The Brazilian Sugar Alcohol Sector in the current national and international conjuncture

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Contents

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ActionAid Brazil

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The David and Lucile Packard Foundation

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Introduction

Brazilian ethanol production is an integral part of the national energy and transport matrix, whose recognition led to ministerial responsibility for the sector being assumed by the Ministry of Mines and Energy (MME), rather than Agriculture and Planning (MAPA). At the same time, as a “flex crop”,[1] sugar is a co-product of which Brazil is the world's largest producer (some 25%) and exporter (some 40% of world trade) in what is a very volatile market. The relative share of ethanol and sugar can vary, usually within a 60-40% spectrum.[2] A mandatory policy for blending ethanol with gasoline is in place, currently at 27%, but the sector is free to respond to a range of prices in deciding its marketing strategy – sugar or ethanol, and domestic or export markets for both products. There are two types of ethanol – anhydrous, which is blended with gasoline, and hydrous, which in “flex” cars, (now 86% of car sales and over 60% of the national fleet), can be used interchangeably with gasoline depending on preferences at the pump. Ethanol has less energy density than gasoline, some 70%[3], and so is only competitive when its price to the consumer is at least proportionally lower. São Paulo is the principal producer State, accounting for some 60% of total production, with new investments moving into Minas Gerais and the Cerrados region. Production continues in the Northeast, where sugar plantations first developed in Brazil, although on a very reduced scale, and with only a few mills able to incorporate new technologies, particularly harvest mechanization. Bioelectricity has emerged as a third co-product achieved through burning the bagasse. For many firms, the energy produced is for internal use in the mill but increasingly it is being sold to the national electricity grid. While its potential has been calculated as the equivalent of two Itaipus, Brazil largest hydroelectric plant responsible for 17% of Brazil's energy supply, its current contribution is relevant but still very modest. Bioelectricity production was calculated by the President of UNICA, the sector's leading association, as equivalent to 12% of Brazil's residential consumption in 2014, some 3% of total energy use. Bioplastics are also now being produced commercially, with Braskem/Odebrecht as the leading firm.

Over the last decade the sector has suffered a roller-coaster existence with a period of boom in the years 2003-2009, followed by crisis and stagnation from 2010-2014. Ethanol production in the first period increased annually by some 13 %, national and global investments poured into the sector, there was huge support from Brazil's National Development Bank (BNDES), and dozens of green field plants came on steam. In addition to a vibrant competitive domestic market as a result of high oil prices, Brazil launched the campaign for a global ethanol market and joined forces with the US to promote global standards for ethanol and biodiesel. By 2008 was leading world exports with some 5 billion liters. Brazil's sugarcane ethanol was presented as a positive environmental response to global warming within the framework of the Kyoto targets and also as a perspective for “green development” for the developing world. To adjust to this image, the sector adopted an AgroEcological Zoning Policy, which excludes sugarcane investments in the Amazon, the Pantanal and biodiversity rich ecosystems, and brought forward plans for the elimination of the practice of burning the cane to dry it for easier harvesting, which also implied accelerating the adoption of harvest mechanization. Cane burning continues, particularly in more hilly terrain, but by 2014 mechanization in the State of São Paulo had reached 84% (Fredo, 2014).

1 At its most descriptive the notion of a “flex-crop” refers to the possibility of varying the final products from the same raw material depending on prices or other variables. It has recently been understood more analytically as a strategic response to agribusiness´s increasing subjection to finance capital and consequent price volatility. For a discussion of Brazil´s sugarcane sector within this perspective see McKay, Sauer, Richardson & Herre, 1015.

2 Other co-products are still marginal although there is considerable potential for growth (bioplastics).

3 Tests have suggested that this figure should be considerably higher, up to 80%, but 70% has become the reference for purchasing decisions.

The global financial crisis of 2008-9 abruptly dried up credit and many firms in the sugarcane sector were caught with high and unsustainable levels of indebtedness. New investments in green-field plants were put on hold and investment, primarily foreign, shifted to buying up plants in difficulty or heading for bankruptcy. The result was an accelerated process of internationalization of the sector. Lack of new investments, teething problems with mechanization, and persistent lack of rain led to a stagnation of production, a decline in exports and even the recourse to imports to meet the blending targets. At the same time, world sugar prices have been in decline, a development Brazil attributes to protectionist measures in major sugar markets, and as a result is currently entering with complaints against Thailand and India in the WTO.

The discovery of new petroleum reserves in Brazilian territorial waters, the pre-Sal, which coincided with the world crisis, further contributed to shifting the ethanol biofuel strategy backstage. In the Dilma government, priority was given to controlling inflation and Petrobras held down gasoline prices, making hydrous ethanol uncompetitive in most of Brazil. Ethanol prices in many cases no longer covered production costs, further aggravating the debt profile of the sector. Some 80 out of around 350 sugar mills had stopped operating in 2014 with some 10 more projected to join this number in 2015.

Late 2014 and 2015 brought more positive measures in support of the sector. The CIDE tax was re-imposed on gasoline,[4] the blending percentage was increased from 25% to 27%, and the ICMS tax was eliminated on ethanol in the State of Minas Gerais. As a result of these measures ethanol is now price competitive at the pump in many regions and production has once again become lucrative. The structural impacts of the crisis and the challenges facing the sector, however, remain, and it is to these which this is paper is addressed. We first discuss the way the crisis and responses to the crisis have profoundly changed the profile of the sugar-alcohol sector. This is followed by analysis of the social implications of the transformations in the sector, the most notable of which has been the end of sugar-cane burning, the acceleration of mechanization and the sharp decline in the numbers of migrant harvest workers. These were responses to the combined domestic and international pressures for social and economic improvements in the sugarcane production system. The crisis, which as we have seen has led to the shutting down of some 80 sugar mills, is having a severe impact at local and regional levels, since many towns are overwhelmingly dependent on this sector for direct employment and the generation of income. In the third section we discuss the medium and long term challenges which the current situation poses for ethanol's participation in transport fuels and broader energy policies. The BNDES has been at the forefront of policies and financing to support the sugarcane sector. In 2011, in collaboration with FINEP,[5] it launched the PAISS Program, which was followed in 2012 by the Renova Program both of which we review in section four. We conclude this paper with an analysis of the international perspectives for the ethanol market.

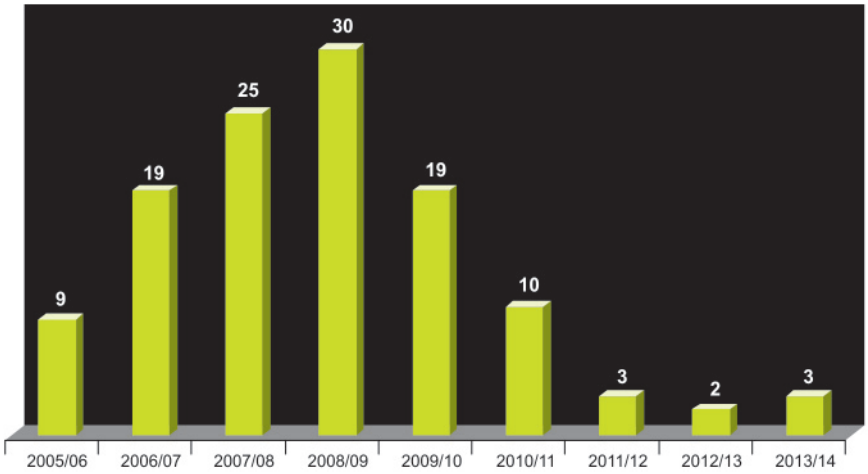
4 A sort of carbon tax.

5 Federal body for the Financing of Studies and Projects

The global financial crisis and the changing profile of the brazilian sugarcane sector

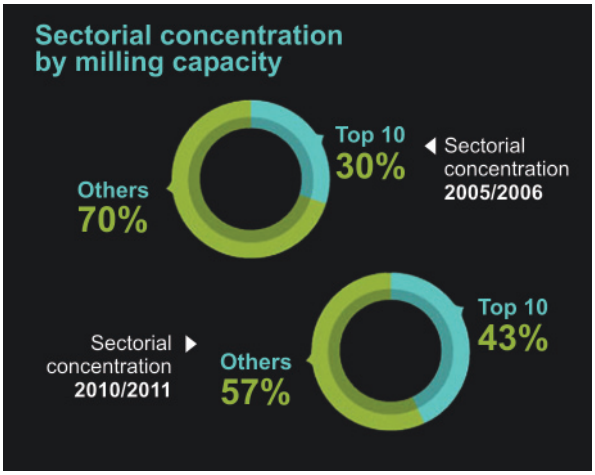
The most striking feature of the Brazilian sugarcane sector in the early years of the new millennium was its rapid expansion based on new investments in sugar plantations and mills as indicated in the Figure below. As the same Figure shows, however, these investments have dried up dramatically in the last three years.

NUMBER OF NEW ETHANOL PLANTS IN OPERATION IN BRAZIL (2005-2013)



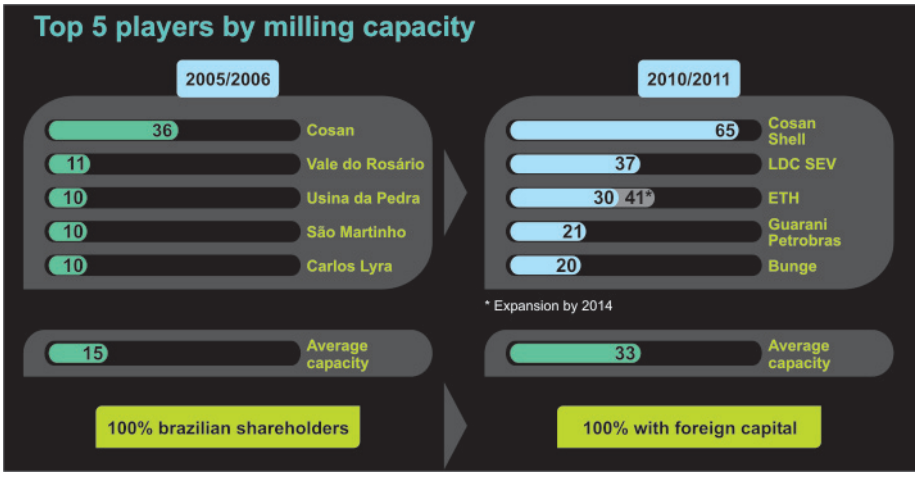
Source: UNICA

In the place of green-field investments, acquisitions of firms in difficulties have now become the major driver leading to an increasing concentration and internationalization of the sector an indicated in the following Tables. The top 10 firms advanced their share of total milling capacity from 30% to 43% between 2005/6 and 2010/2011, a process which has continued since 2011.



Source: Nova Cana

In the same period a comparison of the top 5 firms by milling capacity provides a snapshot of the extent of the transformations in the profile of the leading firms in the sector. In 2005/2006 the top five players were all traditional national firms. Five years later the milling capacity of the leaders had more than doubled and global players were now dominant. Cosan maintained its leadership by way of a joint venture marking the entry of Shell into the sugar-ethanol sector. LDC SEV, the trader Dreyfus, Guarani controlled by the French, Tereos, and Bunge are all now leading players. ETH is the agro-industrial branch of Odebrecht which also controls BRASKEM, pioneer in the production of bioplastics. In these years, the Brazilian sugar/ethanol sector attracted a wide range of investment interests: petrochemical firms wanting to secure a presence in this alternative/complementary transport fuel; agricultural commodity traders seeing the opportunities of a new global commodity; and investment firms interested in diversifying their portfolios.



Source: Nova Cana

More recent figures are provided by Valor's 2014 Edition of Brazil's Leading Firms. The Table below presents the top ten firms by net income. What is interesting here is the top place attributed to Copersucar. As its name suggests, Copersucar was a Cooperative, grouping together a large number of mills and was the sector's most representative organization in the 1970's and 1980's playing a major role in the sector's rapid response to the Pro-Alcohol Program. In 2008, it reorganized as a firm with its members now becoming shareholders. It comprises 24 economic groups with 43 mills over which it has exclusive marketing rights. In addition, it has marketing arrangements with a further 50 mills. With its subsidiary Eco-Energy in the US it controls 12% of global ethanol sales and has a similar percentage of the global sugar trade. In 2014, it formed a joint-venture exclusively for sugar with Cargill, creating Alvean Sugar, which is now the leading global trader in sugar.

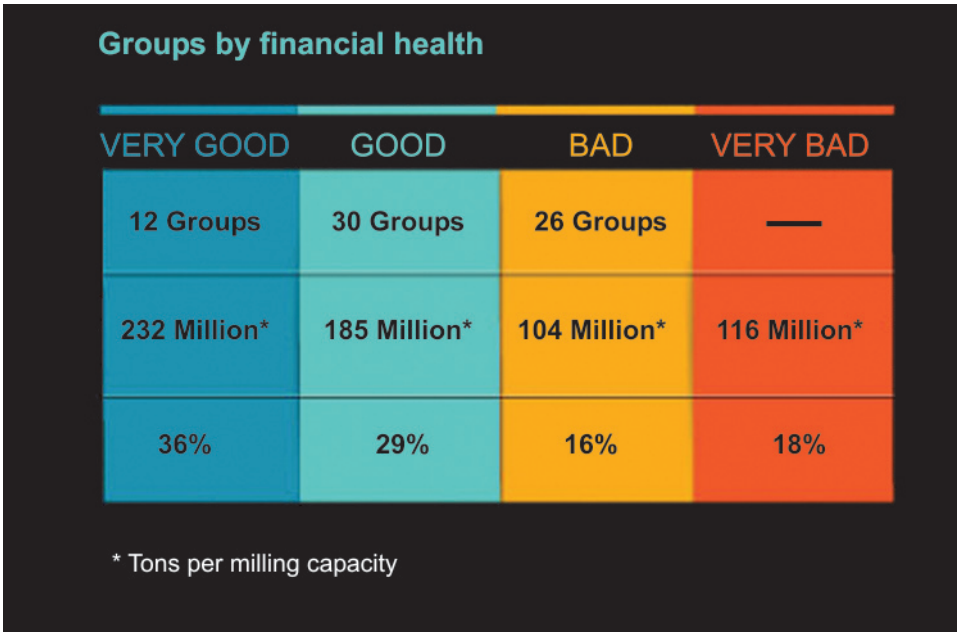
TOP TEN IN THE SUGAR ALCOHOL SECTOR BY NET INCOME, 2013

Classification by Net Annual Sales in Brazilian Reais (R$), Millions		
1	Copersucar	23,153.3
2	Raizen Energia	9,455.2
3	Tereos Internacional	8,399.0
4	Biosev	4,267.5
5	Odebrecht Agroindustrial	2,005.9
6	Lincoln Junquera	1,971.7
7	Santa Terezina Participações	1,957.6
8	San Martinho	1,533.7
9	Empresas Zior	1,423.4
10	Agrop. Nossa Senhora Carmo	1,294.6

Source: Valor Maiores Empresas, 2014

The importance of Copersucar indicates that national actors continue to be relevant players in the sector. Raizen Energia, for its part, is 50-50 joint-venture between Cosan and Shell with Ometto, the head of Cosan, becoming the President of the Administrative Council.[6] On the other hand, it is of note that the Brazilian firms which occupy the bottom five positions in this Table are very much smaller in scale, the same being true of Copersucar's associates. We are still in the early stages of concentration and the crisis in the sector provides favorable conditions for its acceleration.

A recent analysis, see below, of 68 groups in the sugar-alcohol sector which account for over 70% of milling capacity concluded that 12 groups were financially in fine shape and that a further 30 groups could be considered to be financially healthy (Filgiolino, 2014). Together these groups account for 65% of the sample's turnover. On the other hand, 26 groups, accounting for 16% of the total turnover of the groups researched were considered to be in a bad way and a further unspecified number responsible for 18% were in a terrible state. Data from UNICA confirm the depth of the crisis and the probability of further concentration. Of some 360 mills, 80 have paralyzed their milling operations, with a further 10 expected to follow suit in 2015, as mentioned before. In addition to indebtedness deriving from the rush of investments, prices of sugar and ethanol in the last three to four years have been below production costs, (UNICA, 2015).



A significant new development since the financial crisis has been the emergence of a corn-based ethanol sector in the Center-West of the country, the savannah region, where corn is planted in the same area as soy immediately after the harvest of this latter. It is this new dynamic in the grains/oils production system which has transformed corn into a major export crop within the space of a decade increasing from 7 to 21 million tons (See Table below). Exports have become increasingly difficult as volumes of both soy and corn have increased. The corn has to travel some two thousand kilometers to reach the ports where soy, being harvested first, has priority. In this context, a series of initiatives have emerged to promote corn ethanol particularly in combination with sugarcane processed in “flex” mills which would allow for year-long milling. On the other hand, such ethanol would be excluded from the “advanced biofuels” quota of the US ethanol market. Given, however, the declining importance of the export market and favorable analyses of corn ethanol's economic and environmental viability (BNDES, 2014) we are likely to see important advances in corn ethanol in the coming years.

6 Nevertheless Shell has the purchasing option for Cosan´s share at the end of 10 years.

At present two small mills are in operation and a number of projects are in elaboration. The BNDES has conducted viability studies and their positive conclusions have led to its supporting investments in the region.

The most important initiative to date for the promotion of ethanol from sources other than sugarcane is the partnership between USI Biorefineries, a firm from Rio Grande do Sul, and the third largest U.S. trader in ethanol, the Cooperative CHS which has a turnover of US$42 billion. In the case of corn in the Centre-West region, the plan is to build some 15 mills with a capacity for 525 million liters by 2020, around 4% of the region's corn production. To date, four projects have been the object of initial agreements, each with a capacity of between 50.000-100.000 liters. The plants will use USI Biorefineries technology, and farmer integration will be based on exclusive supply contracts, with CHS assuming responsible for the marketing (Valor Econômico, 24/04/2015).

This initiative has built on an earlier agreement between these two firms for the production of ethanol from rice in Rio Grande do Sul in small mills of up to 30.000 liters and a pilot project came into operation in 2013. In partnership with USI, EMBRAPA has produced a new variety of "giant rice", specifically for ethanol, with 40% more starch than traditional varieties.[7] Dried distillers grains with solubles (DDGS) is an important bi-product, increasingly used as feed. Two contracts have now been closed for mills in the municipalities of Itaqui and São Gabriel (Valor Econômico, 24/04/2015). The small scale of these corn and rice ethanol initiatives suggests that their implications for local development should be followed with attention.

DATA ON CORN IN BRAZIL FROM 2007/8 TO 2015/2016 (MILLION METRIC TONS/HAS)

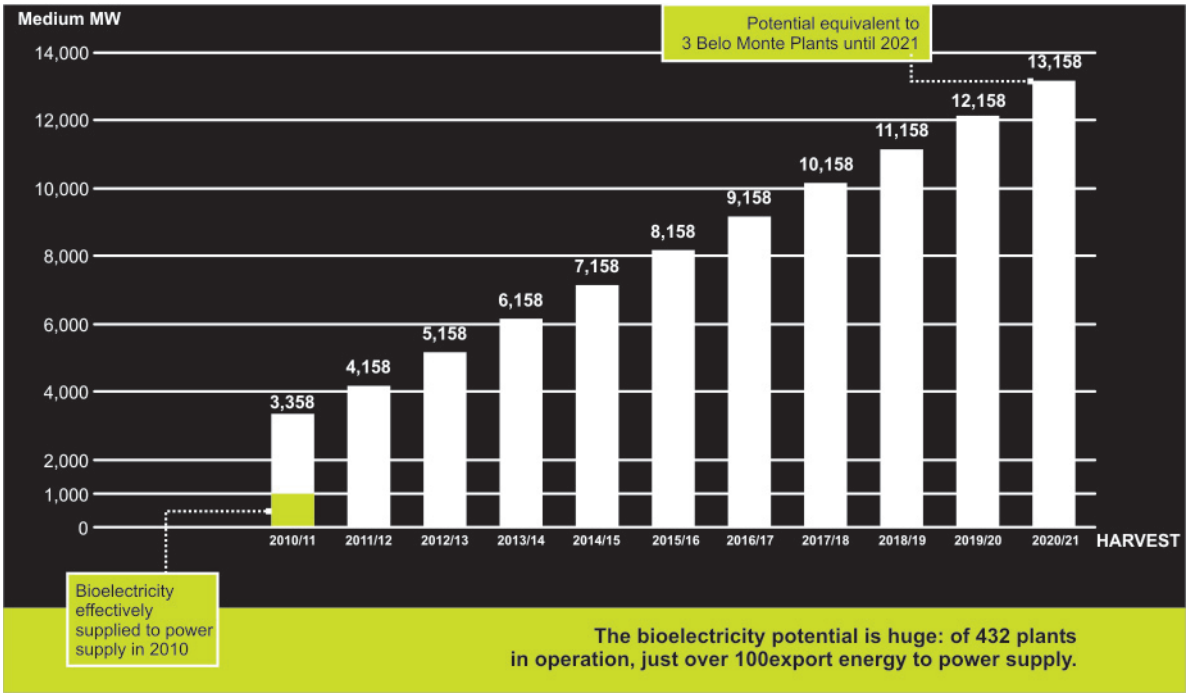
Year	Area Harvested	Yield	Prod	Imps	Exps	Feed/Res	Consump	Stocks
Brazil								
2007/08	14.7	4.0	58.6	0.7	7.8	36.0	42.5	12.6
2008/09	14.1	3.6	51.0	1.1	7.1	38.5	45.5	12.1
2009/10	12.9	4.3	56.1	0.4	11.6	40.0	47.0	10.0
2010/11	13.8	4.2	57.4	0.8	8.4	42.5	49.5	10.3
2011/12	15.2	4.8	73.0	0.8	24.3	43.0	50.5	9.2
2012/13	15.8	5.2	81.5	0.9	24.9	44.5	52.5	14.2
2013/14	15.8	5.1	80.0	0.8	21.0	46.0	55.0	19.0
2014/15	15.0	5.2	78.0	0.8	23.5	48.0	57.0	17.3
2015/16	14.8	5.1	75.0	0.8	22.0	50.0	59.0	12.1

Source: USDAS/FAS, 201

With the current crisis of Brazil's predominantly hydroelectric energy supply system as the result of prolonged droughts drying up the water reservoirs, the sugar-cane sector's capacity to supply bio-electricity has become an object of renewed attention. Brazil's sugar production is overwhelmingly located in the densest energy consuming regions lowering costs of transmission. All sugar mills use the bagasse and the straw for the generation of energy but only around a third has conditions to export this energy to the national grid. According to Elizabeth Farina, UNICA's President, in 2013 the equivalent of 12% of the country's residential electricity consumption was produced by the sugarcane sector, some 25% higher than the previous year. As the Table below indicates this is only a fraction of the sector's potential generation of bioelectricity which it is argued by 2020 could reach the equivalent of three times the energy generated by the Belo Monte plant currently being constructed in the Amazon region. A further advantage of sugar-cane bioelectricity, according to its proponents, is that its supply to the grid would occur in the dry season when hydroelectric power is at its lowest (Bioelectricity.com).

7 This production of dedicated varieties is not restricted to rice and is a central strategy also in the case of sugarcane, to be discussed later in this paper, where hopes are focused on an "energy cane". Neither variety will be used in traditional food markets. Such a strategy calls in question the notion of "flex crops" seen as a dominant tendency in response to market volatility and the increasing dominance of finance capital. For sugarcane see McKay, Sauer, Richardson & Herre, 2015.

BIODIVERSITY MARKET POTENTIAL FOR POWER SUPPLY – BRAZIL (2010-2021)



The ability to use of bagasse and straw directly for the production of ethanol is also seen to provide a solution to concerns over the slowing down of agricultural productivity and the extra pressures on land exerted by ethanol demand. The adoption of “second generation”, or cellulose, technology for the production of ethanol is a global concern, particularly in the US and Europe, which have suffered persistent criticism over the use of food crops for fuel. Commercial cellulose plants were expected to come on stream by 2015 on a scale which could substitute straw and other biomass for corn. A small number of such plants are now in operation but most are still at the pilot stage and the horizon for general adoption has been pushed back to the 2020s. In an atmosphere of reduced support for the promotion of second generation biofuels in the U.S. even this time-scale has been called in question and key players such as British Petroleum have recently put their investment in this sector up for sale. Those promotion second generation biofuels put the blame on the lack of policy support, while others point to over optimist estimates with regard to the technology's maturity. The Table below presents data from BNDES on plants currently in operation worldwide – 3 in the U.S., 1 in Europe and 1 in China, 4 of which use corn. Brazil, with the support of the BNDES, has three plants currently in operation, all using the straw and bagasse of sugarcane. We discuss these perspectives in more detail below in our consideration of the challenges facing the sector and the public policies being put in place particularly by the BNDES and the FINEP.

SECOND GENERATION PLANTS IN COMMERCIAL OPERATION WORLDWIDE

PROJECT	COUNTRY	BIOMASS	VOLUME (000 liters)
POET-DSM	U.S.	Corn Residues	95
Project Dupont	U.S.	Corn Residues	115
Project Abengoa	U.S.	Corn Residues	95
MOG	Italy	Arundo Donax	80
Project Shandong	China	Corn Residues	65
Project Granbio	Brazil	Sugarcane straw/bagasse	80
Project Abengoa	Brazil	Sugarcane straw/bagasse	65
Raizen	Brazil	Sugarcan straw/bagasse	40

Source: Data drawn from BNDES (Nyko, 2015)

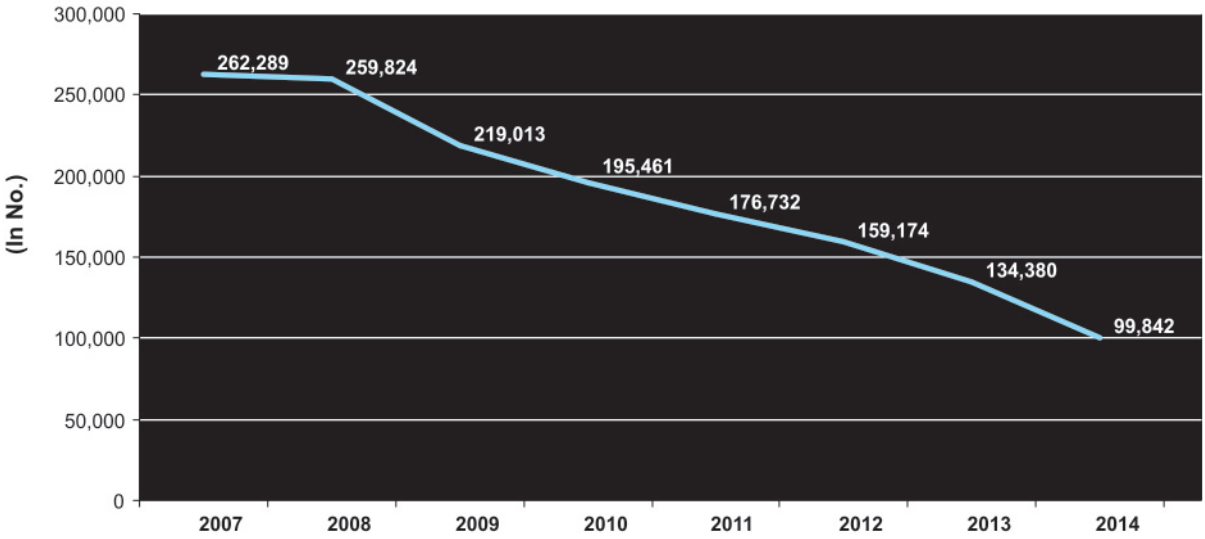
Social implications of modernisation and crisis in Brazil's sugar alcohol sector

One of the commitments assumed by the sugar-alcohol sector when it was positioning itself to lead an emerging global ethanol market was progressively to eliminate sugar-cane burning, whose corollary was the adoption of mechanization for harvesting the cane. Initial regulations to this effect were complemented by voluntary guidelines which anticipated these deadlines. According to the São Paulo State Law no 11.2412 of 2002, the practice of sugarcane burning would have to be eliminated by 2021 on mechanizable land and by 2031 on properties with less than 150 hectares and more than 12% of declivity. In 2007 a voluntary Environmental Protocol between the São Paulo Government and this State's sugar/ethanol sector was agreed on which brought these targets forward to 2014 in the case of properties which could be mechanized and to 2017 for those with the above mentioned restrictions.

Agricultural employment in the sugarcane sector has been traditionally concentrated in the harvest period. In recent years, informal contracting arrangements have been increasingly replaced by formal contracts, although the informal sector remains in some areas, particularly where the cane is supplied by independent producers. The move to formal contracts directly undertaken by the sugar/ethanol plants has however coincided with a sharp decline in manual cane cutting requirements through the adoption of mechanization.

The decline in labor demand has been further exacerbated by indebtedness and drought which have paralyzed a large number of firms. In these cases, non-agricultural labor also suffers. In the following Table which covers admissions to the whole of the sugar-alcohol complex from 2007-2014, overall admissions declined from 262.289 at the beginning of this period to 99.842 at its close in the state of São Paulo.

FORMAL ADMISSIONS TO THE SUGAR-ALCOHOL SECTOR, 2007-2014. STATE OF SÃO PAULO.



Source: CAGED/MTE, IEA.

The impact of harvest mechanization becomes clear in the Table below which estimates the total demand for cane cutters in Sao Paulo's municipalities during 2013-2014 in relation to levels of mechanization. Today, therefore, the cane-cutter sector comprises a little over 50.000 workers in the State of São Paulo compared with hundreds of thousands in the '80s and '90s. The majority of these workers were migrants coming from the North of the State of Minas and the Northeastern States. A consequence of mechanization not captured in these data and worth further research is the withdrawal from the sector of independent suppliers on land under 150 hectares which cannot support the costs of mechanization, a tendency captured in journalistic accounts.

INDICATORS: MECHANIZATION OF THE SUGARCANE HARVEST BY LOCATION OF THE RURAL DEVELOPMENT OFFICE (EDR), SÃO PAULO, 2013/2014

EDR	HARVEST AREA	MECH. AREA	MECH. %	EST. NO. CANE CUTTERS
Andradina	254,641	252,897.2	99.3	126
Araçatuba	244,351	225,646.1	92.3	1,084
Araraquara	278,300	244,000.0	87.7	1,907
Assis	236,182	215,137.4	91.1	1,226
Avaré	68,141	60,893.0	89.4	712
Barretos	457,449	408,056.3	89.2	3,012
Bauru	83,238	58,208.7	69.9	2,354
Botucatu	85,190	68,859.5	80.8	854
Bragança Paulista	2,657	397.3	14.9	200
Campinas	26,634	18,974.1	71.2	534
Catanduva	251,010	204,111.7	81.3	3,215
Dracena	153,774	124,981.4	81.3	1,676
Fernandópolis	70,820	66,025.0	93.2	340
Franca	136,573	120,825.6	88.5	1,194
General Salgado	177,423	143,803.6	81.1	1,639
Guaratinguetá	173	–	0.0	16
Itapetininga	48,785	36,610.0	75.0	921
Itapeva	4,480	2,770.0	61.8	142
Jaboticabal	278,576	245,410.6	88.1	2,437
Jales	44,783	43,857.9	97.9	73
Jaú	235,134	205,752.5	87.5	2,699
Limeira	138,727	111,458.0	80.3	1,716
Lins	169,103	168,505.6	99.6	27
Marília	31,228	27,978.0	89.6	177
Mogi-Mirim	46,010	36,369.4	79.0	734
Orlândia	367,218	283,808.6	77.3	5,941
Ourinhos	108,435	85,577.5	78.9	1,689
Pindamonhangaba	2,075	–	0.0	308
Piracicaba	130,602	95,012.1	72.7	1,880
Presidente Prudente	234,298	180,243.8	76.9	3,900
Presidente Venceslau	141,593	128,661.4	90.9	964
Registro	72	–	0.0	–
Ribeirão Preto	357,821	290,750.9	81.3	3,886
São João da Boa Vista	123,656	102,843.9	83.2	1,503
São José do Rio Preto	268,353	215,259.4	80.2	3,075
São Paulo	10	–	0.0	–
Sorocaba	30,362	20,246.4	66.7	598
Tupã	81,920	65,881.3	80.4	759
Votuporanga	127,321	120,116.7	94.3	350
Total	**5,497,118**	**4,659,684.0**	**84.8**	**51,716**

Source: CAGEST/MTI, IEA, Fredo, 2015

The sharp decline in demand for cane-cutters coincided with a long period of economic growth in Brazil which led to a strong demand for non-qualified labor particularly in the construction industry. During the same period conditions improved in the regions of origin of this migration through the combined effects of continuous increases in the real value of the minimum wage, the "Family Grant" Federal Program, and more favorable economic growth rates in the Northeast. Interviews with migrant cane-cutters suggest that motives have evolved and rather than being driven by absolute poverty, seasonal cane-cutting has become a strategy for investments in house building or vehicle purchases rather than basic needs (Ciscotto, 2015).

The crisis has led to stoppages and mill closures spreading unemployment to the non-agricultural activities which are very significant in the sugar-alcohol sector. In the Table below we see both the relative importance of non-agricultural workers and the extent to which more workers are being laid off than admitted.

ADMISSIONS, LAY-OFFS & BALANCE OF FORMAL AGRICULTURAL AND NON AGRICULTURAL EMPLOYMENT, 2013-2014

Occupation	Admissions		Lay-offs		Balance	
	2013	2014	2013	2014	2013	2014
Agricultural	88,374	60,905	91,525	74,041	-3,151	-13,136
Nonagricultural	46,005	38,937	44,095	48,352	1,910	-9,415
Total	134,379	99,842	135,620	122,393	-1,241	-22,551

Data Source: CAGEDS/MTE, IEA, Toledo, 2015

An important issue of debate in relation to the expansion of sugarcane, which has assumed the profile of a monoculture in many areas of São Paulo, has been its impact on the dynamics of local and regional development. Research by Martinelli and colleagues (2011) compared municipalities which were based predominantly on cattle farming, non-rural municipalities, mixed cattle and sugarcane, exclusively sugarcane, and municipalities which combined sugarcane production with milling activities. Cattle farming municipalities came lowest in relation to a composite index of social, economic and environmental indicators, and municipalities which combined sugarcane production and sugar/ethanol mills came out highest. Other studies by Montangnhami, Fergundes & Fonseca da Silva, (2009), and Shikida (2008) for the State of Paraná support these conclusions and identify the arrival of the sugar mill with a reversal of out-migration and the ability to absorb rural labor displaced by mechanization.

The current crisis, however, has revealed the fragility of local and regional economies dependent overwhelmingly on sugarcane. In many cases mills are located in small municipalities where they are not only the major source of direct employment but also the main factor influencing the development of ancillary industries, commerce and the possibilities for public investment via fiscal contributions. Brazil has developed a high level of self-sufficiency in the capital goods sector for the construction of sugar mills, and many municipalities in São Paulo have developed as industry clusters supplying this sector. The municipality of Sertaozinho, which has some 650 firms supplying the sugar/ethanol sector, is a case in point, and to confront the crisis has contracted services to identify other industrial sectors with demands similar to those of the sugar/alcohol sector. Some 2.2 thousand jobs were lost in Sertaozinho in 2014 and a pact was agreed on to help the unemployed – the provision of hampers at cost price, maintenance of health insurance, and lay-offs based on negotiations. Other municipalities are focusing on retraining programs and policies to attract new industries and services. While these initiatives present themselves as necessary complementary measures, the main energies of these municipalities are dedicated to demands for new policies to reactivate the sugar/ethanol sector given its overwhelming dominance in the local economy. It is clearly easier to reactivate a sector where a whole range of individual and collective competences have been consolidated. On the other hand, the vulnerability of a monocrop economy, not to mention the negative social and environmental externalities associated with this crop, suggest the importance of exploring alternative agricultural strategies.

Medium and long term challenges facing the sector and public policy responses – BNDES and Finep

In the years 2003-2008 when ethanol production was increasing 13% per annum and investments in greenfield plants and extensions to existing plants were accelerating, it seemed quiet realistic to imagine that the sugar/ethanol sector could both attend to the domestic market and assume leadership in what was considered to be an emerging global market for ethanol. By 2010-2011 with production stagnating, investments in new capacity drying up, and the global market proving to be much more modest, attention turned to the problems of supplying the domestic market.[8]

The BNDES Department for Biofuels produced a Report in 2011 which projected a domestic ethanol deficit, as flex cars make up an ever increasing percentage of the light vehicle fleet, to the order of 12 billion liters by 2015, with an accumulated deficit from 2011 to 2015 of 32.4 billion liters. Such a deficit would also stretch petroleum refining capacity and Brazil would have to import both ethanol and gasoline, (Milanez et al, 2011). The suppositions behind these projections, which seemed reasonable at the time, were that Brazil's GDP would grow at a rate of 5%, the global GDP growth rate would be 4.5% and petroleum would average out at US$88.1 a barrel. In fact, after explosive growth in 2010 (7.5%), Brazil's GDP was 2.7%, 0.9%, 2.3% and 0.1% in the following four years. Although flex cars' share of the national fleet continued to increase, car sales peaked in 2012 at 3.63 million and in the following two years declined to 3.58 and 3.33 million. Global growth rates similarly lagged behind the projection, declining or stagnating each year from 4.17% in 2011 to 3.4%, 3.41% and 3.3% in the following years. As a result, the fuel deficit for 2015 was later revised down from 12 to around 3 billion liters.

EFFECTIVE PRODUCTION, POTENTIAL DEMAND AND ESTIMATED ETHANOL DEFICIT (BILLION LITERS)

	2011	2012	2013	2014	2015	Retained Earnings 2011-2015
Effective production - sample	10.3	12.8	15.6	17.0	18.2	73.8
Effective production - remaining	14.7	15.6	16.5	16.9	17.3	81.1
Total effective production	**25.0**	**28.4**	**32.1**	**33.9**	**35.5**	**154.9**
Potential demand	**28.2**	**32.5**	**36.8**	**42.3**	**47.5**	**187.3**
Deficit	**3.2**	**4.1**	**4.7**	**8.4**	**12.0**	**32.4**

Source: BNDES

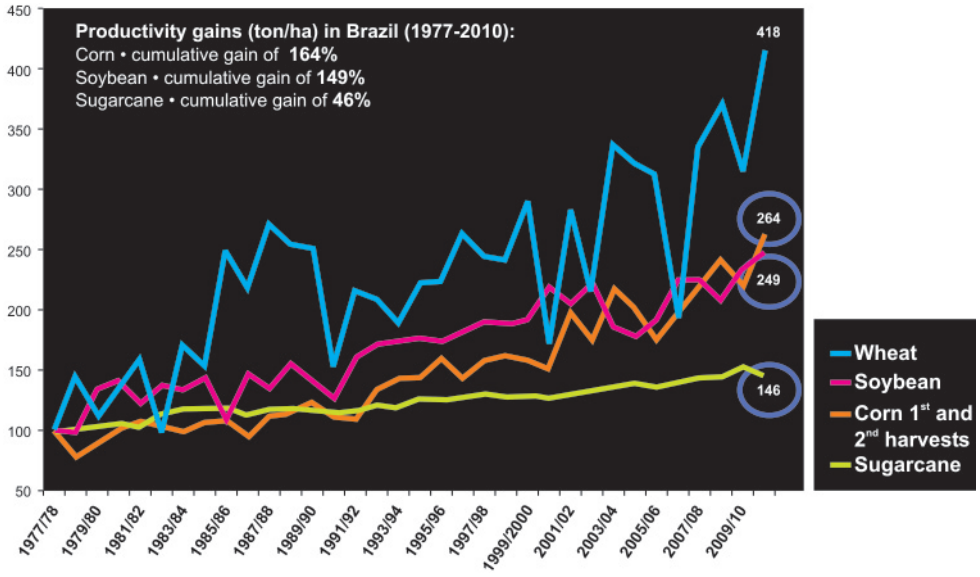
Nevertheless the BNDES and the Ministry for Mining and Energy (MME) maintained its diagnosis of the problems and challenges facing the sugar-alcohol sector on the basis of which they developed the support programs - Prorenova (Program for the Renewal of Sugarcane Production) and PAISS

8 For a more detailed account of the impact of the global financial crisis on perspectives for the sugar/ethanol sector see an earlier Report prepared for Actionaid: Wilkinson: Brazil, Biofuels and Biodiplomacy with a specific focus on Africa and Mozambique.

(Program in Support of Industrial Technological Innovation in the Sucroenergetic and Sucrochemicals Sectors), developed in collaboration with FINEP.

Stagnating or declining productivity in the sugarcane sector, evident as from 2010, could be partially explained by the combined effects of adaptation to socio-environmental standards (elimination of crop burning and mechanization) and the investment/indebtedness crisis. The rapid adoption of mechanization particularly in less than ideal conditions and persistent droughts were certainly important contributing factors. More decisive, however, was the decline in investments to renovate the sugarcane plantations and the Prorenova was designed to stimulate renewed crop investments.

At the same time a more structural cause of declining productivity was identified. When compared over the long term since the '70s, sugarcane productivity was seen to be reaching a plateau and its performance over this period has lagged far behind the other major crops. Taking 1977/8 as a base line, corn in Brazil has increased productivity by 164%, wheat by 318%, and soy by 149% whereas sugarcane has only increased by 46%.



Source: CONAB

While the ethanol deficit, which is calculated in relation to the potential demand for hydrous and anhydrous ethanol, proved to be lower than projected, calculated at some 3 billion liters in 2015, it continues to exist, and is now projected to increase to around 29 billion liters by 2024 if it is to cover also the projected deficit in gasoline.[9] The BNDES/FINEP policies for increasing the sector's competitiveness involve a transformation of agricultural productivity through genetic improvements of cane varieties and the transition to second generation ethanol, using cellulosic technology to enable the processing of bagasse and straw. Improvement in sugarcane varieties it is argued should be based on the use of advanced genetic manipulation techniques, as has already occurred in corn and soy. Such varieties are already being tested.

More importantly, expectations are concentrated on the production of a “cane-energy” variety exclusively for ethanol production and not appropriate for sugar. The following Table spells out the implications of energy-cane adoption. At current technology levels the target to meet potential ethanol demand would require investments in 97 new mills and the incorporation of a further 4.8 million hectares, half as much again as the current planted area. With the adoption of energy-cane the number of mills needed would decline to 35 and the incorporation of new land to 1.8 million hectares. An intermediary scenario combining first and second generation sugar-cane varieties would reduce demand for new mills to 58 and the incorporation of new lands to 2.9 million hectares (Nyko, 2015).

9 Brazil has a limited refining capacity and new refineries coming on line are for diesel, (Milanez et al, 2011)

SCENARIOS WITH SUGAR-CANE (1G, 2G) AND ENERGY-CANE

Biomass	Cane Area. Average New Mill	Ethanol Prod (000s liters)	No. New Mills	New Cane Area
Sugarcane (1G)	50,000	300,000	97	4.8
Sugarcane (1G+2G)	50,000	506,250	58	2.9
Cane-energy (1G+2G)	50,000	840,000	35	1.8

The energy-cane variety presupposes a transition to second generation, cellulosic ethanol, and the PAISS (1&2) Programs focus on the promotion of these second generation mills. Worldwide outside of Brazil, the U.S, has a current production of 305 million liters with three plants (POET-DSM, 95 million; Abengoa, 95 million and Dupont, 115 million liters) all using corn residues; Europe is now producing 80 million liters with one plant in Italy (M&G) which processes *Arundo donax*; and China also has one plant producing 65 million liters from corn residues.

With financing from the BNDES, Brazil now has three second-generation projects in operation producing some 185 million liters. The largest is the Granbio project in the Northeastern State of Alagoas which produces 85 million liters, followed by Abengoa, which as we have seen is also developing cellulosic ethanol in the U.S., and the 40 million liters Raizen, (Cosan-Shell), project. All three are processing cane bagasse.

Evaluations are mixed on the future of second generation ethanol. In the U.S., British Petroleum has put its plant and laboratories up for sale and the sector as a whole complains of lack of US Government support, (Nova Cana, 2015). Novozymes, the leading enzyme supplier for cellulose ethanol moved back its supply targets from 2017 to 2020. U.S. targets for the inclusion of second generation ethanol in its blending mandate have had to be continuously revised downwards, and for 2015 have been set at 400.1 million liters as against a 2007 target of 1.7 billion liters. In Brazil, production costs are still uncompetitive and calculated to remain so until the early 2020s and unexpected technical problems are slowing down production schedules. In spite of these technical problems, GranBio, officially maintains its plans for ten cellulosic plants in the coming years and argues that second generation ethanol will be 20% cheaper when it comes into full production (Nova Cana, 2015).

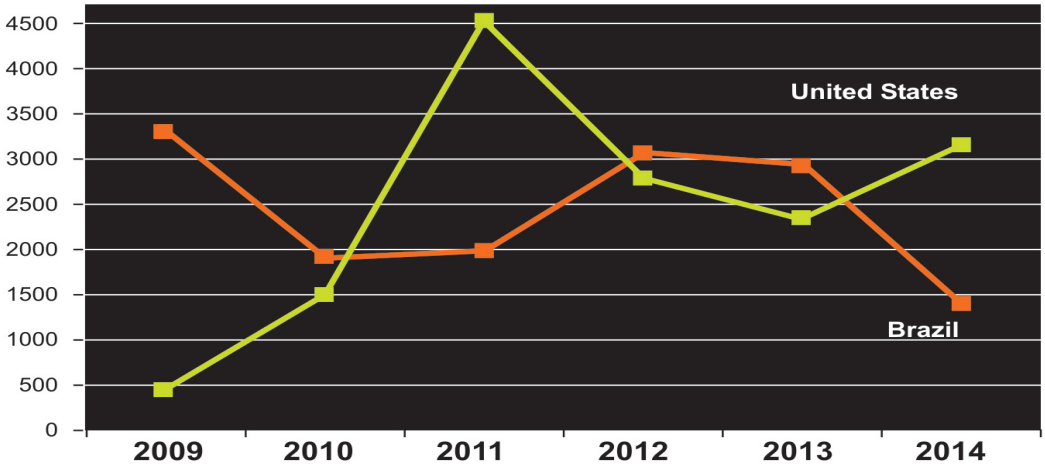
The BNDES is currently pressing for measures on the demand side similar to those adopted in the U.S. which include targets for the inclusion of second generation ethanol in the blending mandate to stimulate production.

SECOND GENERATION ETHANOL PROJECTS IN BRAZIL

International perspectives for the ethanol market

The ambitious targets set in the first decade of the new millennium by both the U.S. - 136 billion liters of biofuels by 2022 - and the E.U. - 10% renewable transport fuels by 2020 were premised on the rapid development of second generation biofuels not based on food crops (HLPE, 2013). In the case of the U.S. it was expected that 80 billion liters would come from advanced biofuels and in the E.U. it was projected that biodiesel would increasingly come from imports based on jatropha and thereby not encroach on food crops. In addition to the technological disappointments with both second generation biofuels technology and jatropha, growing opposition to biofuels particularly in the European Union has led to a reduction in biofuels blending targets using agricultural crops to a maximum of 7% and with member countries allowed to lower this level (Buchanan, 2015). In the U.S., the blending ceiling of 10% has now been reached[10]. The following Figure shows how production levelled off after 2010. However, a combination of low petroleum prices, low corn prices and renewed economic growth has favored an expansion in bioethanol production and exports by the U. S. as from 2014.

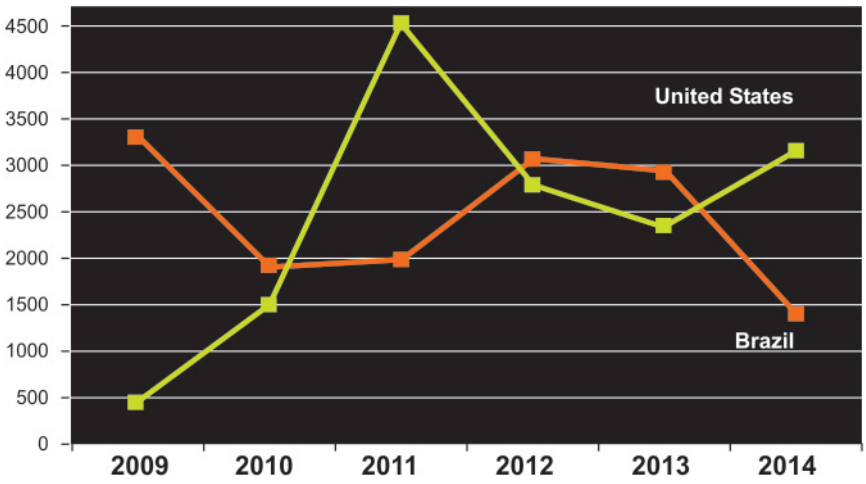
WORLD LIQUID BIOFUELS PRODUCTIONS (BILLION LITERS)



In the early years of the millennium Brazil was both the world's leading producer and exporter of ethanol, increasing its production from 15 billion liters in 2003 to 25 billion liters by 2007/8. In this same period, exports climbed to a high of 5.1 billion liters. With the 2008-9 crisis, Brazilian production stagnated and exports collapsed. In the U.S., on the other hand, production exploded from 23 billion liters in 2007 to 49 billion liters in 2010 and the U.S. took over from Brazil as the world's leading exporter of ethanol.

10 There is as yet insufficient infrastructure in place to disseminate the use of 15% blending. It is also argued that car insurance is not adjusted for such an increase in the blend. Biofuels proponents, however, accuse the petroleum lobby of blocking the increased use of ethanol.

U.S. SURPASSES BRAZIL ETHANOL EXPORTS (MILLION LITERS)

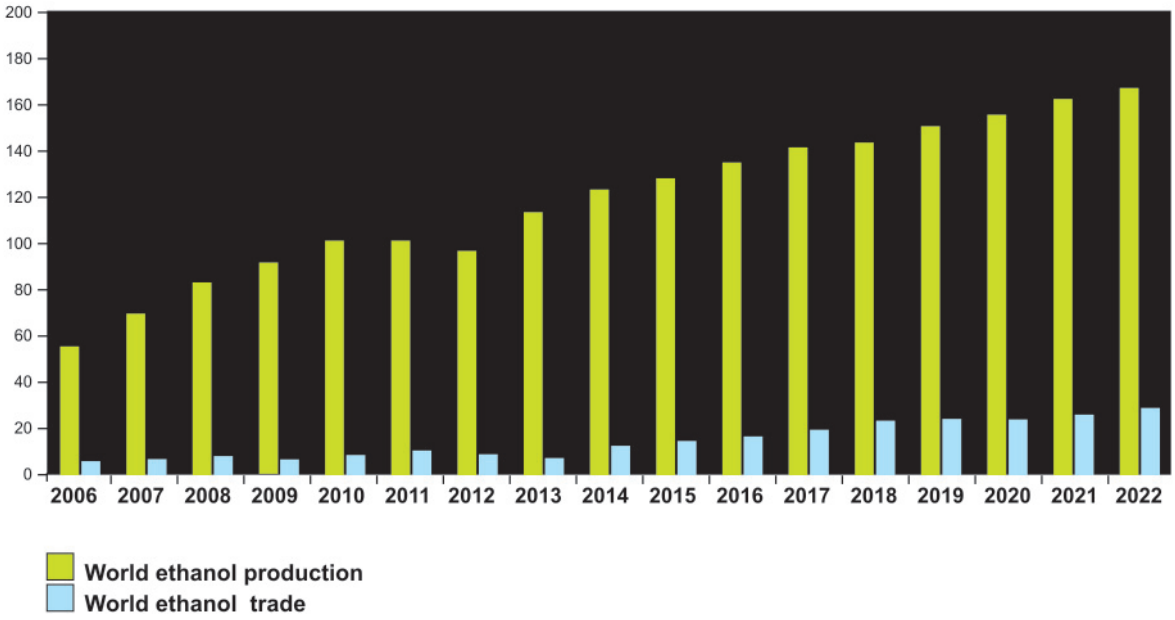


Source: FAZ Global Agricultural Trade System and Global Trade Atlas

Although over sixty countries have adopted mandates or targets, global trade in biofuels is still quite limited (see Figure below) and the emergence of a global market is still in question. Many countries with mandates/targets have very small light vehicle fleets. India, however, with a 5% mandate which is not being met by domestic production, is resorting to imports, as also are the Philippines where a 10% mandate is in place.

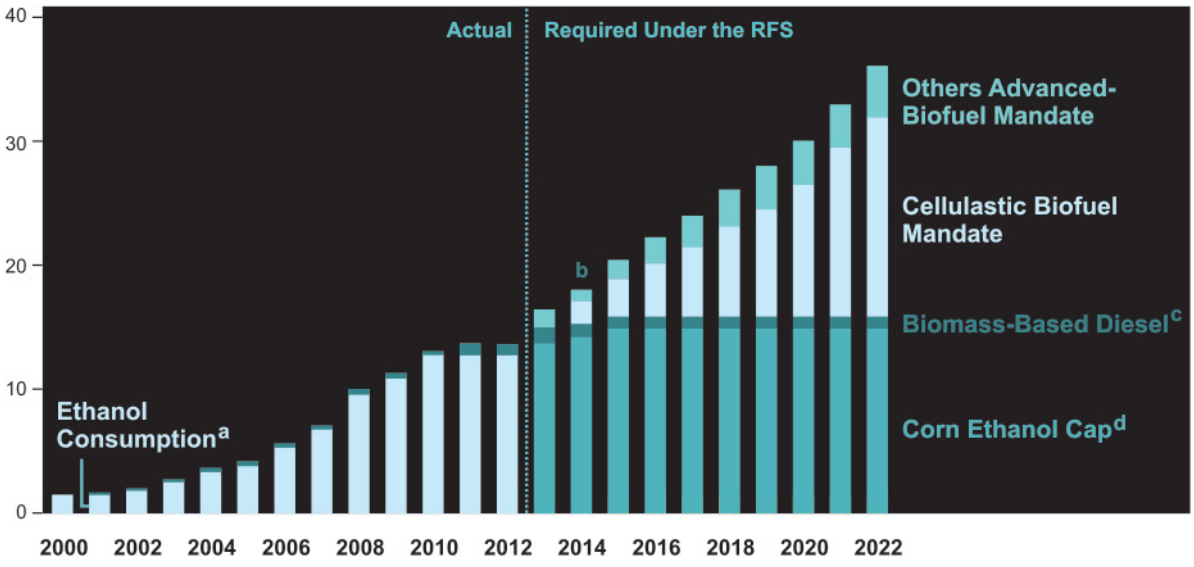
China's mandate applies to only six provinces and 30 cities in another five provinces. Biofuels have been largely based on corn and wheat but the agricultural prices hike of 2008 led to a decision not to increase the use of food crops for biofuels. Cassava has been imported from Thailand but imports of ethanol are prohibited, although a trial import was undertaken in 2014 and there is optimism that the Chinese market will eventually open (USDA/FAS/GAIN, 2015).

PROJECTED DEVELOPMENT OF THE WORLD ETHANOL MARKET



Currently Brazil and the U.S. are responsible for some 85% of world ethanol production and for a similar percentage of world trade. Brazil now primarily exports to the U.S. taking advantage of sugarcane ethanol's characterization as an “advanced biofuel” which has a current quota of up to 10 billion liters in the U.S. blending regulation, decided on a yearly basis by the U.S. Environmental Protection Agency (EPA).[11] With the slow down and even stagnation of production in Brazil, the U.S. also exports to Brazil to ensure this latter's obligatory blending regulation, increased in 2015 to 27%.

PAST USE OF RENEWABLE FUELS AND FUTURE REQUIREMENTS OF THE RENEWABLE FUEL STANDARD (BILLIONS OF GALLONS)



RFS = Renewable Fuel Standard
EISA = Energy Independence and Security Act
EPA = Environmental Protection Agency

Source: Vox Energy & Environment[12]

The main destiny for U.S. exports, however, is Canada which has a 5% blending mandate and in 2014 accounted for 40% of total U.S. ethanol exports. In 2011, 25% of U.S. ethanol exports were to the E.U. but by 2014 this had dropped to 6% after the E.U. imposed anti-dumpíng duties. As a result the U.S. has considerably diversified its exports, but the levels of these exports have remained more or less stable at 3 billion liters.

11 In addition to the 10% blending wall, first generation food crop, basically corn, biofuels are to be capped at 56.8 billion liters.

12 Available in: http://www.vox.com/2014/11/21/7259885/the-fight-over-ethanol-and-the-epa-explained

Conclusion

Based on the above analysis, we would single out the following issues for further examination. In the first place, it is clear that the future of the sugarcane-alcohol sector must be analyzed within the broader framework of energy policy. The perspectives for transport fuel are challenging as we have seen and ethanol plays an increasingly central role. In addition to its contribution to transport fuel, this sector is increasingly important as a supplier of bio-electricity, particularly given the current and foreseeable limitation of hydroelectric supplies. For this to happen, policies and investment priorities need to be defined. New developments in bio-ethanol, which need further research, include the promotion of corn ethanol in the Center-West region and, in particular, rice ethanol in the State of Rio Grande do Sul. This latter is especially important given both the small-scale of the projected plants which raises the issue of the potential for small farmer inclusion and local development, but also for the proposed use of specially adapted non-comestible rice varieties. This initiative is still at a very early stage but merits monitoring. The BNDES and FINEP are firmly committed to pushing the sector forward towards second generation biofuels since even without a global market the challenges posed by the growth of the domestic market for both anhydrous and hydrous ethanol are formidable. A range of issues are worth further research here, particularly the trade-off between dedicated new cane-energy varieties, using advanced genetic techniques and a fivefold reduction in new land needing to be taken into cultivation to reach production targets. And finally the effects of the crisis in the sector on local and regional development should be further researched given the levels of unemployment and the generalized decline in economic activity in many municipalities dependent on the sugar-alcohol sector.

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