Biofuels Prospects in Latin America

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Abstract:

The Western Hemisphere has been a paradise of biofuel development, home to two of the three largest biofuel markets in the world. With a hemisphere rich in natural resources and arable land, the ability to explore new technologies and methods of production of biofuels has been a continuing story of success. Although certain concerns about greenhouse gas emission are substantiated, the biofuels market appears to be growing. After addressing the drawbacks of biofuel production, it is possible that it could continue to be a viable business opportunity for other countries in Latin America as the worldwide market demand increases.

Introduction

The biofuels market has been globally dominated by the United States (US) and Brazil for the past decade, with the European Union (EU) coming in third. The main product being manufactured has been ethanol, followed by biodiesel and methane. Biofuels were born out of the need to diversify energy sources as a consequence of the oil crises of the 1970s. The dramatic shortfalls in oil production and sharp increases in price at the time, turned into a desire to wean off of oil, subsequently maturing into the general development of renewable energies. The Western Hemisphere has been a paradise of biofuel development, since it is rich in natural resources and arable land, and it has the ever growing potential to explore new technologies and methods of production.

Concerns about greenhouse gas (GHG) emissions are the primary issue and have been substantiated as a result of insufficient consideration for the emissions created, as a result of producing biofuels and not just the burning of biofuels on their own. Additionally, a fear that the cultivation of crops for the production of biofuels has been poaching crops that were originally intended for food is driving worldwide concern that biofuels need to be assessed holistically to prevent the intended consequence of food production shortfalls.

In totality, the biofuels market continues to grow, after addressing the drawbacks of biofuel production, it is possible that biofuel production could continue to be a viable opportunity for other countries in Latin America as the worldwide market demand increases. This paper aims to assess those opportunities.

Biofuels in Latin America

When assessing the expansion of biofuel production in Latin America, it is necessary to understand the state of the market and determine the key changes that need to be made in production. This must be done to address persistent issues, and to consider, which countries may be able to expand biofuel production.

History and Current State of the Worldwide Biofuels Markets

1. Origins of the modern biofuel markets

Biofuel production, as we know it today, originated as a consequence of the limits on production and taxes imposed by Arab countries in the 1970s. The most pressing concern became the quest for alternative energy sources to supplement fossil fuel reserves, as it became increasingly clear that energy markets would continue to expand as technology advanced worldwide.

Brazil began fostering their own market for sugarcane-based ethanol production beginning in the 1970s. With a small population and market, Brazil managed to achieve approximately 50% dependence on nationally produced ethanol for transportation use.[i] It grew the industry to help achieve energy independence from oil markets. The US on the other hand did not begin seriously cultivating an ethanol industry until the 1990s, breaking 1 million gallons of production in 1993 (Figure 1) and far surpassing any other country with 14,850 gallons as of 2015 (Figure 2). One of the reasons for its development was to find alternative markets for its corn. This resulted in very different markets between the two countries that supplied different needs. The US only has

approximately 5% dependence on ethanol for transportation use and simultaneously has expanded a very lucrative shale oil market.[ii]

With the increase in US development of ethanol in the 1990s, Europe also began increasing their production, with a worldwide shift towards biofuel production as a result of the following core reasons:

1. To reduce fossil fuel consumption
2. To increase energy diversity in transport
3. To enhance energy supply security
4. To reduce greenhouse gas (GHG) emissions
5. To support farmers[iii]

The use of ethanol globally has been increasing with the US and Brazil at the forefront of production and consumption, accounting for over 75% of worldwide ethanol production.

The transportation industry continues to be biofuels' most promising future. Consuming almost 57% of petroleum products, the transportation industry remains susceptible to fluctuations in the price of oil and can benefit the most from new biofuel technologies as energy demands continue to increase with modernization.[iv]

2. The worldwide biofuel market today

One of the key reasons for the success of the biofuels market lies in the regulatory policies that different markets have employed to foster the growth of biofuels. Policies that mandate the production and trade of biofuels has contributed enormously to the explosion.[v]

The US is the world's largest producer of ethanol, as well as being the largest consumer of ethanol. It drives much of the worldwide market through mandates that require a certain amount of import. Under the U.S. biofuel mandate, sugarcane-based

ethanol qualifies under “other advanced biofuels,” and, thus, it is imported to fulfill the mandate even when domestic production of total ethanol is greater than consumption.[vi] The policies that the US implements directly impacts markets, as was the case in 2012, when tariffs from Brazilian ethanol were eliminated and the subsequent impact, was that Caribbean Basin ethanol imports dropped (Figure 3). In the years prior to the elimination of the tariff on Brazil, the US was importing Brazilian ethanol through the Caribbean Basin to avoid the tariff. The main trade partners for the US include Brazil, Canada, Caribbean Basin and the EU (Figure 3).

In Brazil, the US is the largest supplier of ethanol through the corn-based biofuel. The US was also the largest supplier to the EU, until 2013, when they heavily taxed US ethanol to avoid competition with EU biofuel producers. As a result, the EU has preferential agreements with Guatemala, Peru and Pakistan to account for the balance of ethanol that the continent required.[vii] The main ethanol trade partners for Brazil include the US, EU and Caribbean Basin (Figure 4).

In contrast to ethanol, which is dominated by the US and Brazil, the biodiesel market demand comes very much from the EU. The US and Brazil also trade in biodiesel, as well as Argentina. In total, however, the biodiesel trade is about half of the ethanol trade, “ethanol trade averaged 1.5 billion gallons between 2011 and 2013, while biodiesel averaged 936 million gallons”.[viii]

Intra-industry trade in biofuels is so robust, as a result of the favorable market conditions and government policies that converge to sustain the trade. In the case of biofuels, intra-industry trade occurs because the products traded between countries are

similar but not identical.[ix] Under existing regulatory policies and regional market conditions, it appears that biofuels will continue to grow.

Concerns related to biofuels

When initially described as a renewable resource, biofuels were assumed to be a more environmentally friendly alternative to fossil fuels, because they produce less GHG emissions when expended. In accounting for GHG emissions, the additional expenditure of energy that was required in order to create the biofuel was not considered, thus affecting the overall negative impacts of biofuels through its production.

> Bioenergy can reduce greenhouse gas emissions…only if and to the extent that: 1) land and plants are managed to grow additional biomass and take up additional CO2 beyond what they would absorb without conversion into bioenergy, or 2) bioenergy production uses feedstocks, such as crop residues or wastes that would otherwise decompose and release CO2 to the atmosphere anyway.[x]

The extent to which these changes can be made and enforced through policy will continue to affect the biofuels market. Biomass, in general, has been determined to have accounting discrepancies throughout a range of biomass calculations (Figure 5).

The production of sugarcane ethanol has been shown to be much more efficient as compared to corn, both in terms of greenhouse gas (GHG) emissions and economically. Bioenergy was seen as the a GHG-neutral replacement for fossil fuels, however when analyzed more closely, the processing and expenditure of bioenergy without offsetting what otherwise would not be expended contributes to GHG and undermines the premise of bioenergy being a fossil-fuel substitute.[xi] Ethanol produced by sugarcane has been proven to require less bioenergy expenditure to produce the fuel as compared to corn-based ethanol:

> Ethanol yield (gallons/acre) for sugar cane under good tropical conditions is double that for corn…sugar cane ethanol is seven times more energy efficient; its net energy, expressed as ERoEI, is 9:1 while corn ethanol has an ERoEI of only 1.3:1.[xii]

Economically, corn ethanol currently requires subsidies for farmers in order grow the corn needed to produce the ethanol and offset the value of selling corn for food, whereas in sugarcane, subsidies were not a substantial requirement because of the naturally conducive climate to grow sugarcane in the tropical climates without requiring irrigation.

Possibilities for addressing these discrepancies related to overall GHG impacts rests primarily on the improvement of accounting standards and policy goals that encourages the appropriate offset of GHG emissions to validate the production of biofuels, as well as incentivize the proper balance of food crops for subsistence versus for biofuel production.

In the spirit of these concerns, efforts between the US and Brazil have focused on government and industry partnerships to expand research and development into new conversion methods and processes for creating biofuels. The commitment has risen to enhance production methods and to correct and address issues of GHG effects, as well as efforts to increase investment to build more capacity in advanced biofuels industries. [xiii]

Some of the other main concerns that arise as a result of the expansion of the biofuels market are practical issues of deforestation, land grabs and effects on food security.[xiv] Deforestation concerns are centered on the Amazonian forest for the purposes of cultivating biofuel crops. Soy crops within Brazil are being displaced from traditional areas in order to make room for sugarcane crops. The resulting displacement of soy turns into deforestation of new areas to make room for soy crops which are capable of growing in the Brazilian Amazon, whereas the sugarcane is not.

Issues of land grabs have been reported in Colombia, for areas that were formerly owned by Afro-Colombians, and who were displaced in order to cultivate palm oil production. The social impact of obtaining the necessary land, in order to grow the biofuel crops, can be very detrimental if not appropriately managed. Issues of indigenous and poor populations being displaced for the benefit of biofuels detracts from the social benefits of the market's expansion and value.

The most critical concern however is the feedstock production that may be transferred from food to biofuel production. When not properly managed, the result is an increase in food prices which affects the poor. In countries such as the US, where subsidies can ensure the right balance of food versus biofuel production the issue is not as substantial. However, in the countries of Latin America this can cause tremendous issues as the poor become unable to feed themselves because of rising prices.

> A significant peak in world food commodity prices occurred in 2008, after which the prices dropped again in 2009…Biofuels were accused to contribute to the rapid price development and in some cases, media created the impression that biofuel is the only reason: "Biofuels: Spaghetti Shock in Italy" or "Tortilla-Crisis: Demand for ethanol is starving Mexicans."[xv]

These concerns, which center mostly on Latin America, are indicative of other systemic problems within Latin America, related to the extension of the rule of law and the strength of government institutions. Proper monitoring of social and environmental impacts can address the issues described above and allow for the sustainable and successful expansion of biofuel opportunities.

Assessing emerging biofuel opportunities in Latin America

The global biofuel market is healthy, with a futures market trading at 29,000 gallons of ethanol per contract on the Chicago Board of Trade (CBOT). The futures market exists precisely because it bets on ethanol demand as a consequence of oil demand. An interesting point to note is that while ethanol futures trade on CBOT, an agricultural exchange, crude oil trades on the New York Mercantile Exchange (NYMEX), which is the world's largest futures exchange that deals in energy. The appetite remains smaller for ethanol futures, as the market is still growing. Oil will still have to be factored in when assessing the confluence of government policies and other market information, since a drop in crude oil prices leads to a drop in crude oil futures, along with the price of ethanol futures prices.

Across Latin America, a range of economic and social factors have the potential to give the region an advantage over other competitors such as the US and EU.

1. Brazil

The biofuel market in Brazil is very sophisticated and lucrative. As already discussed, the production of ethanol from sugarcane is critical for the country. In addition, Brazil has implemented social programs to boost the production of crops suitable for biodiesel, such as palm oil.[xvi] Other opportunities in biofuels include the expansion of cultivable areas for sugarcane and increased overall production.[xvii] The partnerships with the US and EU will also yield significant developments in research and development as Brazil continues to the lead breakthroughs in biofuel production and innovations.

2. Argentina

With a large segment of the Argentine crops producing soy, the country has already become one of the top five producers of biofuels in recent years. A combination of soils rich in nutrients, suitable climate conditions, land availability and cheap labor give it a marked edge.[xviii] The country itself relies mainly on fossil fuels and natural gas for its energy needs, but it does have the geographic potential to improve biofuel production. The Argentine sector is more oriented towards biodiesel, since the diesel sector is dominant in Argentina. There remains more opportunity in Argentina to implement regulatory frameworks that can increase the domestic demand, since until now almost all soybean oil produced has been focused towards export for the US and EU markets.[xix]

3. Chile

Chile suffers from a lack of geographic terrain that would allow it to produce biofuels from the traditional sugarcane crop. Options include the crops of rapeseed and sunflower.[xx] The country does, however, have an immense need for energy since it lacks many natural resources and has to import most of its energy in order to support its infrastructure and transportation needs. An increased shift to biofuels would help diversify its dependence on the oil markets.

4. Colombia

Colombia has been the subject of controversy regarding land grabs as addressed earlier, however, the government's ability to resolve that issue will support their success

in developing palm oil for biofuels. Already in 2013, Colombia had become the fifth largest producer of oil palm in Latin America and the fifth largest in the world.[xxi] Despite all the progress, Colombia has shown a preponderance for gradual change in their conversion to biofuel usage, thus limiting the rate of conversion and market expansion for domestic transportation needs.[xxii] It will take more regulatory changes before opportunity expands greatly within the country.

4. Mexico

Mexico is an unfortunate story of failure, where the country created a biofuel regulatory framework that sought to support energy independence for the country. They brought investors in to support a crop called Jatropha between 2008 and 2013. Unfortunately, the yields were much lower than expected and the program did not work. Although the effort was made, Mexico does not have a biofuel market because it cannot compete with fossil fuels at this time.[xxiii]

Other countries within Latin America, such as Central America, Paraguay, Peru, Uruguay, and Venezuela are limited in their markets because of demand. Although they have developing biofuel markets, they are not very big and usually seek to meet the needs of mandated blending of ethanol and biodiesel to gas and diesel.[xxiv] These countries need to find the right regulatory frameworks in order to expand the use of biofuels and incentivize its implementation.

<u>Conclusion</u>

Biofuel markets should continue to grow as modernization increases energy needs. Accounting for the proper offset of GHG emissions when planning out the expansion of the markets in individual countries will keep them in compliance and support the goals of efficient renewable energy sources. Additionally, countries will need to follow legal and fair frameworks to find the land resources necessary to expand crop production. When coupled with the market trends and conducive government policies, the biofuel market can be lucrative for a hemisphere already rich in resources.

APPENDIX:

Figure 1: U.S. Ethanol Production, Source: ethanolrfa.org

Year	Millions of Gallons
1980	175
1981	215
1982	350
1983	415
1984	510
1985	617
1986	712
1987	819
1988	831
1989	843
1990	848
1991	866
1992	985
1993	1,154
1994	1,289
1995	1,358
1996	1,088
1997	1,288
1998	1,405
1999	1,465
2000	1,622
2001	1,765
2002	2,140
2003	2,810
2004	3,404
2005	3,904
2006	4,884
2007	6,521
2008	9,309
2009	10,938
2010	13,298
2011	13,929
2012	13,218
2013	13,312
2014	14,340
2015	14,810

Figure 2: 2015 World Ethanol Production, Source: ethanolrfa.org

Country	Millions of Gallons
United States	14,806
Brazil	7,093
European Union	1,387
China	813
Canada	436
Thailand	334
Argentina	211
India	211
Rest of World	391

Source: RFA analysis of public and private estimates

Figure 3: US Ethanol Imports and Exports by country

Imports	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
					Percent of total					
Brazil	57.93	25.42	61.94	42.09	38.34	2.65	0	46.00	81.81	78.99
Canada	4.18	2.38	1.13	1.71	0.95	5.66	84.18	1.50	0.82	1.77
Caribbean Basin	37.89	72.20	31.15	55.21	60.48	91.69	15.82	52.50	16.00	15.31
Others	0	0	5.78	0.99	0.23	0	0	0	1.37	3.94
Exports	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
					Percent of total					
Brazil	0	0	0	0	0	0	5.68	33.10	11.59	7.58
Canada	0	0	0	0	0	0	29.96	24.90	41.92	52.33
EU	0	0	0	0	0	0	55.51	24.35	22.65	4.21
Others	0	0	0	0	0	0	8.84	17.65	23.84	35.87

Note: Caribbean Basin countries include Costa Rica, El Salvador, Guatemala, Jamaica, Trinidad and Tobago, and the Virgin Islands.
Source: USDA, Economic Research Service using data from U.S. Energy Information Administration, Petroleum and Other Liquids database (2014).

Figure 4: Brazil Ethanol Imports and Exports by country

Imports	2009	2010	2011	2012	2013
			Percent of total		
EU	0	0.08	5.31	0.02	0.10
United States	0	97.97	94.61	99.86	99.63
Others	0	1.95	0.07	0.12	0.28
Exports	2009	2010	2011	2012	2013
			Percent of total		
Caribbean Basin	20.69	3.97	14.03	14.43	10.53
EU	25.21	12.47	4.90	2.97	2.86
United States	8.17	8.77	34.38	66.77	65.05
Others	45.93	74.79	46.69	15.83	21.55

Note: FAS (2014a) does not report fuel ethanol trade by destination; rather, only total ethanol trade is given.
Source: USDA, Economic Research Service using data from FAS (2014a).

Figure 5: Accounting errors according to source of biomass

Degree of likely accounting error when CO_2 emissions from biomass combustion are not properly considered.

Source of biomass	**Degree of likely accounting error**	Form of error
Converting forests currently sequestering carbon to bioenergy crops	Very high	Ignoring both immediate release of carbon and often continuing carbon sequestration of the forest if unharvested
Harvesting live trees for bioenergy and allowing forest to regrow	High	Same
Diverting crops or growing bioenergy crops on otherwise high-yielding agricultural land	High	Ignoring ongoing uptake of carbon on cropland and likely release of carbon in replacing the crops or reduced crop consumption
Using crop residues	Variable	Potentially ignores existing uses, need to replace nutrients, or potential effects on soil productivity (Blanco-Canqui and Lal, 2009)
Planting high-yielding energy crops on unused invasive grasslands	Low	Little or no error
Using post-harvest timber slash	Little or none	Could ignore temporal dimension of decomposition or existing uses
Using organic wastes otherwise deposited in landfill	Little or none	Little or no error

Endnotes:

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