid hydrolysis process was used in a pilot scale facility (100 liters/day) for a five year period during the 1990's. Dedini has plans to upgrade this to a 5000 liter/day demonstration plant and further the research on cellulosic biomass conversion. This equipment could ultimately be of use to the Georgia Tech/UGA research programs. Dedini's process design is of interest, although they are under pressure to produce the demonstration level equipment by a tight Brazilian Federal Government deadline. Some of the research organizations are also engaged in looking at other crops (beside sugarcane) as feedstocks for ethanol.

The University of Georgia has several ties to Brazil including one faculty member who has served as a scientific advisor to a FAPESP (Brazilian equivalent to National Science Foundation for the state of Sao Paulo) initiative to develop genomics resources for sugarcane. Many Brazilian researchers are presently using UGA data from sorghum, which is very closely-related to sugarcane (some genotypes can be crossed, etc).

One area of interest that would be particularly applicable to Georgia Tech would be optimization of engine control systems for use with ethanol fuel, utilizing the engine laboratories already in place on the Georgia Tech campus.

Just as an illustration, the two related but very different initiatives described above would also demonstrate the abilities of Georgia Tech and UGA to work together on bioenergy without substantially duplicating efforts. Further exploration of this type of collaboration is desired by both Universities.

Funding

The Brazilian government will invest almost US\$23 billion to expand and consolidate the National System of Science, Technology and Innovation. Half of the funding will originate from the Ministry of Science and Technology and half from the ministries of Mines and

Energy, Health, Education, Agriculture, and the National Bank of Economic and Social Development. This apparently includes increasing human resources in scientific research and improving their research and educational infrastructure. Promoting innovation in the industry sector is the second priority. Next year, federal agencies will offer approximately US\$267 million of tax-rebates and funds to companies to develop research and development. The last two priorities are to support research and innovation in strategic areas, particularly biotechnology, biofuels and biodiversity; and to foster education. This amount of research funding is impressive, and far overshadows the money being provided by U.S. DOE. One UGA researcher has been funded for the past 12 years and has current funding from Copersucar, essentially the largest sugarcane research organization in the world. It would be desirable to explore existing connections in more depth and to build upon these ties with both UGA and Georgia Tech.

In addition, state funding of research is available in Brazil. For example, the State of Sao Paulo Research Foundation (FAPESP) receives funding by the State of Sao Paulo from a state levied 2% circulation tax (sales tax). State law sets a minimum funding level of 1% of total state revenues to go to FAPESP.

Results Applicable to Georgia

Brazilian research and development in the ethanol industry has a variety of potential implications that should be considered by the U. S. The emphasis on Government participation and support is very important and perhaps underestimated by many. Specific feasibility studies of potential crops for Georgia should be a priority. For example, tropical maize could be investigated along with sorghum and other sucrose rich crops. Tropical maize produces 25% more sugar (mostly sucrose, fructose and glucose) than corn. According to the University of Illinois, tropical maize could be considered the Sugarcane of the Midwest (Fred Below, U of IL www.cropsci.uiuc.edu.) The processing of sugar cane bagasse for ethanol is also of interest and has overlap with conversion of wood and grasses to ethanol. Additional information regarding the Dedini reactor design for hydrolyzing bagasse would be useful to consider for other feedstocks. Bagasse actually has several similarities to wood in that it is also high in lignin. Lignin has a high BTU value and is used directly for energy in Brazil. This aligns very well with the planned design of a

wood-to-ethanol conversion process that utilizes waste lignin as an energy source. Beyond crops and conversion processes are logistical issues that should be studied, such as an analysis of the potential for pipelining ethanol blends.

Potential Cooperative Ventures between Georgia and Brazil Universities

Brazil boasts a number of fine Universities, many of which are tuition-free. These include the University of São Paulo (Universidade de São Paulo--USP), the Campinas State University (Universidade Estadual de Campinas--Unicamp), the Federal University of Minas Gerais (Universidade Federal de Minas Gerais--UFMG), the Federal University of Rio de Janeiro (Universidade Federal do Rio de Janeiro--UFRJ), and the University of Brasília (Universidade de Brasília--UnB). The Georgia delegation visited the University of São Paulo and briefly discussed opportunities for collaborations with this group. One of the presenters had spent some time at Georgia Tech (at the Institute of Paper Science and Technology) and is interested in further collaboration. Investigation of an exchange program of some sort was discussed with a few members of the group and appeared to be an idea worthy of further exploration. UGA has had at least 8 different study abroad programs in some form, with a major emphasis in Forestry and Natural Resources/Sustainable Systems.

Campinas State University seemed to be the recipient of significant Federal Government funding and is the site for a new Institute of Bioenergy. Collaborations involving visiting scientists, exchange of students, and training programs were discussed. However the Institute has not had the groundbreaking ceremony yet, so these opportunities are for some time in the future.

The Federal University of Rio de Janeiro is another possibility for collaborations as their researchers are investigating bagasse conversion processes for fermentation to ethanol and there are already contacts in place. The establishment of a new Brazilian Consulate in Atlanta (to be accomplished in 2008) should enhance the ability to engage in cooperative agreements.

D. PRODUCTION AND TRADE IN BIOFUELS

Current Status of Production

The 359 sugar processing plants in operation in Brazil currently process 428 MM tonnes of sugarcane annually. The amount of sugar cane processed has been increasing an average of 12% per year for the past several years. The sugar processing plants produce both sugar and ethanol with the product mix shifting in favor of ethanol to supply the growing domestic demand. Two grades of fuel ethanol are produced: hydrous (96% ethanol/4% water) is sold for Flex Fuel vehicles and anhydrous (99.5% ethanol/0.5% water) is blended with gasoline.

A typical plant produces less than 20 million gallons/year of ethanol using less than 1 million tonnes of sugar cane from approximately 30,000 acres of harvest. For comparison, a typical U. S. corn ethanol plant produces over 50 million gallons/year.

The waste fiber from the sugar mills (bagasse) is burned at each sugar mill to provide electricity and steam for the plant. Additional electricity is sold to the electrical grid. The wholesale price range of power sold to the grid was quoted by University of Sao Paulo researchers to be .12 – .15 reals per kWh (7 – 8 US cents per kWh), but this was unconfirmed.

Sugar cane production in southern Brazil averages 75 tonnes/ha (33 US tons/ac). Approximately 85 liters of ethanol can be produced from each tonne resulting in approximately 6000 liter/ha (630 gallons/ac) annual yield of ethanol, in addition to sugar. These quoted production and conversion factors do not result in Brazil's total production of 17.6 billion liters (4.7 mil gallons). This may be explained by the differences in productivity from northern to southern Brazil and by the rapid growth of the industry.

The energy-output to energy input ratio of ethanol production from sugar cane was quoted by University of Sao Paulo researchers to be approximated 8:1. This included the burning of the bagasse as an energy source.

The Central/South area of Brazil produces 85% of Brazil's sugarcane. The remainder is grown in the Northeast. Harvest season in Central/South is April to early December. Plant

production in the region is limited to approximately 200 days during this harvest time. Also, cane must be processed in the plant within two days of harvest to avoid sugar degradation. As a result, ethanol supply during the off-season must come from storage.

The Georgia delegation visited the Cosan sugar plant near Piracicaba. This plant is the third largest of 17 Cosan plants. Details of the plant include:

1. The plant has a capacity of 23,000 tonnes sugarcane/day. Cane for the plant is harvested primarily within 25 km (15 mi.) of the plant.
2. A sample of sugarcane is taken from each truck entering the plant. The sample is tested for purity and sugar yield with the results used in a payment formula.
3. Plans are to replace 9 older low pressure boilers with 2 new high pressure boilers, which will allow export of excess 40 MW electricity beginning in 2008.
4. The overall plant and systems evolved over many years and have many inefficiencies (typical of existing plants in Brazil).
5. Significant volumes of water/stillage from the plant process are returned to spray on sugar cane fields as “fertilizer”.
6. The plant produces approximately 390 MM liters (100 million gallons) of ethanol/year.

Changing Plant Design

There are 89 additional sugar/ethanol plants in the planning or construction stage in Brazil. New plants will be much more efficient. Most will make only ethanol and burn bagasse to generate power. New plants will have much higher boiler efficiencies producing higher levels of excess electricity to export to the grid. There are also future plans to convert excess bagasse and sugar cane “trash” from the fields to cellulosic ethanol. An increase in ethanol yield of 26-35% is estimated possible by adding this cellulosic ethanol conversion to the current process.

New plants planned for major export markets will be in clusters of 3 or 4 plants, each processing 15 MM tonnes/yr of sugarcane. Clusters will be located on new acreage further from developed areas and will take advantage of lower land cost, efficient logistics and new transport infrastructure (rail, barge, pipelines, port improvements).

Brazil Ethanol Industry – Future possibilities

A national sugar cane strategy has been developed by researchers at NIPE at the University of Campinas in Sao Paulo state. A cross section of industrial and academic institutions interviewed during the mission supported and relied on the facts outlined by NIPE. The cane industry historically has produced sugar as the primary product with ethanol a secondary product. While incentives and mandates were in place since the 1970's to produce demand and provide distribution infrastructure, no current incentives are offered for ethanol production.

Strategic Objective of Brazil's Ethanol Production Industries

The strategy in Brazil is to build an industry capable of producing 205 billion liters (54 billion gallons) by 2025. This is equal to their current forecast of world demand. Tactics to accomplish this include expanding production, increasing efficiencies of production, improving logistics of ethanol shipment, and developing an export market. Specifically, they plan to use the following tactics:

1. Develop ethanol as a primary product, sugar as a secondary product and electricity as a tertiary product.
2. Large scale increases in acres of planted cane and building of new production facilities to deliver targeted volumes.
3. Improve productivity and yield of all three value added products by capital investments in automated harvesting, high pressure efficient utility boilers and possible conversion of excess bagasse and field waste cellulose to ethanol
4. Build pipelines linking major production regions to major cities and ports and bulk ships for export. Develop global markets in Europe and Asia and compete in the US market where possible
5. Hold ethanol wholesale price at current levels of R\$0.80 per liter (\$1.71/gallon)

Probability of Success and Barriers to Implementation

Although some barriers exist, the advantages available to Brazil's sugar/ethanol industry will likely lead to progress toward their goals. Issues related to the likely success include:

1. The industry is fragmented and production and land is owned by over 200 family companies. Many are undercapitalized and inefficient and have a history of rejecting outside partners. This will slow scale up and efficiency gains.
2. Availability of enough suitable land to meet the forecast production.
3. Logistics is a major hurdle with an inefficient road and port system. This will require significant capital infrastructure investments. It would appear that they are willing to invest and active investments both public and private sectors are under way.
4. Ethanol from sugar cane is the current low cost production route.
5. Even a 50% success rate will deliver an industry on par with that forecast in the US with a RFS of 35 Billion Gallons/year, with a significant production cost advantage and diversified income streams from three commodities in ethanol, sugar and power.

E. DISTRIBUTION AND RETAIL INFRASTRUCTURE

Distribution

Ethanol is distributed using a variety of means in Brazil. A limited pipeline network is used to transport both petroleum products and ethanol. Rail and barges are also employed. However, ethanol is transported primarily by tanker trucks. The growing market for fuel ethanol has created bottlenecks in the delivery process due to traffic congestion on the underdeveloped highway system. New pipelines are planned that will allow ethanol to be shipped from production terminals (central to production areas) to the ports.

The seasonal nature of the growth of sugarcane and production of ethanol makes fuel storage important. The Brazil ethanol infrastructure can store six months of ethanol production.

Petrobras, the largest petroleum company in Brazil, is building a pipeline system called the Ethanol Export Corridor. Several presentations included this network, which will have a capacity of over 1 billion gallons per year. Together with the many ethanol production plants under construction and planned, Brazil's commitment to be a major exporter will likely be realized.

Retail

Quality control of the retail fuels in Brazil is left up to the operator. Solvents and other contaminants are sometimes added to fuels and a buyer-beware attitude sends many consumers to the branded retail fueling locations. The retail prices observed during the delegation's visit varied widely. In Sao Paulo, ethanol was sold at a midrange equivalent of \$2.64/gallon. The lowest price for gasoline blend was \$4.81/gallon. In Rio, ethanol sold for \$3.63/gallon with the gasoline blend at \$5.67/gallon. The extent of the government's control of pricing and the taxes on fuel are subjects for further investigation.

Brazil has about 35,000 fuel outlets all of which are required to have an ethanol (E-93) dispenser. The popularity of full-flex vehicles in Brazil has given consumers a variety of choices at the pump. The industry has responded in some of the newer facilities we visited by installing blender dispensers which allow any combination of ethanol and gasoline to be dispensed (the gasoline already has a minimum of 20% ethanol pre-blended). The E-85 infrastructure growth in the southern U.S. is reminiscent of the introduction of unleaded gasoline in the late 1970s. In the beginning, unleaded pumps were a novelty while the production of cars using the new fuel was ramping up. The concern now is the ability of the free market and the public's resolve to make the change toward ethanol blends, instead of imposed mandates accomplishing the change.

The current strength of the Brazilian ethanol market is a result of the introduction of the flex-fuel vehicle in 2003, which can utilize fuel as it is currently available. During the 1990's it became evident that the up and down movement of sugar and ethanol markets would discourage the use of the 100% ethanol-only vehicle and ultimately the use of ethanol. Full flex-fuel vehicles can operate on any range of fuel from 100% ethanol to 100% gasoline or any blend of these two fuels. The delegation visited a Toyota dealership and examined a full flex Toyota Corolla. It was also observed that many of the taxis operated as full flex plus another fuel option of natural gas.

Environmental Impacts of Ethanol

The cleaner emissions associated with using ethanol and the fact that ethanol is biodegradable were two important aspects of ethanol use at the retail level that were

learned during the mission. Before the use of ethanol became common, Sao Paulo had a problem with air quality. There is still visible evidence of smog, but it is apparently much better than in years past. Mr. Walfredo Linhares with Brenco stated that this was an obvious result of the increased ethanol use there. He plans to provide additional documentation on this ethanol benefit. In addition, several speakers mentioned that the biodegradable aspect of ethanol greatly reduces the cleanup problems after accidental spillage. One speaker even suggested that ethanol is used as a mitigating material in hazard material cleanup.

Ethanol Myths

One of the great benefits of our visit was seeing and hearing the truth about some perceived impediments to the utilization of alternative fuels.

“It ain't what you don't know that gets you into trouble. It's what you know for sure that just ain't so.” Mark Twain

Some comparisons of the industry in Brazil with what have been some common perceptions in the U.S. are listed below:

1. USA: Conventional cars will only run on E-10; Brazil: Conventional cars will run on E-25
2. USA: Ethanol cannot be sent in our pipelines; Brazil: Ethanol shares the pipeline with petroleum.
3. USA: Ethanol dispensers are not UL listed; Brazil: Ethanol dispensers are advertised as UL listed
4. USA: Rainforest is cleared for cane production; Brazil: Sugar cane will not grow effectively in those areas

It was obvious in our discussions that Brazilian companies recognize Georgia's strategic location to serve as the supply point for the Southeast. Our excellent corridors to the ports and the grid of four lane highways are efficient for both production-to-market intrastate and import-to-market interstate. At a 10% blend in gasoline, our ethanol market would be 500 million gallons per year in Georgia. With our 5 contiguous states included, the combined market is 23% of the total gasoline sold in the U.S., and could create a 2.5 billion gallon annual ethanol market for blends.

The potential for E-85 is even greater. Georgia and its 5 border states have over 38,000 gasoline outlets with only 81 offering E-85.

Listed below are some potential actions that could be pursued in Georgia relative to what was learned about the ethanol distribution and retail infrastructure in Brazil:

1. Continue discussions with companies representing all potential export business models. Further discussions with ethanol producer group on possible direct mill to domestic distributor partnerships.
2. Encourage the GA Department of Agriculture to expedite the relaxation of gasoline blend standards.
3. Promote state and federal E-85 infrastructure grant programs in Georgia and educate retailers and distributors regarding existing tax incentives on biofuel equipment installation.
4. Compare The Energy Independence and Security Act of 2007 to Georgia's strategy.
5. Plan a follow-up trip to Brazil to discuss partnerships and investigate the industry further.

F. PORT OF SANTOS – LOGISTICS – ETHANOL EXPORTS

Port of Santos

Sixty-five (65) percent of the ethanol exported by Brazil is moved through the port of Santos. Most of the ethanol exported is received via truck (See bellow more information). The ethanol received via pipeline is transported in the same pipeline used for gasoline.

The Port of Santos is located at the middle of the coastline of the State of São Paulo at latitude 23°53' S – longitude: 046°19' W. It was built along the banks of an estuary, lbordered by the islands of São Vicente and Santo Amara; and also by the continent itself,

where the cities of Santos, São Vicente, Guarujá and Cubatão are located. It is only 65 Km (40 milies) away from São Paulo, the largest Brazilian city.

The port of Santos is the largest port in South America. The hinterland of the Port includes the States of São Paulo, Goiás, Mato Grosso do Sul and part of the States of Minas Gerais, Rio de Janeiro, Paraná and Mato Grosso.

The Port Authority is exerted By CODESP (**CO**mpanhia **D**ocas do **E**stado de **S**ão **P**aulo), a mixed economy company controlled by the Federal Government. The port of Santos has: a specialized terminal for handling containers and general cargo (break-bulk), facilities for dry and liquid bulk cargoes, and handles passenger vessels at passenger terminals.

The Port of Santos port performance includes the following:

1. Year 2006: 76 millions tons (42.1 percent break bulk & containers; 38.9 percent dry bulk and 19 percent liquid bulk).
2. Year 2007: 82 millions tons (Estimated)
3. Year 2006 passenger vessels: 500,000 passengers
4. Year 2007 passenger vessels: 550,000 passengers
5. The port of Santos moves annually more than 25 percent of value of goods negotiated by Brazil in international markets.

Overall Characteristics of the port include:

1. Port Area: 770 hectares (Right Margin: 370 hectares and Left Margin: 400 hectares)
2. Number of Berths: 64 (CODESP: 55 - Private Terminals: 9)
3. Berths extension: 13,000 meters (CODESP: 10,900 meters, Private Terminals: 1,670 meters and Brazilian Navy: 430 meters).
4. Warehousing: 480,000 cubic meters (including silos)
5. Yards: 112 hectares.
6. Tanks: 545,00 cubic meters (255 tanks)
7. Ducts: 55,000 meters

8. Draft: 14 meters.
9. Access to the port: Highway (BR 101, SP 55 and Ecovias), Railway: 5 corridors operated by: M.R.S. Logistica (1), FCA (2) and ALL (3), Waterway: Tiete-Parana Rivers System, Pipes
10. Equipment: Electric cranes, portainers, transtainers, reach stackers, ship loaders, sucker pumping.
11. Port operation: 24 hours a day, 7 days a week.

Logistic and Infrastructure Support for Ethanol Exports

Brazil produced approximately 17.6 billion liters (4.6 billion gallons) of ethanol and exported approximately 3.4 billion liters (880 million gallons) during 2006. The ethanol is moved internally as per the following detail:

Transportation Method	1980	2006
Truck	32 %	90 %
Rail	33 %	7 %
Barge	22 %	1 %
Pipe	13 %	2 %

Source: UNICAMP

Note the great decline of the use of the rail, barge and pipe to move the ethanol from the production place (mills) and storage centers to the ports. Brazil's infrastructure is perhaps the major problem facing the ethanol industry. Lack of investment and deterioration of the existing infrastructure produced the current situation. These circumstances generate high domestic logistics costs, delays and limit their ability to increase exports. However, Petrobras (State Oil company) is planning to build two new pipelines: one to the port of Santos and the other one to the port of São Sebastiao. The port of São Sebastiao, is located in the northern part of the State of São Paulo.

Ethanol Exports by Loading Port:

Port	Percentage (%)
Santos	65
Paranagua	14
Suape	14
Others (Rio de Janeiro, Maceio, etc.)	7

Source: UNICAMP

Export Destinations

From a total of 3.4 billion liters (880 million gallons) of ethanol exported, 1.8 billion liters (460 million gallons) were exported to the United States (51.58 percent of the total exported). US is by far the first destination of the Brazilian ethanol. The second export destination is Holland with 346 million liters (90 million gallons) and the third one is Japan with 225 million liters (59 million gallons). (Source: Ministry of Agriculture).

Port of Savannah

There are two companies with capability to handle ethanol imports from Brazil: Vopak Terminals Savannah, Inc. and Colonial Oil Industries Inc.

G. THE POTENTIAL FOR FUTURE COOPERATION AND OTHER ACTIONS

Sustained cooperation is driven by mutual advantage, and the fundamentals for that kind of sustained cooperation between entities in Georgia and in Brazil on ethanol already exist. The key task now is to organize and focus the effort.

Academic and business leaders in Brazil were very receptive to the idea of collaboration with equivalent entities in Georgia. It is clear, however, that their own resources for collaboration are finite. It is also clear they are receiving visits from many other states and institutions. We do not face a reluctance in Brazil to collaborate on ethanol, but given limited resources we need to focus on the strengths each group brings to sustained cooperation.

As to Georgia, we should emphasize Georgia's assets such as:

- Our readily available feedstock from forests and timberland in Georgia;
- Our worldclass research and scientific talent in ethanol production from timber products as one aspect of cellulosic ethanol production; and
- Our critical position at the center of the Southeast's distribution network, including the Port of Savannah as an entry port for import of Brazilian ethanol and ultimately as an exit port for exports of Georgia ethanol, and in particular we should investigate the possibility of investment or other financial support by Brazilian entities in the Port of Savannah.

As to Brazil, we should recognize Brazil's assets such as:

- Real world experience for decades in production, distribution and use of ethanol in vehicles;
- Capacity to export ethanol to the Southeast to enhance development of a consumer market and related logistics while Georgia builds its capacity to produce ethanol; and
- Worldclass research and scientific talent in ethanol production from bagasse as one aspect of cellulosic ethanol production.

Given these strengths, there are two key areas where collaboration may be most productive.

Production of Cellulosic Ethanol.

We should fashion ways to collaborate on development of commercially feasible production of large quantities of ethanol from feedstock such as timber products. This would be driven primarily by the research and scientific communities. Many examples of potential collaboration are suggested in this report.

Development of Distribution System for Ethanol use in Vehicles

We should also fashion ways to collaborate on development of a market driven distribution system for use of various levels of ethanol in fuel for vehicles in Georgia, and through Georgia to the Southeast. Initially significant quantities of ethanol could be imported into the Port of Savannah. We would need to analyze the distribution all the way to the vehicles themselves so that consumer use of the blended ethanol/gasoline fuel would be the economic force that drives the system

. Additional Opportunities for Georgia

There are many specific opportunities for Georgia private companies and other organizations. Most the the following opportunities are described previously in this report.

- Pipeline infrastructure construction for US companies in Brazil and in the US
- US bagasse research
- Brazilian ethanol exports to US markets
- Building the market for ethanol fuel in the US, and especially Southeast
- Working with auto federations/organizations to explore how the auto industry can become more involved in producing ethanol-ready engines
- Establishing MOU's between US and Brazilian universities on research and cooperation
- Developing synergies between GA Ports and Brazilian ports
- Investigating the potential for infrastructure opportunities where Brazilian companies can invest in Ga Ports
- Georgia firms utilizing Brazilian vendors to construct and/or supply equipment to ethanol production facilities in Georgia

Persons and firms interested in developing the opportunities described in this report and in pursuing business ventures related to biofuels in Georgia should contact:

Gretchen Corbin
Division Director, International Operations
Georgia Dept. of Economic Development
75 Fifth St., NW, Suite 1200
Atlanta, GA 30308
Tel: 1-678-640-4373
Fax: 1-404-962-4021
gcorbin@georgia.org

Deborah Lohnes
Renewable Fuels Project Manager
Georgia Dept. of Economic Development
75 Fifth St., NW, Suite 1200
Atlanta, GA 30308
Tel: 1-404-962-4038
Fax: 1-404-962-4023
dlohn@georgia.org

LIST OF AUTHORS

1. William Boone, Director, Georgia Ag Innovation Center, bboone@uga.edu
2. William Bulpitt, Sr. Research Engineer, Georgia Tech, bill.bulpitt@energy.gatech.edu
3. Ariel Canzani, Georgia Ports Authority, baires@gaports.com
4. Gretchen Corbin, Georgia Dept. of Economic Development, gcorbin@georgia.org
5. Davis Cosey, Davis Oil Company, dcosey@mac.com
6. Jorge Fernandez, Metro Atlanta Chamber of Commerce, jfernandez@macoc.com
7. Ross Harding, Herty Advanced Materials Development, rharding@herty.com
8. Deborah Lohnes, Georgia Dept. of Economic Development, dlohnes@georgia.org
9. Nathan McClure, Georgia Forestry Commission, nmclure@gfc.state.ga.us
10. Laura Meadows, University of Georgia, lmeadows@uga.edu
11. Tim Perry, Miller & Martin PLLC, tperry@millermartin.com
12. Joy Peterson, University of Georgia, jpeterso@uga.edu
13. Roger Reisert, C2 Biofuels, rreisert@c2biofuels.com
14. Donnie Smith, Agriculture Liaison to the Governor, dsmith@gov.state.ga.us

LIST OF CONTACTS MADE DURING BRAZIL MISSION

Contact Name
Title
Organization
Mailing address
Telephone number
Email Address

US Consulate, Sao Paulo

Danny DeVito
Minister Counselor for Commercial Affairs
US Department of Commerce
Rua Henry Dunant, 700 04709-110 SP
55 11 5186 7172
danny.devito@mail.doc.gov

Sao Paulo State Government

Aline Barabinot
Coordinator for Intl Relations
São Paulo State Government
Rua Bela Cintra, 847 7º floor 01415-903 SP
55 11 3218 5769
abarabinot@sp.gov.br

Sérgio Robles
Coordinator for Investment Promotion and Innovation
São Paulo State Government
Rua Bela Cintra, 847 7º floor 01415-903 SP
55 11 3218 5730
squeiroz@sp.gov.br

Sao Paulo Federation of Industries (FIESP)

Roberto Giannetti
Director
FIESP
Av. Paulista, 1313 - 4o andar 01311-923 SP
55 11 3549 4571
rgiannetti@e-silex.com.br

Thomaz Zanotto
Director FIESP
Av. Paulista, 1313 - 4o andar 01311-923 SP
55 11 3549 4571

Rubens Barbosa
Former Embassador
FIESP
Av. Paulista, 1313 - 4o andar 01311-923 SP
55 11 3549 4571

Federation of Sugar Growers (UNICA)

Alfred Szwarc
Advisor to the President
ÚNICA
Av. Brig. Faria Lima, 2179 9º floor 01452-000 SP
55 11 3093 4949
alfred@unica.com.br

University of Campinas

Mirna Ivonne Scandiffio
MSc.PhD
NIPE - UNICAMP - Energy Group - Ethanol Project
Cidade Universitária Zeferino Vaz PO Box 1170 13084-971 Campinas SP
55 19 3512-1120
mscandiffio@energiabr.org.br

Carlos Rossell
MSc. PhD
NIPE – UNICAMP – Energy Group Ethanol Project
Cidade Universitária Zeferino Vaz PO Box 1170 13084-971 Campinas SP
5 19 3512-1120
crossell@energiabr.org.br

University of Sao Paulo- Piracicaba

Weber Amaral
Professor, PhD
ESALQ - Brazilian Center for Biofuels
Av. Pádua Dias, 11 CP 9 13418-900 Piracicaba SP

55 19 3429 4224
wamaral@esalq.usp.br

Angela Peres
ESALQ – USP
Av. Pádua Dias, 11 CP 9 13418-900 Piracicaba SP
55 19 3429 4419
arpperes@esalq.usp.br

João Martines
Professor, PhD
ESALQ – USP
Av. Pádua Dias, 11 CP 9 13418-900 Piracicaba SP
55 19 3429 4419
arpperes@esalq.usp.br

Francides Gomes
Professor, PhD
ESALQ - USP
Av. Pádua Dias, 11 CP 9 13418-900 Piracicaba SP
55 19 3429 4419
arpperes@esalq.usp.br

Port of Santos

Fabio Oliari
Marketing and Business Dev. Manager
Santos Port Authority
Av. Cons. Rodrigues Alves s/n 11015-900 Santos SP
55 13 3221 1773
foliari@portodesantos.com.br

Wagner Gonçalves
Marketing and Business Dev. Manager
Santos Port Authority
Av. Cons. Rodrigues Alves s/n 11015-900 Santos SP
55 13 3235 1698
wagnergolcalves@portodesantos.com.br

Paulo Pantojo
Marketing and Business Dev. Manager
Santos Port Authority
Av. Cons. Rodrigues Alves s/n 11015-900 Santos SP
55 13 3221 1773
pantojo@portodesantos.com.br

Ronaldo Forte
Institutional Director
Santos Brasil
Av. Senador Feijó, 14 5º floor 11015-500 Santos SP
55 13 3211 5510
institucional@santosbrasil.com.br

Private Industry

Sao Paulo

Luiz Ernesto Migliora
Director Special Projects
CSN
Av. Brig. Faria Lima, 3400 20º floor 04538-132 SP
55 11 3049 7585
migliora@csn.com.br

Paulo Roberto Gozzi
Legal Manager
CSN
Av. Brig. Faria Lima, 3400 20º floor 04538-132 SP
55 11 3049 7586
pgozzi@csn.com.br

Arno Schwartz
Financial Operations
CSN
Av. Brig. Faria Lima, 3400 20º floor 04538-132 SP
55 11 3049 7170
arno.schwartz@csn.com.br

Dante Venturini
Supervisor
Camargo Corrêa
Rua Funchal, 160 10º floor 04551-903 SP
55 11 3841 3965
dante.venturini@camargocorrea.com.br

Henro Philippe Reichstul
BRESCO
Av Brig. Faria Lima, 1309 4º floor 01452-002 SP
55 11 3095 2250
phreich@attglobal.net

D'Arcy Carroll
BRESCO

Av Brig. Faria Lima, 1309 4^o floor 01452-002 SP
55 11 3095 2250
darcy.carroll@brenco.com.br

Luciano Guidolin
Chief Financial and Planning Officer
ETH Bioenergy Inc
Av. das Nações Unidas, 4777 11 ^ofloor 05477-000 SP
55 11 3025 8595
lguidolin@odebrecht.com

Francisco Nuno Neves
Logistics
ETH Bioenergy Inc
Av. das Nações Unidas, 4777 11 ^ofloor 05477-000 SP
55 11 3025 8738
fnunoneves@odebrecht.com

Eduardo Carvalho
Director ETH Bioenergy Inc
Av. das Nações Unidas, 4777 11 ^ofloor 05477-000 SP
55 11 3025 8586
epcarvalho@odebrecht.com

David Peebles ETH Bioenergy Inc
201 Alhambra Circle, Suite 1400 Coral Gables FL 33134 USA
1 305 341 8805
dpeebles@odebrecht.com

Regina Ribeiro do Valle
Partner
TozziniFreire Advogados
Rua Borges Lagoa, 1328 04038-904 SP
55 11 5086 5221
rvalle@tozzinifreire.com.br

Moira Virginia Huggard-Caine
Partner
TozziniFreire Advogados
Rua Borges Lagoa, 1328 04038-904 SP
55 11 5086 5259
mhuggardcaine@tozzinifreire.com.br

Pedro Luis Seraphim
Partner
TozziniFreire Advogados
Rua Borges Lagoa, 1328 04038-904 SP
55 11 5086 5396

pseraphim@tozzinifreire.com.br

Santos

Roberta Forte
President
FortePar
Rua XV de Novembro 201-42 Santos SP
55 13 3219 2789
fortepar@uol.com.br

Nelson Zorovich
Owner
Zorovich Engenharia
Rua Dr. Carvalho de Mendonça, 224 Cj 42 11070-101 Santos SP
55 13 3233 2001
nelson.zorovich@zorovich.com.br

Piracicaba

Guiomar Pardi
Communication
COSAN - Costa Pinto Unit
Bairro Costa Pinto s/n 13411-900 Piracicaba SP
55 19 3403 2957
guiomar.pardi@cosan.com.br

Rodrigo Santos
Marketing
DEDINI Industrias de Base
Rod. Rio Claro-Piracicaba Km 26,3 13414-970 Piracicaba SP
55 19 3403 3093
odrigo.santos@dedini.com.br

Losé Luiz Olivério
Senior Technology and Dev. Vice President
DEDINI Industrias de Base
Rod. Rio Claro-Piracicaba Km 26,3 13414-970 Piracicaba SP
55 19 3403 3006
jose.oliverio@dedini.com.br

Brasilia (met in Sao Paulo)

Ércio Lima Energy
Dev. Manager
Eletronorte
SCN-Quadra 06 Cj A Bl B, S-812 Ed Venancio 300 70718-900 Brasilia D5F5
61 3429 6275
ercio@eln.gov.br