

FUTURE INTERNATIONAL TRADE ISSUES: IS BRAZIL THE SOLUTION TO WORLD ENERGY SHORTAGES THROUGH ETHANOL TRADE?

JOE A. FLORES*

This article is based on the international push for finding alternatives to energy based on oil production and the urgent need that has been underlined by President Bush to do so within the next generation. Brazil has been a model of a successful transformation, which can occur in less than 30 years with the combined effort of consumers, businesses and government intercession, into a self-sufficient energy producing nation. The purpose of this article is to explore the use of Ethanol and inform the reader of Brazil's pivotal role in aiding to ease the world's dependency on oil by facilitating trade of Ethanol. This article will not only compare and contrast Brazil's and the United States' initiatives to solve the environmental and energy problems that are clear and present, but will also explore international trade initiatives throughout the world that use ethanol to feed the world's ever-increasing need for fuel.

The fact that the United States leads the world in energy demands comes as no surprise to economists, international traders and most people in the world. Statistically speaking oil prices increased over 40% at the end of 2005 and continue to grow. The price of oil rose and remained constant throughout the latter part of 2007 and 2008 at or near \$100.00 per barrel and now has exceeded well over \$100.00 per barrel.

Joe A. Flores is an attorney with offices in Corpus Christi and Houston, Texas. He received his Juris Doctorate from South Texas College of Law and is currently studying for his Practice Doctorate in Nursing. He also serves as a consultant for Latin American Businesses in Texas.

America spends nearly half a billion dollars per day, which translates to about \$500.00 per person, to meet the current oil demand and this number is growing. Over 95% of our transportation system relies on oil, which constitutes only two-thirds of what the United States requires. Regardless of fluctuations in prices the U.S. Department of Energy estimates that the price of oil will remain at least between \$50 and \$100.00 per barrel over the next generation¹.

One of the factors for the increase in demand has been surges created by growing economies such as China and India. China is the second largest oil importer, and according to the U.S. Department of Energy the demand will nearly double in less than 20 years. These statistical facts illustrate how vulnerable emerging economies in India, China and the western industrialized countries are to shocks in the oil industry. The reality is that most of the oil supply is either in politically unstable areas or areas

that do not have the friendliest relations with the United States. Point of fact, President Bush has verbalized the need for America to become less dependent on foreign oil by using alternative fuels within the next 20 years. His visit to Brazil in 2007 underlined the fact that the United States recognizes that self-sufficiency through exploration of ethanol is a viable fuel alternative in a world where oil has become more expensive to extract, produce and export in unstable parts of the world.

President Bush's words sent a message loud and clear to the energy sector to begin implementing the exploration and procurement of alternative fuels. In fact, corn producers in this country have been critical of the use of corn to create ethanol similarly to the production of sugarcane to create ethanol in Brazil. The comparison/contrast between the two sources of ethanol strongly suggests that ethanol is superior in fuel efficiency and production.

Brazilian ethanol production is a story of one country's jump start into Ethanol over the last generation and how it has made corrections and innovations to have both oil and ethanol strike a balance in an emerging and progressive country that is rapidly taking its place on the world stage for solving the energy crisis. The article will also address

energy crisis. The article will also address the trade issues that the United States faces with Brazil. This article will also examine the initiatives that are already in place in the Caribbean as well as the United States' own ethanol production efforts.

I. ETHANOL: A BRIEF OVERVIEW

Long ago ethanol was known as an intoxicating drink. Traditionally in the United States, ethanol is produced mainly by the fermentation of corn. It is the same alcohol used in beverage alcohol but, in this case, meeting fuel grade standards.² Ethanol that is to be used as a fuel is denatured by adding a small amount of gasoline to it. This makes it unfit for drinking.³

Ethanol was popular in the United States in the 1800's as a source for lamp fuel and over 25 million gallons were being produced until the oil industry demanded a tax on ethanol during the Civil War.⁴ The tax was so severe that it essentially hobbled ethanol growth until the turn of the century when the tax was lifted in 1906. Large scale use of petroleum occurred in Europe during petroleum shortages.⁵ Interestingly, Henry Ford's Model T and other cars from the twenties were designed to run on alcohol based fuels. In World War II Hitler and the United States relied on ethanol to power their armies.⁶

After World War II ethanol was replaced for the most part with oil due to a price decrease in oil. It was not until the 1970's with the Organization of Petroleum Exporting Countries (OPEC) oil crisis that ethanol regained popularity.⁷ Thus it is clear that as oil prices increase, consumers worldwide become more open to the use of ethanol. The

OPEC crisis called attention to the fact that the United States was extremely dependent on foreign oil. The focus shifted once again to alternative fuels such as ethanol. At that time gasoline containing ethanol was called gasohol. Later, when gasoline became more widely available, the names used for gasoline also changed to reflect the increasing use of octane. For example, today we use names such as unleaded plus or super unleaded.⁸

Ethanol is being favored today because when used as a gasoline component it improves combustion and reduces carbon monoxide emissions.⁹ With global warming issues in the forefront, the benefits of the use of ethanol are spe-

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cially felt in those areas of the United States that are considered "to exceed Environmental Protection Agency air quality standards during the winter months."¹⁰ Some studies have confirmed that ethanol can also reduce emissions which contribute to the formation of smog.¹¹

Ethanol supporters have also touted other advantages of using ethanol such as the ability to provide octane in place of other environmentally harmful components in gasoline.¹² Ethanol cannot only slow global warming, as some studies suggest, but can also reduce imports by replacing imported gasoline and crude oil.¹³ This is a goal that is seen by the American people as a high priority, as shown by a recent poll conducted by Research Strategy Management, where 75%

of American voters believe the country needs to do something to reduce its dependence on foreign oil.¹⁴

II. BRAZIL'S ETHANOL INITIATIVES

As we have seen, the energy crisis of the 1970s increased the price of gas just as we are seeing it happen today and generated an interest in renewable fuels and independency from foreign oil.¹⁵ Unfortunately, as soon as the gas prices plummeted in the 1980s, renewable fuels and energy independence were quickly forgotten.¹⁶

Brazil, however, continued to invest heavily in renewable fuels in the 1970s, and kept the alternative fuel program, chief of which was ethanol, alive during the 1980s.¹⁷ This has given them an advantage over the rest of the countries in the Americas and maybe the world.¹⁸ With over 30 years of increased ethanol use, Brazil is expected to become energy independent this year.¹⁹

Brazil's decision to produce ethanol from fermented sugarcane was based on the low cost of sugar at the time. It is an inverse correlation between the cost of gasoline and ethanol that occurred in the 1980's. Prior to the advent of "flex-fuel" converters which gave the option of using gasoline, ethanol or a mix such as E-85 blend the either/or choice stalled the success of ethanol push in Brazil. Other sources of fermentable carbohydrates were tested such as the manioc. Sales of alcohol-only cars tumbled after an alcohol shortage coupled with low gas prices in the late 1980s to early 1990s.²⁰

Conversely, the United States still imports over half of its oil. But comparing Brazil to the United States is more complex. For

instance, the U.S. economy is much larger, the number of U.S. cars is much greater and the U.S. highway system is much more extensive than in Brazil. Consequently, U.S. energy independence is a much bigger and more complicated challenge, for instance the largest oil companies in the world are based in the United States, and U.S. workers rely on the oil industry for employment.²¹

A. BRAZIL'S ETHANOL PLAN

Brazil implemented the following four policies in 1975 to stimulate ethanol production:

- 1) Petrobras, the major oil company of Brazil, was required to purchase a certain quota of ethanol.
- 2) Brazil allocated nearly 5 billion U.S. dollars in low-interest loans to stimulate ethanol production.
- 3) Subsidies were provided so that ethanol's pump price was approximately 40 percent lower than the price of gasoline.
- 4) It required that all fuels be blended with a minimum of 22 percent ethanol.²²

In 2000, Brazil took a revolutionary step. It deregulated the ethanol market and removed its subsidies.²³ In addition, all fuels were required to be blended with at least 20 to 25 percent ethanol.²⁴

Flex-fuel vehicles, vehicles that can run on straight ethanol, straight gasoline or a blend of the two, were introduced in the Brazilian market in 2003.²⁵ Today "more than 70% of the new cars sold in Brazil are flex-fuel."²⁶ The flex-fuel technology requires a small converter unit that switches from ethanol, gasoline or the blend without causing damage to the vehicle. Most of the converter installations can be done quickly and efficiently and solves the dilemma that Brazil faced in the 80's when it was an "all or none" proposition between cars that ran on ethanol and those that did not.²⁷

TABLE 1: BRAZIL-U.S. ETHANOL INDUSTRY COMPARISON

Brazil - Sugarcane

Sugarcane provides five cuttings over six years and is replanted annually

Sugarcane yields about 35 tons per acre

About 100 pounds of sugarcane produce 1 gallon of ethanol

Sugarcane feedstock is cheaper than corn per gallon of ethanol

An acre of sugarcane produces 650 gallons of ethanol

The sugar in sugarcane can be converted directly to ethanol

Sugarcane-ethanol can be produced cheaper than corn-sugarcane-ethanol

About 6,500 kcal of energy is used to produce one gallon of ethanol

The energy source for ethanol production is bagasse (sugarcane by-product)

Brazil is the second leading ethanol producer at 35% of total

Currently about 7 million acres are used for ethanol production

Brazil has great potential for expanding sugarcane acreage without limiting the acreage of other crops

No subsidies for ethanol

No import tariffs on ethanol

U.S. - Corn

Corn provides a crop every year and is planted annually

Corn yields 4.2 tons per acre (150 bushels)

About 20 pounds of corn produces 1 gallon of ethanol

Corn feedstock is more expensive than sugarcane per gallon of ethanol

An acre of corn produces about 400 gallons of ethanol

The starch in corn is first converted into sugar. Then the sugar is converted into ethanol

Corn-ethanol is more expensive to produce than sugar-ethanol

About 28,000 kcal of energy is used to produce one gallon of ethanol

The energy source for ethanol production is natural gas, coal and diesel

U.S. is the leading ethanol producer at 37% of total

Currently about 14 million acres are used for ethanol production

U.S. Expansion of corn acreage will come at the expense of reduced soybean and other crop acres

A \$51 per gallon subsidy

A \$54 per gallon import tariff³⁴

All fueling stations in Brazil must provide an "ethanol or ethanol-blend pump" in order to receive an operating license, which allows consumers to choose "the combination of gasoline and ethanol they purchase."²⁸ The price of ethanol at the pump is 60 to 70% cheaper than the price of gasoline, but the prices of gasoline and ethanol "vary independently of each other."²⁹

B. U.S. AND BRAZILIAN ETHANOL SOURCE COMPARISON

There are fundamental differences between the ethanol produced in Brazil and the ethanol produced in the United States. The feedstock for Brazilian ethanol is sugarcane while in the United States, the feedstock is corn.³⁰ The Brazilian government has been deeply involved in the production and improvement of sugarcane varieties, which has resulted in sugarcane more resistant to drought and pests at the same time yielding higher sugar content.³¹ These efforts have been successful, for instance, sugarcane yields have increased more than three times during the last 30 years.³²

The table on page 64 outlines the differences between the Brazil's sugarcane-ethanol industry and the U.S. corn-ethanol industry.³³

C. THE EFFICIENCY OF BRAZIL'S SUGAR-BASED ETHANOL IN COMPARISON TO U.S. CORN-BASED ETHANOL

Brazil's sugarcane-based industry is far more efficient than the U.S. maize-based industry. Brazilian distillers can produce ethanol for 22 cents per liter, compared with the 30 cents per liter for corn-based ethanol.³⁵

The cultivation of sugarcane requires a tropical or subtropical climate, "with a minimum of 600 mm (24 in) of annual rainfall."³⁶ Sugarcane is a very efficient photosynthesizer, "able to convert up to 2% of incident solar energy into biomass."³⁷ Ethanol, in turn, is produced by the fermentation of the yeast of the sugar extracted from sugarcane.³⁸ Sugarcane in the United States is produced in the states of Florida, Louisiana, Hawaii, and Texas.³⁹ For instance, in Hawaii, sugarcane can produce 20 kg "for each square meter exposed to the sun."⁴⁰ The U.S. ethanol produced from corn costs 30% more because the corn starch "must first be converted to sugar before being distilled into alcohol."⁴¹ Unfortunately, despite this difference in production cost, in contrast to Japan and Sweden, the United States does not import Brazilian ethanol because of strict U.S. trade barriers (tariffs) corresponding to a levy of 54-cents per gallon, which is designed to offset the 51-cents-per-gallon blender's federal tax credit that is applied to ethanol regardless of its country of origin.⁴² These are promoted by the powerful American sugar lobby, which does not want a competitor to high-fructose corn syrup, and domestic sugar interests.⁴³ The United States and Brazil lead the industrial world in global ethanol production. On March 9, 2007 Ethanol diplomacy was the focus of President Bush's Latin American tour, in which he and Brazil's president, Luiz Inacio Lula da Silva, agreed to share technology. The Brazilian sugar cane trade agreements permit various Central American (Colombia, Costa Rica, and Panama), Caribbean, and various Andean Countries tariff-free trade thanks to concessionary trade agreements.⁴⁴

III. WHY BRAZIL IS A NATURAL RESOURCE FOR WORLD ETHANOL PRODUCTION

Brazil, the largest country in South America, has a vast amount of unused land that has been and is still being converted to agricultural production, as well as a tropical climate well suited for sugarcane production.⁴⁵ The Amazon forest, which much of the world is concerned about regarding global warming, makes up approximately half Brazil's land mass.⁴⁶ The remaining half is mostly pasture land with intermittent permanent crops such as oranges and sugarcane as well as lakes, reforestation efforts and savannahs.⁴⁷ The primary language of Brazil is Portuguese and its population consists of individuals of European and African descent.⁴⁸ It has rapidly become a leader in trade under the Mercosur agreement with several other Latin American countries and has large tracts of land which remain unexplored for oil as well as mining. Brazil has been and still is a popular country for foreign investment. Japan has imported far more ethanol than any other country, with agreements to import millions of barrels of more ethanol over the next few years to comply with the Kyoto agreement.⁴⁹

Brazil dedicates about 14 million acres to sugarcane production of which about 7 million acres are for ethanol production, which represents almost "ten percent of Brazil's current cropland acreage."⁵⁰

According to Brazilian government sources the plan for Brazil is to produce one sugar-ethanol plant per month the next 6 years. In order to achieve this goal, Brazil will have to increase its internal financial capacity to adequately expand its ethanol industry, as well as to promote foreign investment.⁵¹

There are many challenges that Brazil's ethanol production will have to face in the future. For example, high world sugar prices have stimulated the planting of sugarcane in the world, resulting in a shift of the use of the land from the production of ethanol to the production of sugar.⁵²

A. THE CONTRIBUTION OF BRAZIL TO THE REDUCTION OF CARBON EMISSIONS

As a result of the replacement of gasoline with ethanol that occurred between 1975 and 2000, carbon emissions were reduced by 100 million tons, an improvement specially felt in the big cities.⁵³ Conversely, the air quality degradation during a partial return to gasoline in the 1990s was also evident thus establishing a direct correlation between the use of ethanol and gasoline and carbon emissions in the environment.⁵⁴ Sugarcane production and the resultant byproducts are not without hazard. The tradition is to burn sugarcane fields "just before harvest to remove leaves, fertilize the fields with ash, etc."⁵⁵ The burning of the sugarcane fields has been recently banned by law because of the damaging effects on the air quality of the surrounding towns as a result of the smoke coming out from the burning of the fields.⁵⁶

Manual labor also is a must during the sugarcane harvest. This may not be the case soon since further investment may lead to the mechanization of harvest similar to what occurred in the United States, which may create loss of jobs for migrant workers who rely on the few months of work per year for subsistence.⁵⁷

B. BY-PRODUCTS OF ETHANOL PRODUCTION

Thirty-five percent of sugarcane is made up of *bagasse*, a "fibrous material that is left . . . after pressing" the sugarcane.⁵⁸ Bagasse, in turn, is burned to provide an energy source for the ethanol facility.⁵⁹ Many new to the field of ethanol production are impressed by the fact that the by-product itself may create energy to fuel a plant and create self-sufficiency. The remaining bagasse has also been utilized for the energy grid needed to feed the ever increasing demand of Brazilians for electricity. This bagasse is sold to utility companies for the generation of electricity. At the current state of technology, "it is possible to generate 288 MJ of electricity from one ton of sugarcane."⁶⁰ Of this amount, the ethanol plant only needs 188 MJ for energy.⁶¹ The processing of sugarcane has also allowed Brazil "to become energy self-sufficient in electricity."⁶²

1. U.S. - BRAZIL ETHANOL ALLIANCE

As early as March of 2007, President Bush and Brazilian President Luiz Inácio "Lula" da Silva met and agreed to form an ethanol alliance. This relationship focused and continues to focus on creating a global ethanol market. The relationship has the potential for creating a global presence for Brazil "as a major ethanol exporter to the world's energy starved markets."⁶³

Brazil currently exports almost 20% of its ethanol production. The United States, Japan and India are the major importers of Brazil's ethanol. However, Japan and Sweden may change this scenario because they are

looking to increase ethanol imports from Brazil to be able to meet the obligations undertaken under the Kyoto agreement.⁶⁴ The concerns over global warming will further improve Brazil's economic opportunities.⁶⁵

In addition, the United States is slowly shifting the use of its land from the production of soybean to corn for ethanol, opening up export opportunities to Brazil's corn and soybean production.⁶⁶

IV. WHAT ETHANOL MEANS ECONOMICALLY AND SOCIALLY TO BRAZILIANS AND ULTIMATELY TO THE INCREASING EXPORTATION OF ETHANOL TO THE WORLD

As the United States and the other industrialized countries and emerging markets turn to Brazil for ethanol, these countries must understand the social and economic implications of the production of ethanol from sugar. Sugarcane provides an important social contribution to the poorest people of Brazil. This segment of Brazilian society relies on the temporary work provided by the Sugarcane harvest just to survive.⁶⁷

Unfortunately, as Brazil moves forward towards automation of harvesting, particularly near the more expanding and progressive producers of sugarcane near Sao Paulo state, many hundreds of sugarcane workers have been dismissed from their jobs and have been replaced by harvesting trucks.⁶⁸ This has driven the agrarian and seasonal workers and leaders of other states in Brazil to demand incentives from expanding harvesters to retain workers in the field and slow down automation. As with many countries that are coming into their own on the world stage,

Brazil has its growing pains such as these, which require a balance between employment, sheer human survival and the need for mechanization and industrialization of ethanol production.

There are some concerns over the viability of biofuels like ethanol as total replacements for gasoline/crude oil.⁶⁹ For instance, there is the issue of the use of the land for sugarcane cultivation displacing other crops, causing food shortages.⁷⁰ This has proved, however, not to be the case in the real experience of Brazil, a country which despite having the world's largest sugarcane crop, the 45,000 km² that currently devotes to sugarcane production amounts to only "one-half of one percent of its total land area of some 8.5 million km²."⁷¹ Some also fear that only the rich will benefit from the use of the crops for fuel purposes, "while the poor starve and biofuels cause environmental problems."⁷² It is unclear how this would be different from the current situation, as most food crops are grown and exported to richer nations, and neglects the very real environmental problems that the burning of fossil fuels causes.⁷³

A. WORLDWIDE

Ethanol is being used throughout the world to ease the demand for oil. Other countries are either producing and using ethanol in large quantities, or are providing incentives to expand ethanol use.⁷⁴

Brazil and Sweden are using large quantities of ethanol as a fuel. Some provinces of Canada are promoting the use of ethanol by offering subsidies of "up to 45 cents per gallon of ethanol."⁷⁵ India is in the beginning stages of initiating the use of ethanol as an

automotive fuel.⁷⁶ In France, ethanol is produced from grapes that are of "insufficient quality for wine production."⁷⁷ Brazilian ethanol, which is made mainly from sugar cane, is used in approximately 40% of the cars in Brazil.⁷⁸ From an energy standpoint, research indicates that sugar is superior to corn in the amount of energy created in the form of ethanol.⁷⁹ The remaining vehicles use blends of 22% ethanol with 78% gasoline. Brazil consumes nearly 4 billion gallons of ethanol annually. In addition to consumption, Brazil also exports large quantities of ethanol.⁸⁰

Along with Brazil the country of Sweden has used ethanol in chemical production for many years. Crude oil consumption in Sweden has been reduced by 50% since 1980.⁸¹ During the same time period, however, use of gasoline and diesel for transportation has increased.⁸² Emissions have been reduced through the use of catalytic converters, which in turn decrease "carbon monoxide, hydrocarbon, and oxide of nitrogen emissions."⁸³ The amount of carbon dioxide produced cannot be further increased while burning fossil fuels, so the use of "[e]thanol blended gasoline and diesel are being considered as a viable choice to lower emission levels."⁸⁴

There has been a move by distilleries in India to use surplus alcohol as a blending agent or an oxygenate in gasoline. Based on experiments by the Indian Institute of Petroleum, a 10 percent ethanol blend with gasoline and a 15 percent ethanol blend with diesel is being considered for use as road fuel in at least one state.⁸⁵

B. EXPORTS OF BRAZILIAN ETHANOL

On December 19, 2005, the state-run Petrobras announced a contract with the Japanese Nippon Alcohol Hanbai for the creation of a joint-venture based in Japan to import ethanol from Brazil. Brazil-Japan Ethanol, the company created for this purpose, will have as its main objective the creation of an ethanol market in Japan. To further peak the interest of world trade in this commodity, the exportation of Brazilian ethanol to the United States reached a total of US\$1 billion in 2006, an increase of 1020% over 2005 (US\$98 million).⁸⁶ The United States, potentially the largest market for the Brazilian ethanol, currently imposes trade restrictions on Brazilian ethanol in order to encourage domestic ethanol production, most of which has so far been based on processing corn instead of sugar cane or soybeans, which is much less efficient. There is concern that allowing the Brazilian ethanol to enter the U.S. market without taxation will undercut the budding ethanol industry in the United States.⁸⁷ One of the arguments for that is that Brazil currently subsidizes its ethanol production, which is false, as the subsidies program ended in the 1990s.⁸⁸ Others argue that rather than imposing trade restrictions on the import of the Brazilian product the United States should make subsidies available to support its own fledgling domestic producers. Sweden also imports large amounts from Brazil due to its 5% use of ethanol in all of its fuels.

V. ETHANOL'S FUTURE

Vehicle manufacturers are developing and applying new technologies, especially now when oil prices have reached new highs. The goal is that changes in traditional internal combustion engines along with the development of non-traditional power plants and alternative fuels will improve fuel efficiency and reduce carbon emissions.⁸⁹

According to the Manufacturers of Emission Controls Association, since 1970 total vehicle emissions have been reduced by more than 1.5 billion tons. New technologies such as “adjustable compression, direct fuel injection, lighter but stronger materials, and electronic integration of vehicle systems will further enhance the internal combustion engine fuel economy, performance, and emission control in the future.”⁹⁰

There is no doubt that the use of ethanol will increase because of its biodegradable, renewable, and performance qualities. For instance, ethanol blends were approved by the Environmental Protection Agency for use during wintertime oxygenated fuel programs precisely because of the fact that ethanol blends lower vehicle carbon monoxide emissions.⁹¹

Emission levels will also improve due to improved engine technology applied to mass transit city buses and over-the-road trucks. It is expected that some manufacturers will convert diesel engines to burn 100% ethanol, while others will burn E-diesel, a blend of ethanol and diesel fuel.⁹²

Currently, ethanol is widely used and available in most areas of the United States, and it is “contained in over 11% of all gasoline sold in the United States.” Ethanol is marketed by

companies such as Exxon, Sunoco, Texaco, Amoco, Mobile, ARCO, Super-America, Chevron, Union, Shell, and Phillips, as well as independent marketers. In fact, since ethanol was first sold in 1978, “American consumers have driven more than two trillion miles (80,000 trips around the world) on ethanol blended gasoline.”⁹³

In 1990 flexible fuel vehicles (FFV) were introduced in the market. These FFV vehicles are able to operate on E-85, which is a blend of 85 percent ethanol and 15 percent unleaded gasoline. For instance, the Ford Taurus FFV car was introduced to Iowa in

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1996 and was used first by some city governments, but they became available commercially shortly thereafter. The advantage of an FFV is that they can operate on “unleaded gasoline or any mixture of gasoline and ethanol up to an 85 percent blend.”⁹⁴

FFCs’ key component is a sensor which determines the percentage of ethanol in the fuel, and “with the help of a computer, makes adjustments automatically for best performance and emissions.” In 1998 Chrysler began to offer FFV minivans, while Ford continues to offer the Taurus and added the Windstar and Ranger in 1999. “Explorer and Sport Trac were offered in 2001.”⁹⁵

In the United States, the phased-in adoption of cleaner-burning vehicles was mandated by the Clean Air Act Amendments of 1990 and the Energy Policy Act of 1992. These federal laws required that by

1998 state, municipal and private fleets must meet stricter emission guidelines. This was accomplished in part by “replacing existing vehicles with newer technology like flexible fuel vehicles.” The law also requires that “70 percent of all new fleet vehicle purchases meet these new standards in 2000.”⁹⁶

Private companies were also required to meet the new standards. “Beginning in 1996, new model vehicles were equipped with on-board diagnostic monitoring systems capable of monitoring tailpipe and evaporative emissions.”

A. FUEL ETHANOL FOR AMERICA

Ethanol is an alcohol fuel produced from the fermentation of simple sugars. Most ethanol in the United States comes from corn, but it can also be produced from sugarcane or other plants. In the United States, the demand for corn has increased over the last decade leading to higher income for U.S. corn farmers. Ethanol is blended with gasoline, a mixture called gasohol, “to increase octane, improve combustion, and extend gasoline stocks.” Today in the United States, about 1% to 2% of total gasoline demand is actually met by ethanol, and roughly 30% of U.S. gasoline contains some ethanol.⁹⁷ In America, ethanol plants are being built all over the mid-west or farm belt.⁹⁸ Today, there are enough grain ethanol refineries, over 100 in the U.S., with the capacity to produce 5 billion gallons of ethanol per year. But with ethanol demand expected to jump 50% over the next couple of years, there are over 50 plants being built that will add nearly 4 billion gallons of capacity in the next 2 years.⁹⁹

Some Americans, and understandably many in the oil industry, find ethanol as a viable alternative to be unrealistic. However, over the last 30 years Brazil has created a market where 75% of the vehicles on the road can use ethanol and has successfully replaced imported oil to the tune of US\$120 billion. With the conversion of the vast majority of its automobiles to ethanol ready automobiles, the net savings to Brazil is approximately US\$2 trillion.¹⁰⁰

B. THE UNITED STATES POLICY ON ENERGY

The U.S. Congress observed the Brazilian solution and as a result passed the Energy Policy Act of 2005. The bill requires that renewable fuel usage increase from 4 billion gallons today to 7.5 billion gallons by 2012. Moreover, it requires that ethanol replace the toxic additive MTBE. This switch alone is expected to increase demand for ethanol production by 2 billion gallons annually.¹⁰¹

Furthermore, pure ethanol uses 30% less energy per unit than gasoline, the goal is for ethanol to gradually relieve consumer dependence on the 150 billion gallon per year market for gasoline.¹⁰² Industry in America is also responding: American automakers are encouraging the use of ethanol through “flex-fuel” automobiles which can run on gasoline or ethanol or a mixture.

The United States is also providing extremely advantageous incentives which may create a new source of industry and wealth. If the price of oil and gasoline remains high, the funding will continue and incentives to use ethanol will remain present. A 52 cent tax credit with no taxes on the profits for

every gallon of ethanol produced is effectively giving those who deal in ethanol a very profitable enterprise. Investors are keying in on this fact and are beginning to see the advantages of “going green.”¹⁰³

C. FROM TRASH TO TREASURE THE WORLD OVER

Until very recently almost all ethanol produced was yielded from the fermentation of yeast in expensive materials such as corn starch and cane syrup.¹⁰⁴ However, now more scientists are beginning to research biomass which comes from agricultural waste such as wood waste, plant stalks, corn stems and even sewage sludge. In biomass, the energy is stored in cellulose and in hemicellulose which is approximately 75% of the

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waste. Scientists now have uncovered how to create energy by uncovering cellulose-hungry organisms and microbes that consume this biomass.¹⁰⁵ This could lead to mass production of ethanol from waste products. Both the U.S. Department of Agriculture and Department of Energy state that converting this organic waste into ethanol could replace half of all imported petroleum in the United States.¹⁰⁶

D. E-COLI AND TERMITES: THE FUTURE OF AMERICAN ENERGY?

Competition has begun to genetically engineer e-coli to convert cellulose found in plant cell walls into fuel ethanol. Scientists are also searching for different organisms with the ability to digest cellulose. Some engineers are studying a fungus that devoured Army tents during World War II, which now is converting cotton into ethanol. Additionally, researchers in China are cultivating strains of tall grasses and tinkering with plants’ genes to make better energy crops. Researchers at Colorado State University recently announced a partnership with Solix Biofuels to develop a prototype conversion plant at a local brewery to convert common algae to biodiesel.¹⁰⁷ As expressed by these researchers, “swimming pools and aquariums can produce up to 100 times more oil per acre than soy or canola, the current major sources of biodiesel.”¹⁰⁸

Currently, the U.S. government is subsidizing research and technology of new cellulosic ethanol. In fact, in the 2007 President Bush proposed US\$150 million for that year’s budget dedicated to research into advanced forms of ethanol, which represents a 65% increase over current levels. As expressed by Bush: “The ethanol industry is on the move, and America is better off for it.”¹⁰⁹ Some suggest that developing a commercial use for the 300 million tons of cellulosic waste generated annually would reduce pollution. A major benefit of cellulosic ethanol produced from waste “is that it’s environmentally-friendly.”¹¹⁰ For instance, bio-based chemicals produce only a small fraction of the pollution generated by the use of petroleum, and the burning of biological fuels “creates far less carbon

dioxide than fossil fuels.¹¹¹ In fact, investors such as Microsoft founder Bill Gates and Sir Richard Branson of Virgin Atlantic Airways, have invested millions in ethanol producers. In summary, as expressed by Bloomberg “investors have pumped more than US\$14.3 billion into the ethanol industry in the past year alone.”¹¹²

VI. ENERGY AGRICULTURE — BRAZILIAN ETHANOL

Many countries have extolled the virtues of the Brazilian system, but can it be extrapolated to the U.S. that easily? This model may not be that easy to replicate in the United States. For one, the population of the United States is 62% larger. Second, the average U.S. consumer burns 6 times more fuel. Finally, the U.S. produces 3 to 1 more oil per capita than Brazil. Thus, the gap between production and consumption in the United States is 16 barrels per person per year, while Brazil's gap amounts to just 0.85 barrels. Moreover, the United States is pushing for corn production as the source of ethanol, while research demonstrates that sugarcane conversion to ethanol is 8 times more energy efficient. In other words, as an ethanol feedstock, sugarcane is more efficient than corn by a factor of nearly 8. And even if switchgrass-based cellulosic ethanol becomes a reality soon, the United States will still lag behind Brazil.¹¹³ Additionally, Brazilian production costs are “40% to 50% lower than in the United States.” With U.S. wholesale ethanol prices ranging from \$1.80 to \$2.06 per gallon from January to March 2006, the tariff the United States has in place with Brazilian ethanol imports represents a significant barrier to the ethanol trade between the two countries.¹¹⁴

A. U.S. CORN GROWERS' VIEWS ON LIFTING TARIFFS ON ETHANOL

“It would appear that corn farmers are concerned by recent announcements from the Bush administration that they want to suspend the current import tariff on ethanol and are looking for ways to increase ethanol imports to the United States,” said Mitchell, the chief executive of the American Corn Growers Association. He further noted, “Importing ethanol is not the proper course

[A]s an ethanol feedstock, sugarcane is more efficient than corn by a factor of nearly 8.

to treat what the president diagnosed as an ‘addiction to imported oil.’¹¹⁵ National Corn Grower leaders say they believe the increase in ethanol imports created by lifting the tariff would be filled mainly by Brazil, which has been involved in several dust-ups involving U.S. agriculture. In one of those, Congress voted to change the U.S. cotton program to comply with a WTO ruling in a case brought by Brazil.¹¹⁶

Even if the United States was able to make the ethanol industry as efficient as Brazil's, the corn farming lobby argues that its much more ravenous appetite for energy consumption would still greatly limit ethanol's contribution to real energy independence.¹¹⁷ The United States is expected to produce 4.8 billion gallons of ethanol in 2006 -- and that will displace only about 3 percent of gasoline use.¹¹⁸

The United States, however, should not decide to abandon research on cellulosic ethanol. Furthermore, it should not simply “keep burning a quarter of the world's oil with just 5 percent of global population.”¹¹⁹ Instead, United States should learn from Brazil and reduce consumption of petroleum, because “the reason [Brazil] achieved energy independence is primarily because of their frugal energy usage, not because of ethanol.”¹²⁰

VII. THE CARIBBEAN BASIN INITIATIVE'S ROLE IN ETHANOL PRODUCTION

Under the Caribbean Basin Initiative (CBI), up to 7 percent of domestic ethanol production may be imported to the United States free of the 54 cent per gallon secondary tariff so long as the fuel ethanol is derived from nations covered by the CBI. The U.S. International Trade Commission is charged with determining the volume of duty-free ethanol imports, and set that rate at 452 million gallons for 2008. U.S. imports of ethanol totaled around 205 million gallons in 2006, and while imports are expected to exceed that total in 2007, imports remain within the duty-free limit. Nothing prohibits imports of ethanol to exceed the duty-free limits.¹²¹

Under the CBI, Brazil is allowed to export ethanol tariff free, which currently provides up to 7 percent of the U.S. supply, and “[i]n fact, Brazil is already on a pace to break all records for exports of ethanol to the United States, nearly doubling the amount it exported to the United States last year,” said the CEO of the National Corn Growers Association, Rick Tolman.¹²² Further, he noted,

“[w]ith the Caribbean Basin option and the high price of fuel, the import tariff has not been a constraint to ethanol exports to the United States by Brazil.”¹²³

Most of the U.S. market is supplied by domestic refiners producing ethanol from American corn. However, imports do play a role, albeit small, in the U.S. market. One reason for the relatively small role is a 54-cent-per-gallon tariff on imported ethanol. This tariff offsets an economic incentive of 51 cents per gallon for the use of ethanol in gasoline.¹²⁴ However, to promote development and stability in the Caribbean region and Central America, the Caribbean Basin Initiative (CBI) allows the imports of most products, including ethanol, duty-free. While many of these products are produced in CBI countries, ethanol entering the United States under the CBI is generally produced elsewhere and reprocessed in CBI countries for export to the United States. The U.S.-Dominican Republic-Central America Free Trade Agreement (CAFTA-DR) would maintain this duty-free treatment and set specific allocations for imports from Costa Rica and El Salvador. Duty-free treatment of CBI ethanol has raised concerns, especially as the market for ethanol has the potential for dramatic expansion under Pub. L. 109-58.¹²⁵

In 2004, imports from Brazil to the United States grew dramatically, but in 2005, CBI imports again represented more than half of all U.S. ethanol imports. In total, imports currently play a relatively small role in the U.S. ethanol market. “Total ethanol consumption in 2005 was approximately 3.9 billion gallons, whereas imports totaled 180 million gallons, or about 5%.”¹²⁶

Under the CBI and other laws, the total ethanol produced or processed in certain

Caribbean and Central American nations imported into the United States cannot exceed 7 percent of total U.S. domestic use. Brazilian ethanol could qualify up to that limit, but only if it is first sent to a CBI nation for processing before coming to America.¹²⁷

As of 2005, imports from the CBI totaled only approximately 2.7%. One reason for the limited amount imported is a most-favored-nation tariff of 54 cents per gallon. In many cases, this tariff negates lower production costs in other countries.¹²⁸ In addition, and considering the U.S. wholesale ethanol prices

[Ethanol] imports do play a role, albeit small, in the U.S. Market

ranging from \$1.80 to \$2.06 per gallon from January to March 2006, the tariff presents a significant barrier to imports.¹²⁹ Also, the tariff, which was created to offset the tax incentive for ethanol-blended gasoline (“gasohol”), valued at 51 cents per gallon of pure ethanol used in blending, represents no motivation for ethanol imports.¹³⁰

Another reason for the limited amount imported is that the actual “ethanol production in some nations just meets their domestic consumption, leaving only small quantities for export.”¹³¹ Also, “the costs of diverting Brazilian or other supplies to CBI nations has discouraged full use of the tariff exemption,” given the relatively low ethanol prices that have prevailed in the United States unless the tariffs are dropped, foreign producers have no incentive to export to the United States. “Allowing this ethanol into the country without penalties or special requirements would, over time, act as a catalyst for increased global production.”¹³²

One of goals of the CBI was to promote “a stable political and economic climate in the Caribbean region.”¹³³ As a result of this initiative, Congress passed the Custom and Trade Act of 1990, which granted duty-free status to a large array of products from beneficiary countries, including fuel ethanol under certain conditions.¹³⁴ Some limitations apply depending on the quantity of local feedstock content, but still only “up to 7% of the U.S. market may be supplied duty-free by CBI ethanol containing no local feedstock.”¹³⁵ In order to take advantage of this benefit, ethanol exporting countries like Brazil or other European countries ship hydrous or wet ethanol to a dehydration plant in a CBI country for reprocessing. It is only then, when the ethanol is dehydrated, that it is imported duty-free into the United States.¹³⁶ Dehydration plants operate in Jamaica, Costa Rica, El Salvador, Trinidad and Tobago. From 1999 to 2003 Jamaica and Costa Rica were the two largest exporters of fuel ethanol to the United States but in 2004, direct imports from Brazil exceeded imports from all other countries combined.¹³⁷ In spring and summer of 2004, it was reported that a major U.S. ethanol producer and a major petroleum company had announced possible plans to construct new dehydration plants in El Salvador and Panama.¹³⁸

Imports of dehydrated ethanol under the CBI as of 2005 were far below the 7% cap. For the year of 2005, “the cap was about 240 million gallons, whereas about 100 million gallons were imported under the CBI in that year.”¹³⁹

It was reported in 2004 that it was possible that two new dehydration plants were to be constructed in El Salvador and Panama, which could represent an additional 60 mil-

lion gallons of ethanol per year.¹⁴⁰ If all the ethanol from those plants were exported to the United States, “it would lead to a significant increase in U.S. imports of CBI ethanol.”¹⁴¹ As a result of these initiatives, a new dehydration facility began production in Trinidad and Tobago in September of 2005. This trend, however, is facing strong resistance in the United States. For instance, U.S. corn growers and ethanol producers, and even some Members of Congress have criticized these initiatives arguing that “expansion of duty-free imports from the CBI would undermine the domestic U.S. ethanol industry.”¹⁴²

Negotiations leading to CAFTA-DR also covered duty-free ethanol imports.¹⁴³ The Bush Administration and the participating countries have allocated a portion of the 7% duty free cap for CBI ethanol for Costa Rica and El Salvador. These allocations effectively limit the amount of fuel that other CBI countries can import duty-free. Costa Rica’s allocation is 31 million gallons per year, while El Salvador was granted an initial allocation of approximately 6.6 million gallons per year, increasing by roughly 1.3 million gallons in each subsequent year. However, El Salvador’s allocation may not exceed 10% of the total CBI allocation (or 0.7% of the U.S. market).¹⁴⁴ The agreement was signed on May 28, 2004. Congress approved the agreement in 2005, and implementing legislation was signed by President Bush on August 2, 2005.¹⁴⁵ However, in 2005 both El Salvador and Costa Rica exceeded their allowed allocations. There is not a clear answer to the question of what would be the effect of actual imports of ethanol in excess of these allocations.¹⁴⁶

VIII. GROWING U.S. ETHANOL MARKET

The U.S. ethanol market continues to grow at a very rapid pace every year. “Between 1990 and 2005, U.S. ethanol consumption increased from about 900 million gallons per year to 3.9 billion gallons per year.” This growth has been attributed to minimum standards established by the Clean Air Act requiring that “gasoline in areas with the worst ozone pollution contain an oxygenate, such as ethanol.”¹⁴⁷ Also, there is a growing concern that methyl tertiary butyl ether (“MTBE”), the main competitor of ethanol, is contaminating groundwater. As a result, several states have banned or limited the use of MTBE, and decided instead to increase the consumption of ethanol.¹⁴⁸

Currently, about 5% of U.S. demand is met by imported ethanol fuel...

Partially as a result of the concerns over MTBE, the Energy Policy Act of 2005¹⁴⁹ established a renewable fuels standard (“RFS”) “requiring the use of 4.0 billion gallons of renewable fuel in 2006, increasing to 7.5 billion gallons in 2012.” Most of these requirements can be met by ethanol, so the “RFS could lead to nearly a doubling of the U.S. ethanol market.” However, domestic producers also anticipate that duty-free ethanol imports through the CBI “could dramatically increase, to their detriment.”¹⁵⁰

A. CONGRESSIONAL ACTION

Some members of Congress have expressed concern over duty-free imports of dehydrated ethanol that originates in Brazil or other countries and the effect of those imports on U.S. production. As a result of these concerns, bills were introduced in the 108th Congress to amend the CBI provisions on ethanol.¹⁵¹ For example, S. 2762 (Grassley) would have lowered the cap on allowable duty-free imports of dehydrated ethanol. Instead of the existing cap of 7% of the U.S. market (about 240 million gallons in 2005). This initiative would have established a cap of 90 million gallons. Amending the cap would have affected the ethanol provisions of CAFTA-DR. CRS-6 S. 2769 (Daschle) “would have prohibited the use of imported ethanol to any renewable fuels standard.”¹⁵²

Currently, about 5% of U.S. demand is met by imported ethanol fuel, and much of this ethanol is not covered by CBI (or other trade agreements, such as NAFTA) and is, therefore, subject to the 54-cent-per-gallon tariff. S. 2769 was introduced on July 22, 2004, and was referred to the Senate Environment and Public Works Committee. Although some stakeholders are concerned over increased ethanol imports and their effect on the U.S. industry, others on the contrary believe that tariffs on imported ethanol should be eliminated entirely. They contend that increased use of ethanol, regardless of its origin, would further free the United States from oil dependence. In the 109th Congress, the H.R. 4409 (Kingston) proposed the elimination of tariffs for all fuel ethanol. This bill was referred to various House committees.¹⁵³

B. CURRENT TRENDS IN ETHANOL TRADE BETWEEN THE U.S. AND BRAZIL

Since the early 1980s, a variety of measures and incentives for the production of domestic ethanol in the United States have made it more difficult for Brazilian ethanol to gain access to the U.S. market.¹⁵⁴

A tax incentive of 54 cents per gallon was introduced in 1978 for ethanol when mixed with gasoline. Today, refineries and distributors that mix ethanol with gasoline (regardless of whether ethanol is domestic or imported) receive a tax credit of 51 cents per gallon, which is granted as an income tax rebate. In 1980, as a way to offset the tax incentive granted to domestic ethanol produced from wheat grown in the U.S. Midwest, a special tariff on imported ethanol fuel was introduced, amounting 54 cents per gallon (thus nullifying the tax credit for ethanol mixed with gasoline in the case of imported ethanol).¹⁵⁵

Some countries like Israel, Canada, Mexico and countries of Central America and the Caribbean are exempted under preferential trade agreements. The tax credit increases the competitiveness of domestic production vis-à-vis imported ethanol. The subsidies for U.S. corn producers, constitute another factor that distorts the relative competitiveness of domestic over imported ethanol in the U.S. market. In addition, the “Energy Policy Act of 2005 established a minimum consumption target of 7.5 billion gallons per year by 2012.”¹⁵⁶

As a direct consequence of this U.S. policy supporting domestic ethanol consumption, the U.S. production capacity expanded dramatically “from 175 million gallons in 1980

to 4.2 billion gallons in 2005 (an amount almost identical to Brazil’s annual production, estimated to be 15.9 billion liters).”¹⁵⁷

Despite the tariff barrier, Brazil was the main exporter of ethanol to the United States in 2005. “The value of the Brazilian ethanol sold to the United States in 2005 was US\$ 88.51 million, compared with US\$ 76.85 million in 2004 (an increase of

The tax credit increases the competitiveness of domestic production vis-à-vis imported ethanol.

15.2%).”¹⁵⁸ Other CBI countries, such as Jamaica, Costa Rica and El Salvador are also major exporters of ethanol. The duty-free ethanol that enters the United States, “is primarily anhydrous Brazilian ethanol dehydrated in the Caribbean.”¹⁵⁹

Under the preferential trade agreement, CBI producers are authorized to export to the United States, a volume of ethanol produced from “non-domestic” raw material corresponding to up to 7% of U.S. annual consumption. In 2004, a bill was introduced in the Senate to place a cap on the duty-free export to the United States of ethanol reprocessed in the Caribbean—with a ceiling of 90 million gallons per year.¹⁶⁰ However, that bill was not approved.¹⁶¹ Thus, it seems that the tariff that remains in effect in Brazil is not, at least in the near future, to be applied to the CBI countries which creates a barrier or at the very least a delay in the introduction of a greater amount of sugarcane-based ethanol from the largest exporter of that product: Brazil.

IX. CONCLUSION

The purpose of this article has been to provide a global perspective of the role ethanol is playing in supplementing or replacing the demand for oil in the United States and in the world market. Brazil is becoming an ever increasing world player in supplying the need for ethanol. The model Brazil has developed in energy self-sufficiency has evolved over the last three decades with the coordination of government intervention, industry cooperation and mandates that were dependent on world oil prices. Now, with the flex-fuel converter technology, drivers can choose between gasoline, ethanol or a mixture. The U.S. demand for energy and the initiatives started by President Bush and the U.S. Congress will also take several decades to develop, and it is indeed difficult to extrapolate the example of Brazil to the United States or any other industrial country due to the differences in demand and use of oil and gasoline. The new President-Elect Barack Obama will also have to address this issue and it is expected that he will support the use of alternative fuels. In fact, during his campaign he voiced his concern for America to become more self sufficient through not only domestic oil but also exploring the potential for alternative fuel resources.¹⁶² Many investors worldwide have seen Brazil as not only a world leader in ethanol but also a favorable country to trade, invest and purchase ethanol plants and land for such future endeavors.

The ethanol market and the tariffs that are presently in place in the United States are an issue that is contested. On the one hand corn farmers in the United States are hoping for corn to be a main source for ethanol, yet sugar and cellulosic ethanol from biological waste

may be more efficient at yielding more ethanol. The Caribbean Basin Initiatives at most play a 7% role in the United States, but may soon be increasing due to the oil demand that only seems to be increasing now with the emerging

demand for oil from countries such as China and India who themselves are studying ways to use ethanol to aid their respective countries to become less dependent on foreign oil from regions that lean towards instability.

Regardless of the present state of ethanol production, it is clear that the world has certainly seen the result of a 30 year plan such as that of Brazil in bringing about a lack of dependency and ever increasing cost from oil dependency.

END NOTES

* This article is dedicated to my wife, Priscilla, and daughter, Vanessa.

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128. Yacobucci, *supra* note 97, at 2.
129. *Id.* at 3; *see generally* Country Analysis Briefs: Brazil, *supra* note 3.
130. Yacobucci, *supra* note 97, at 3;

Praises Ethanol Plant in Peking, PEKIN DAILY TIMES, March 16, 2005.

- see also* U.S. Int'l Trade Comm'n, *Interactive Tariff and Trade DataWeb*, <http://dataweb.usitc.gov> (last visited March 9, 2006).
131. Lieberman, *supra* note 127.
132. *Id.*
133. Yacobucci, *supra* note 97, at 3.
134. *Id.* If produced from at least 50% local feedstocks (e.g., ethanol produced from sugar cane grown in the CBI beneficiary countries) ethanol may be imported duty-free. *Id.* at 3-4.
135. Yacobucci, *supra* note 97, at 3.
136. *Id.*
137. *Id.* at 4.
138. *Id.*
139. *Id.*
140. *Id.*
141. *Id.*
142. *Id.*
143. *Id.*; *see generally* J.F. HORNBECK, *The Dominican Republic-Central America-United States Free Trade Agreement (CAFTA-DR)*, CRS REPORT RL31870, Jan. 16, 2008, available at <http://www.nationalaglawcenter.org/assets/crs/RL31870.pdf>. For more information on MTBE, *see* JAMES E. MCCARTHY & MARY THEMANN, *MTBE in Gasoline: Clean Air and Drinking Water Issues* (April 14, 2006), available at <http://ncseonline.org/nle/crsreports/06may/RL32787.pdf>.
144. Yacobucci, *supra* note 97, at 4-5.
145. *See generally* CAFTA-DR Implementation Act, Pub. L. 109-53.
146. Ariel Cohen, *Two Cheers for Bush's Brazilian Ethanol Initiative*, SPERO NEWS, March 21, 2007, available at <http://www.speroforum.com/site/article.asp?id=8576>.
147. Yacobucci, *supra* note 97, at 5.
148. *Id.*
149. *See generally* Energy Policy Act, *supra* note 125.
150. Yacobucci, *supra* note 97, at 5; *see generally* Energy Policy and Conservation Act, Pub. L. No. 94-163, 89 Stat. 871.
151. Yacobucci, *supra* note 97, at 5.
152. *Id.*
153. *Id.*
154. Brazilian Embassy to the United States, *Report on Brazilian Trade Barriers*, at 11 (March 2006), available at http://www.brasilemb.org/trade_investment/2006_Embass_%20Report_on_US_Trade_Barriers_English.pdf.
155. *Id.*
156. *Id.*
157. *Id.*; *see also* United States Int'l Trade Comm'n, *supra* note 130.
158. *Report on Brazilian Trade Barriers*, *supra* note 154, at 12.
159. *Id.*
160. *Id.*
161. *Id.*
162. Jason Carson Wilson, *Senator Obama*