Sugar-Energy Sector

BIOETHANOL – THE RENEWABLE FUTURE

INDUSTRY MEETING FOR SUSTAINABILITY

CNI – NATIONAL CONFEDERATION OF INDUSTRY – BRAZIL

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FORUM NACIONAL SUCROENERGÉTICO

CNI SESI SENAI IEL

CNI
National Confederation of Industry
Brazil

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SUMMARY

CNI PRESENTATION

The diversity of the national industry and the significant availability of natural resources reveal excellent opportunities for the sustainable development of Brazil, combining economic growth, social inclusion and environmental conservation. The materialization of concerns related to sustainability in the strategic agenda of enterprises and governments is a reality. Apart from isolated cases of success, the consequences of this attitude are felt in entire sectors of the economy. Further advances are still needed, but the path has already been identified and going back is impossible.

After coordinating an unprecedented critical thinking process on sustainability with 16 industry associations, the National Industry Confederation (CNI) delivers to the Brazilian society a wide range of information on progress, challenges and opportunities yet to come. The results presented here may not portray the significance of the discussion process experienced by the industry in preparing these documents. Developments on the process will be beyond the Rio +20 Conference, and are definitely incorporated on the daily lives of companies.

The subject of sustainability is inserted differently in each of the industrial sectors. However, some elements are common to all. The continuous pursuit for efficiency in use of resources and the need to increase industrial competitiveness are on the agenda of all the sectors. Encouraging innovation and scientific and technological development is strategic on the transition to more sustainable patterns of production.

Strategies to intensify actions coordinated internally in the industrial sectors and with governments and civil society organizations are no less important. The dissemination of sustainable practices by means of the supply chain and incentives for companies to undertake the role of integrated management of the territories are powerful tools.

The sectorial volumes developed by industry associations are valuable contributions to addressing subjects such as sustainability and competitiveness of domestic industry. One of the most representative results of this process will certainly be the strengthening of structured programs of action with a focus on promoting sustainability in the production. These initiatives will act as raw materials so that the industries involved and CNI are able to systematically publish documents presenting the national industry´s developments towards the goals of sustainable production.

The documents presented here are intended to be a valuable contribution to enhance the debate on sustainability. Each of the sectorial associations is to be congratulated for their efforts.

Robson Braga de Andrade
President of the National Confederation of Industry – Brazil

SECTORIAL PRESENTATION

The sugar-energy sector has contributed to Brazil excel in the use of renewable energy, which represents more than 45% of the energy mix. Only the sugarcane products are responsible for 17.8% of all primary energy supply in the country, surpassing the power supplied by hydroelectric plants.

The importance of this sector as a source of employment generation, income, taxes and engine of development in the interior of the country, is presented in this Sectoral Fascicle, as well as its direct benefits and positive externalities, particularly to the demand in order to boost the resumption of the investments and a new growth cycle.

Due to its characteristics and the impacts it generates, the Brazilian sugar-energy sector proved that it is possible to achieve balance in the evolution of economic, social and environmental aspects of sustainable development.

This is also the only agribusiness sector in which Brazil has mastery of technology, both in agricultural and industrial fields, with extensive stock of innovations that could be implemented and great potential for a new productive leap.

Opportunities abound for this sector to consolidate even more and continue giving its great contribution to the development of the country and also of other countries with experience transfer and improvement of its environmental conditions.

Luiz Custódio Cotta Martins
Coordinator of the Brazilian Sugar-Energy Forum – FNS

1 INTRODUCTION

The sugar-energy sector in Brazil includes all activities related to agricultural and industrial production of sugar, ethanol and bioelectricity. In Brazil, these products derive almost exclusively from processing sugarcane used for industrial purposes[1]. There is also a volume of sugarcane produced for other uses, mainly animal feed and processing in brandy (aguardente).

The Sugar-Energy National Forum represents the sugar-energy sector at production level and on a national basis. The Forum includes the following unions and producers associations:

- Bioenergy Producers Association of the State of Paraná – Alcopar;
- Alcohol Manufacturing Industry Union of the State of Mato Grosso do Sul – Biosul;
- Alcohol Industry Union of the States of Rio Grande do Norte, Ceará and Piauí – Sonal;
- Alcohol Manufacturing Industry Union of the State of Minas Gerais – Siamig;
- Ethanol Manufacturing Industry Union of the State of Goias – Sifaeg;
- Alcohol Manufacturing Industry Union of the State of Paraiba – Sindálcool/PB;
- Sugar and Alcohol Industry Union of the State of Alagoas – Sindaçúcar/AL;
- Sugar and Alcohol Industry Union of the State of Bahia;
- Sugar and Alcohol Industry Union of the State of Pernambuco – Sindaçúcar/PE;
- Sugar and Alcohol Industries Union of the State of Mato Grosso – Sindálcool/MT;
- Sugar, Alcohol and Sugarcane Producers Union of the State of Piauí – Sindaçúcar/PI;
- Sugar and Alcohol Producers Union of the State of Rio de Janeiro – Sindaaf;

1 During the 1970's, initiatives have been developed for the production of ethanol from cassava processing in the states of Rio Grande do Sul and Mato Grosso, and from timber in the state of Minas Gerais. However, due to economic and technological issues, these initiatives using other biomass sources besides sugarcane did not prosper.

- Brazilian Sugarcane Industry Association – Unica;
- Bioenergy Producers Union – UDOP;
- Industry Union for Industrial Chemicals, Pharmaceuticals, Manufacturing of Animals and Vegetable Oils, Soap and Candles, Manufacturing of Alcohol, Coatings and Fertilizers and soil additives of the State of Espirito Santo – Sindquímicos
- Sugarcane, sugar, and alcohol producers Union of the States of Maranhão and Pará – Sindicanalcool.

The sectoral issue on the sugar-energy sector, prepared by the Sugar-energy National Forum, aims to portray the sector from the economic, social and environmental points of views. The issue also discusses the main outlines of the sector´s current regulations and the most relevant business practices aimed at sustainable development. It also points out what are the main challenges and opportunities for the sugar-energy sector on the path towards sustainability.

The sugar-energy sector is considered one of the most successful examples of an integrated strategy for decentralized economic development, which is capable of achieving high level of sustainability over time. The integrated and sustainable energy and food production from sugarcane preserves natural resources and respects the environment and this resulted in poverty and misery reduction and in a recognized impact on the development of the regions where production is installed.

In regards to economic field, the sector's contribution has been significant, mainly because of its remarkable multiplier effect on the economy and its significant foreign currencies savings in fuel imports.

Concerning the social and environmental fields, the development of the sector has enabled a significant improvement in the conditions and quality of employment, and presented significant gains in reducing the emission of exhaust gases from light vehicles. It has also contributed greatly in reducing greenhouse gas effects (GHG)

Due to its characteristics and the impacts it generates, the Brazilian sugar-energy sector has proved that it is possible to achieve balance in the development of the economic, social and environmental dimensions of sustainable development. It is important to note that this experience can be transferred successfully to other countries, provided that the basic conditions of regulation and initial support are well established.

The sugar-energy sector is also the only agro-industrial sector in which Brazil has full domain over its technology, in both agricultural and industrial fields, with a vast stock of innovations yet to be implemented, and great potential for a new leap in productivity.

The direct benefits and positive externalities from the development of the sugar-energy sector are recognized and indisputable. The demand for ethanol, bioelectricity and sugar, both in the domestic and foreign markets, continue to grow. However, recent evidences of government regulations have generated uncertainties that discourage new investments to increase industrial capacity. Therefore, the greatest challenge of the Brazilian sugar-energy industry is to change this scenario and resume their upward trend.

2 ECONOMIC, SOCIAL AND ENVIRONMENTAL CHARACTERIZATION OF THE SUGAR-ENERGY SECTOR

2.1 Economic Characterization

2.1.1 Description of the production chain

Brazil has a prominent position worldwide in renewable energy use, which represents more than 45% of the country's energy matrix. The sugar-energy sector has key role in this, as sugarcane´s products alone are responsible for 17.8% of all primary energy supply in the country, exceeding the share supplied by hydroelectric plants (EPE; MME, 2011).

From sugarcane´s introduction in Brazil in 1532, until the beginning of the diversification process of sugar and ethanol production in 1975, the sugarcane crushing for industrial use reached 68.3 million tons. Until 2010, 35 years later, it went up to 620.0 million tons. It is estimated that by 2020, the demand for sugar and ethanol in domestic and foreign markets, will require that the annual crushing of sugarcane double to about 1.2 billion tons.

Sugarcane is produced in 22 of the 27 states of the Federation, and in 2010 occupied 9,147,238 hectares of cultivated area. Of this total, 4.957 million hectares were converted into ethanol, which represented only 0.5% of the national territory, and 1.46% of total arable area of the country[2]. This area was able to generate enough ethanol to meet the domestic and foreign markets, and replace 44.6% of the gasoline consumed in the country in 2010 (DATAGRO, 2011).

2 Considering a total of 340 million hectares of arable lands, according to Embrapa

The sugarcane production chain consists of the following subsectors:

- Input/raw materials suppliers, agricultural implements, tractors, planters and harvesters, fertilizers, chemicals for crop protection (fungicides, insecticides, herbicides), suppliers of fuels, lubricants and greases;
- Agricultural and industrial service providers;
- Farmers and sugarcane suppliers;
- Land owners, lessors and agricultural partners;
- Suppliers of equipment, facilities and industrial projects;
- Sugar, etanol and bioelectricity producers;
- Trading companies;
- Fuel distributors;
- Retail fuel stations – Gas stations.

An important feature that distinguishes the Brazilian sugar-energy sector is the flexibility in producing food and energy: sugar, ethanol and bioelectricity. Ethanol, a clean, renewable, high-octane fuel, can easily replace petrol, and is becoming an important input for the production of various high added value products. Bioelectricity is a clean and renewable energy generated from bagasse and straw. As a result of the reinvention of the sugarcane industry with new technologies, sugarcane is considered the best crop for producing fuels and low carbon electricity. This came about because of the possibility of producing food and energy from a single integrated industrial park. The bioelectricity from sugarcane residues is potentially very significant, reaching 13,158 MW in 2020 (Jank, 2011).

The choice between producing anhydrous ethanol, hydrated ethanol or sugar was previously determined and driven by the public sector, through Annual Harvest Plans. Recently, it became a more efficiently decision taken solely by the private sector, based mainly on the relative prices of products. The flexibility in the combination of end products, in response to changes in relative prices, is one of the factors that favour the sugar-energy sector when compared to other national agri-industrial, and similar sectors in other countries.

2.1.2 Value of the domestic production of the sector

The value of the sugarcane production in 2012 was R$ 28.31 billion, which represented 18.4% of the total value of the Brazilian agricultural production. In terms of participation, sugarcane is in the second place, after soybean, with 24.3%, and immediately above corn, with 9.9%. Considering that the areas occupied by soybean and corn were, respectively, 23.34 and 12.97 million hectares[3], the production value per hectare of the sugarcane, R$ 3,095, was practically twice the value of soybean, R$ 1,603, and three times the value obtained for corn, R$ 1,175.

2.1.3 Production growth rate of the sector

Since the diversification of the production started with the large scale production of ethanol, in 1975, while the sugarcane crushing grew 8 times, the total production of sugar and ethanol, evaluated in terms of Total Recoverable Sugar (TRS), increased by 11 times, from 7.13 to 86.88 million tons. Ethanol production grew 48 times, from 0.55 to 27.37 billion liters (11.8% CAGR) and the sugar production increased 5.5 times, increasing from 5.88 to 38.0 million tons (5.5% CAGR). In 2010, the production of anhydrous ethanol, mainly used in mixture with gasoline, reached 8.32 billion liters, and the production of hydrated ethanol, mainly used by the fleet of ethanol vehicles, or by the flex-fuel fleet, reached 19.05 billion of liters.

TABLE 1. THE EVOLUTION ON SUGAR CRUSHING AND THE SUMMARY OF PRODUCTION, 1975/76 AND 2012/11

Safra	2010/11	1975/76	Var. %
Cana (milhão tons)	620.00	68.32	807.5%
Oferta ATR (milhão tons)	86.88	7.13	1118.6%
Açúcar (milhão tons)	38.00	5.89	545.2%
Etanol (bilhão litros)	27.37	0.55	4876.4%
% cana para etanol	54.2%	13.4%	
% cana para açúcar exportação	30.8%	16.8%	
% cana para etanol exportação	3.9%	0.0%	

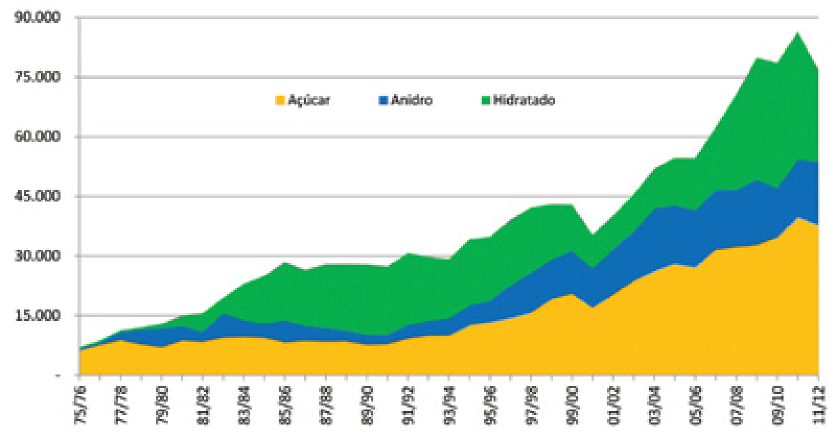
Source: NASTARI, 2012a.

It is important to note that already in 1975/76, 16.8% of the sugarcane was directed for exports as sugar; however, the exported value was of only 1.15 million tons. In 2012/11, the percentage of sugarcane directed for exports as sugar was 30.8%, but the volume had grown to 25.6 million tons.

3 Em todo o Brasil, foram destinados 63,98 milhões de hectares para a agricultura, incluindo culturas temporárias e permanentes, em 2010, segundo o IBGE.

On the 2011/12 harvest, sugarcane crushing decreased temporarily to 561.07 million tons mainly because of weather-related factors. The conversion of the sugar and ethanol production to a common denominator, total recoverable sugar, allows for a better understanding of how the production diversification on the sugar-energy sector evolved from1975.

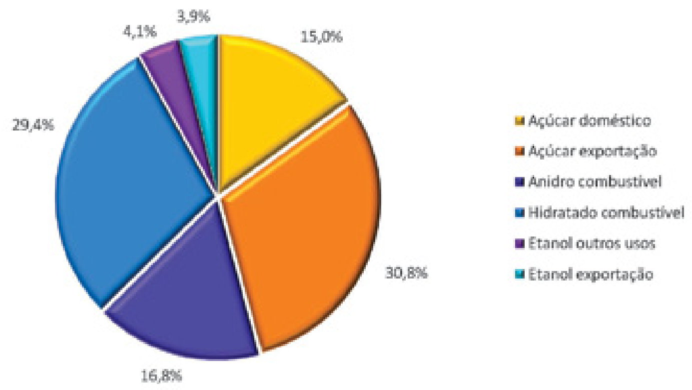
CHART 1. EVOLUTION ON THE OFFER OF TOTAL RECOVERABLE SUGAR (TRS, SUGAR PLUS ETHANOL), 1975/76 TO 2011/12, IN 000 TONS PER YEAR



Source: NASTARI, 2012a.

Na safra 2010/11, a produção total de açúcar e etanol, em ATR, foi destinada para os seguintes mercados: 15,0% açúcar doméstico; 30,8% açúcar de exportação; 16,8% etanol anidro combustível; 29,4% etanol hidratado combustível; 4,1% etanol anidro e hidratado para outros usos; e 3,9% etanol anidro e hidratado para exportação.

CHART 2. DISTRIBUITION OF THE PRODUCTION BY FINAL DESTINATION, 2012/11 HAVEST, BRAZIL, AS A PERCENTAGE OF TRS FOR EACH MARKET



Source: NASTARI, 2012a.

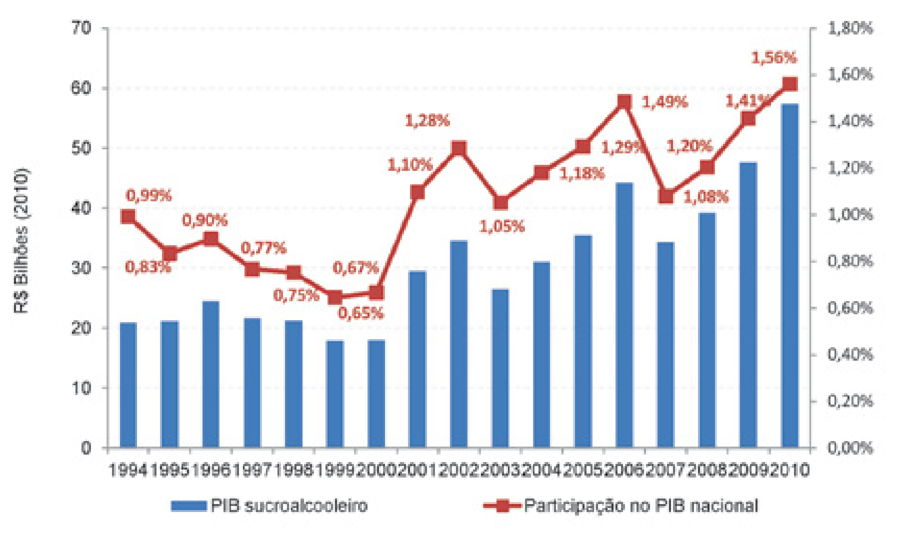
2.1.4 Sector participation in the Brazilian industrial GDP

The GDP of the sugar-energy sector is estimated at R$ 57.33 billion in 2010[4], which is equivalent to 1.6% of the total GDP. Since 1992, the sectorial GPD grew 170%, in 2010 constant currency. The sugar-energy sector GDP represented, in 2010, 9.9% of the agriculture GDP and 7.0% of the total Brazilian agriculture and livestock GPD.

The breakdown of the sectorial GDP shows that, in 2010, the ethanol sold in the domestic market accounted for 49.3% of the total; whilst ethanol for export market, accounted for 4.0% only. The sugar for the internal market, accounted for 11.8%, and the sugar for the export market, for 35.0%[5].

The expansion of the sugar-energy sector has brought a large multiplier effect in the Brazilian economy. Since 2005, 117 new sugar, ethanol and bioelectricity producing units, went into operation. The impact of building these new plants boosted other economic sectors, such as construction, steel, manufacturing of tractors, machinery and other capital goods, fertilizers, crop protection products and many others.

CHART 3. GDP OF THE SUGAR AND ALCOHOL SECTOR AND ITS PARTICIPATION IN NATIONAL GDP, FROM 1994 TO 2010



Source: FREITAS; NASTARI, 2011.

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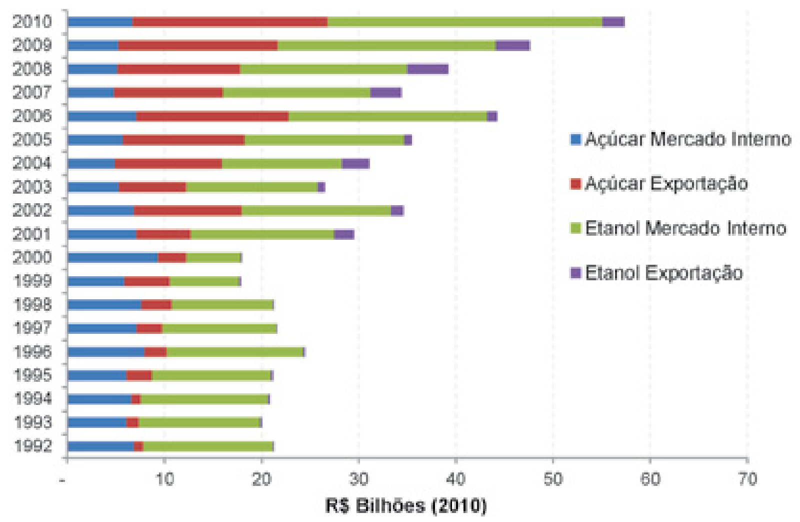
4 At constant prices, free of taxes. Source: FREITAS; NASTARI, 2011.

5 FREITAS; NASTARI, 2011.

CHART 4. PARTICIPATION OF END PRODUCTS IN THE SUGAR AND ALCOHOL GDP, FROM 1992 TO 2010



Source: Datagro.

The heating up of the labor market has brought positive impact on the interiorization of the development. Studies indicate that the installation of 41 new sugar-energy plants was responsible for a variation of 0.55% on the Brazilian GDP (TERCIOTE, 2006).

The development of new poles of economic growth is remarkable in regions where pastures have been replaced by sugarcane, such as Ribeirão Preto, São José do Rio Preto, Araçatuba, Presidente Prudente and Bauru, all in the state of São. This transformation process, generated by the development of the sugarcane culture and its processing, begins to impact, in a decentralized manner, new regions located in the states of Minas Gerais, Goiás, Mato Grosso do Sul, Tocantins e Bahia. .

The contribuition of the sugar-energy sector to the economy can also be perceived when looking at the municipalities GDP performance. Data available from IBGE show that Monções, a small town in the interior of São Paulo, recorded the highest growth rate among all municipalities in Brazil, from 2008 to 2009. The GDP in that city increased almost five times, from R$ 29.9 million, in 2008, to R$ 143.8 million, in 2009. This high growth rate is due to the installation of a sugarcane processing plant, whose operations began precisely in 2008. In 1999, the Monções GDP was only R$ 9.2 million.

According to from IBGE´s last survey, the GDP growth rates from other cities in São Paulo, whose economies are based on the sugarcane industry, also stood out nationally. This is the case of Brejo Alegre, that increased its GDP by three times from 2008 to 2009 and by nine times since 1999. A new sugar and ethanol plant went in operation in 2008 in Brejo Alegre, crushing 942 thousand tons in the harvest of 2008/09.

Other economies in the most traditional sugarcane regions of the state of São Paulo also take part in the sector´s intense phase of expansion. This is the case for the city of Ribeirão Preto, considered the national capital of the sugar-energy agribusiness. Its GDP grew to R$14.7 billions, which corresponds to a growth of 198% in nominal terms, or 32% in real terms, between 1999 and 2009. The fairly high socioeconomic development status of Ribeirão Preto confirms the potential contribuition the sugar-energy sector has to offer.

The inauguration of new sugarcane plants not only provided the enrichment of cities, but improved their quality of life index. The FIRJAN Municipal Development Index (FMDI)[6] of the municipality of Monções confirmed positive developments in the entire history, from 2000 to 2009, increasing from 0.5954 para 0.8364. It is a simple interpretation. The FMDI index ranges from 0 to 1, and the closer it gets to 1, the higher the local development. A FMDI above 0.8 indicates high development.

2.1.5 Number of Jobs created by the sector

Between 1992 and 2009, the number of people employed in the agriculture and livestock sector decreased from 18.4 to 15.5 million. In that same period, the number of people working in the agriculture sector decreased from 12.6 to 9.7 million)[7]. The number of people employed in sugarcane plantations reduced strongly after the sugarcane agroindustry deregulation, which occurred in the 1990s, due to the innovation in the production process. However, between 1999 and 2009, the sector´s new cycle of expansion, the volume of employment in sugarcane grew at an average rate of 2.1% per year.

Between 1992 and 2009, the average labor productivity in sugarcane plantation increased from 291.4 to 998.6 tons per job. In some micro-regions, the average productivity exceeded 1,600 tons of sugarcane per job, particularly in South-Central region.

In the other states of South-Central region, except São Paulo, where part of the sugar-energy sector expansion took place, the licensing for the installation of new plants was conditioned to practices in which the burning of the straw could not be applied, from the beginning of operation. This requirement led to the introduction of mechanized harvesting, and, often, to mechanized planting as well, contributing significantly to the increase on the average labor productivity in those states.

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6 The FIRJAN Municipal Development Index (FMDI) is an annual study part of the Firjan System that monitors the development of all 5,564 Brazilian municipalities in three areas: employment and income, education, and health. It is constructed exclusively based on official government statistics, provided by the Ministries of Labour, Health and Education.

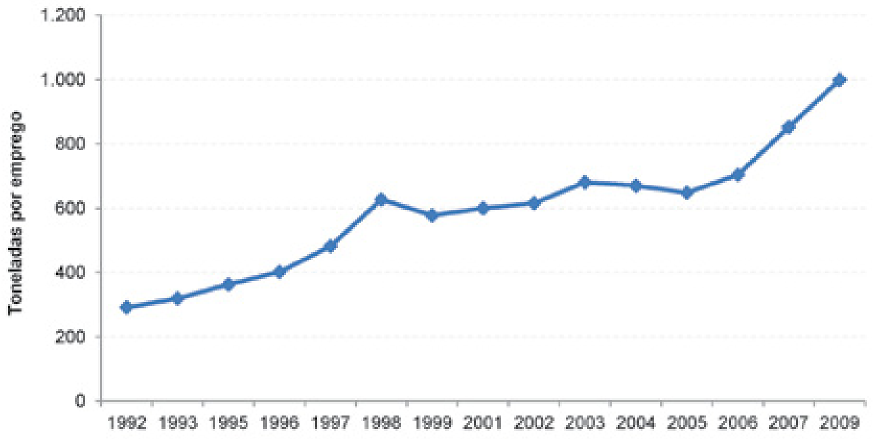
7 National Survey by Household Sample/IBGE.

CHART 5. NUMBER OF PEOPLE EMPLOYED IN SUGARCANE PLANTATIONS IN BRAZIL (ONLY AGRICULTURAL AREAS), 1992-2009

Source: PNAD/IBGE.

In the state of São Paulo, by means of Law No. 11241, of September 2002, it was determined that the burning of sugarcane should be banned by 2021 in mechanized areas and by 2031 in non-mechanized areas. Even so, representatives of the agroindustry (Unica) and the state government of Sao Paulo signed a cooperation protocol in 2007, aiming to voluntarily anticipate the elimination of the use of fire in harvesting by 2014 on land apt for mechanization (with slopes below 12%) and, by 2017, on other areas. Moreover, the burning would not be allowed on new areas of expansion.

CHART 6. AVERAGE LABOR PRODUCTIVITY IN SUGARCANE PLANTATIONS, FROM 1992 TO 2009



Source:. Datagro, employment data from PNAD/IBGE.

Considering integrated production, from the cultivation of sugarcane to the production of sugar and ethanol, the sugar-energy sector was responsible for 1.12 million formal jobs in 2011[8]. This means that the sugar-alcohol sector accounted for 1.93% of the all workforce formally recorded in the country, or that one in every 50 formal workers are employed by the sector.

2.1.6 The Sector´s export value and its share in Brazil´s total exports

The sugar-energy sector´s exports, in volume and total value, as well as the participation on the country's total exports, were driven by several factors since the early 90s. The extinction of state monopoly on sugar exports in 1990, as part of the deregulation process, allowed the industry to begin to finance its expansion with future export contracts.

A second reason is related to the changes in Brazilian exchange rate policy, in January 1999, when, the so called "band exchange rate regime", which determined the limits of foreign currency price fluctuation, was terminated and the floating exchange rate regime was adopted. The exchange rate liberalization was accompanied by a gradual devaluation of the Brazilian currency, which increased the competitiveness of domestic products, favoring, among others, the sugar-energy export sector.

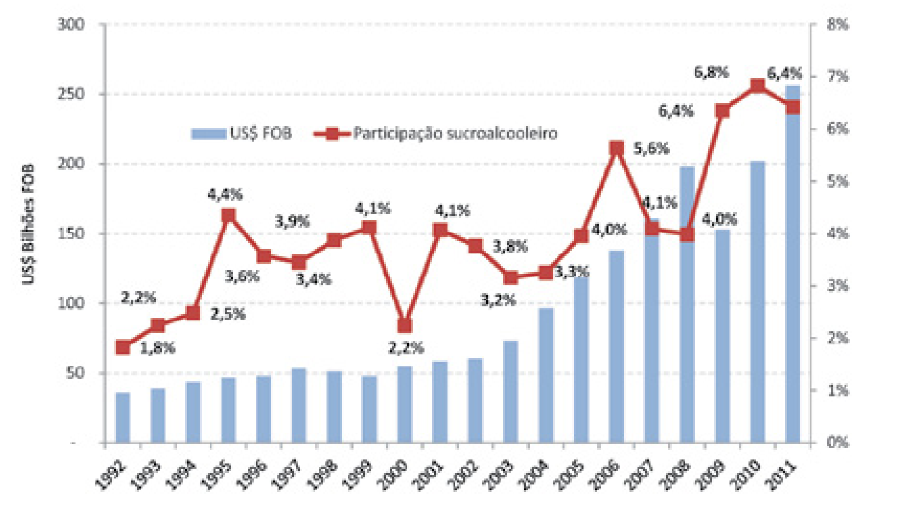
Other reasons contributed to the expansion of sugar exports: (i) the continuous increase of global demand, which grew at a rate of 2.1% per year over the period of 1991 to 2010; (ii) Brazil's ability to produce raw sugar of high polarization in bulk, adequate under the tougher standards required by the new independent sugar refineries, which began to demand a higher quality raw material; and (iii) the reform of the common sugar regime in the European Union, implemented after the World Trade Organization´s decision on its subsidized sugar exports that could not exceed the limit agreed in the Uruguay Round, of 1.3 million tons per year.

Finally, and most recently, the introduction of flex fuel vehicles in Brazil, starting in 2003, which encouraged the renewal of ethanol production, creating new growth momentum for the sugar-energy sector. As a consenquence, there was an increase in the use of ethanol by the domestic market to replace gasoline, which resulted in less expenses with the imports of oil and derivatives.

Taking into account all revenues from sugar, ethanol and sugarcane syrup exports, the sugarcane agroindustry increased its share in the total exports of the country, from 1.8%, in 1992, to 6.44%, in 2011.

8 Data from the Ministry of Labour.

CHART 7. SUGAR, ETHANOL AND SUGARCANE SYRUP EXPORTS SHARE IN THE TOTAL BRAZILIAN EXPORTS, FROM 1992 TO 2011

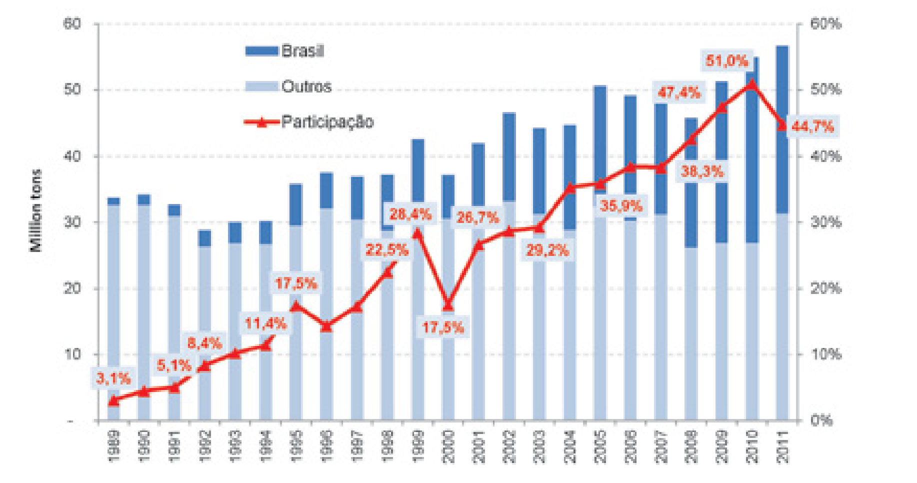


Source: Datagro.

The increase on the sector´s participation on the total exports is explained by the fact that Brazilian sugar exports increased by more than 10 times, from 2.4 million tons in 1992 to 28.0 million tons in 2010, thereby accounting for 51% of the world's sugar exports. Due to adverse weather, in 2011, this number dropped to 25.4 million tons, and the share decreased to 44.7%.

In numbers, sugar exports generated US$ 14.94 billion in revenues in 2011, compared to only US$ 598.84 million, in 1992. The main destinations of Brazilian sugar are Russia, China, Egypt, UAE, Algeria, Saudi Arabia, Bangladesh, Nigeria, Malaysia and Canada, which represents 59.3% of the total.

CHART 8. BRAZILIAN SUGAR EXPORTS AND ITS PARTICIPATION ON THE GLOBAL SUGAR EXPORTS, FROM 1992 TO 2011



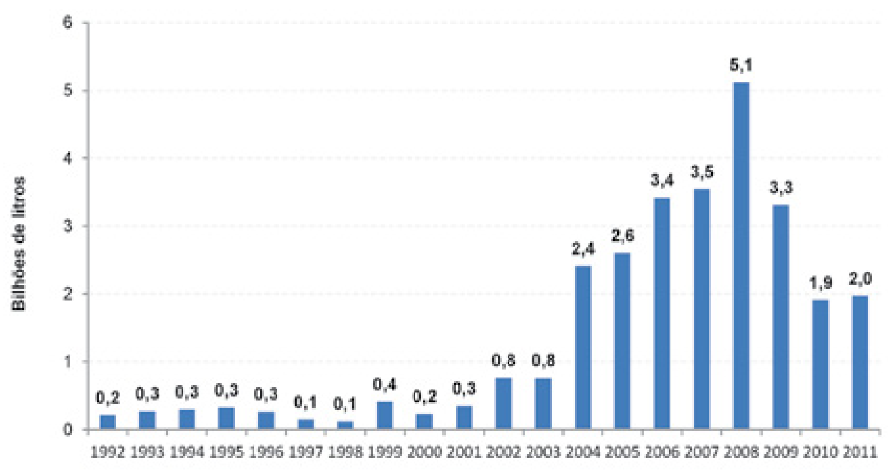
Source: Datagro.

Ethanol exports started to grow in 2004, when the world began to encourage consumption of renewable fuels. Because of this and the increase in the domestic supply, Brazil was able to export 5.1 billion liters of ethanol in 2008, of which 1.52 billion liters were shipped directly to the United States, followed by the Netherlands, with 1.33 billion liters. Considering the dehydration of ethanol in Caribbean countries members of the Caribbean Basin Initiative (CBI) for further export to the United States, which represented 1.13 billion liters in that year, the total volume shipped to the U.S. was 2.65 billion liters.

However, since 2009, ethanol exports have decreased as a result of the reduction of exportable surplus, eventhough there is still a huge potential to be exploited in the medium term. Currently, the global demand for ethanol for fuel use, estimated at 88.2 billion liters in 2010, is already responsible for 7.12% of the global consumption of gasoline, and continues to grow. At the same time, it is expected that the global demand for fuels for vehicle should grow at least 97% by 2015.

In 2011, Brazil exported 1,967,556 cubic meters[9], generating US$ 1.49 billion of revenues. The main destinations of ethanol exports in 2001 were the United States, South Korea and Japan, which absorbed a volume of 655.88, 303.1 and 282.7 million liters, respectively. If the mixture of 10% is implemented worldwide, the global demand for ethanol should rise to 123.9 billion liters, equivalent to 206.5 million tons of sugar, which corresponds to 122.5% of the world demand.

CHART 9. EVOLUTION OF BRAZILIAN ETHANOL EXPORTS, FROM 1992 TO 2011

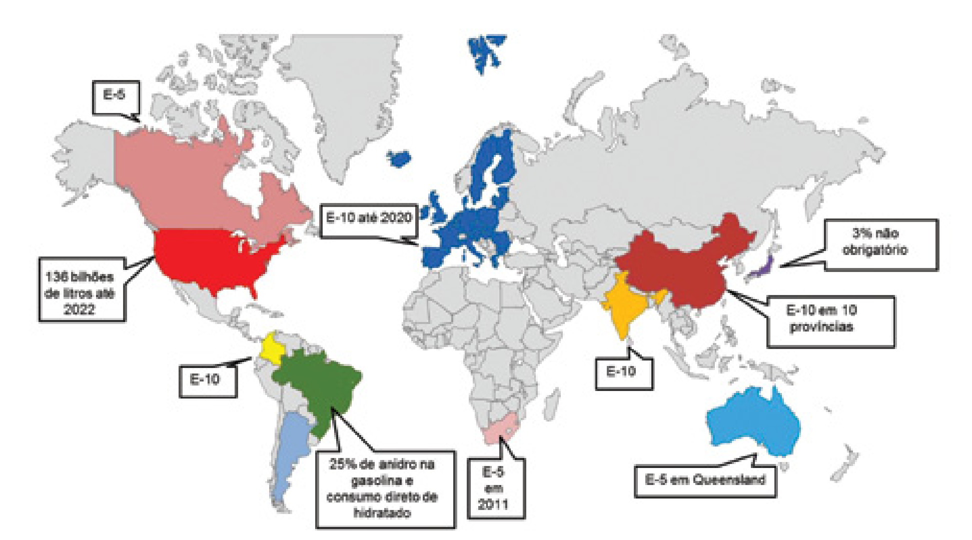


Source: Datagro.

There are an increasing number of countries encouraging the use of ethanol, many of which are already large-scale sugar producers.

9 One cubic meter equals one thousand liters.

FIGURE 1. POLICIES ADOPTION TO ENCOURAGE THE USE OF ETHANOL IN SEVERAL COUNTRIES



Source: Datagro.

2.1.7 Value of imports and the participation in the total Brazilian imports

Currently, the sugar and ethanol imports represent only 0.37% of everything that is imported by Brazil, in revenue. This participation was even lower until 2009.

The imports were only occurring to meet special demands, and were never associated to a lack of supply, except starting in 2010, when the sugarcane fields suffered three years of adverse weather, which limited the growth of the domestic production. Despite the increase in ethanol imports and the decrease in sugar exports, in 2011, the trade balance of the sugar-alcohol sector, which is the difference between exports and imports, grew in comparison to the previous year, increasing from US$ 13.7 billion, in 2010, to a record of US$ 15.6 billion, in 2011. This growth is attributed to the increase in the price of sugar and ethanol in the international market.

To evaluate the impact of the sector on the trade balance and, consequently, on the country´s revenues generation, it is important to take into account the amount of gasoline that ceased to be not imported and the amount of gasoline that began to be exported due to the domestic consumption of ethanol.

It is estimated that in 2011, there was a consumption of 19.91 billion liters of ethanol, anhydrous and hydrated, in Brazil, which is equivalent to 16.18 billion liters of gasoline. This volume enabled a foreign currency savings of US$ 11.74 billion, which means that the sugar-energy sector's contribution to the trade balance was of US$ 27.34 billion, in 2011, compared to US$ 23.51 billion, in 2010, and to only US$ 1.589 billion, in 1992.

In cumulative terms, the foreign currency savings with the avoided imports of gasoline, due tof the use of ethanol fuel, had very significant impacts. From 1975, when the large-scale ethanol use program started in Brazil, until 2011, the total consumption of ethanol for fuel purposes totaled 388.28 billion litters. From 1992 to 2011, the total volume of ethanol consumed for fuel purposes was 285.09 billion liters.

From 1975 to 2011 the consumption of ethanol fuel as gasoline equivalent denoted the replacement of 331.14 billion litters of gasoline. This volume is equivalent to 2.08 billion barrels of gasoline. From 1975 to 2011, according to Datagro surveys, the price of the replaced gasoline, according to its world´s market price, using as reference the FOB Rotterdam price plus shipping, reached the accumulated figure of US $ 137.11 billion, in constant dollars from December 2011.

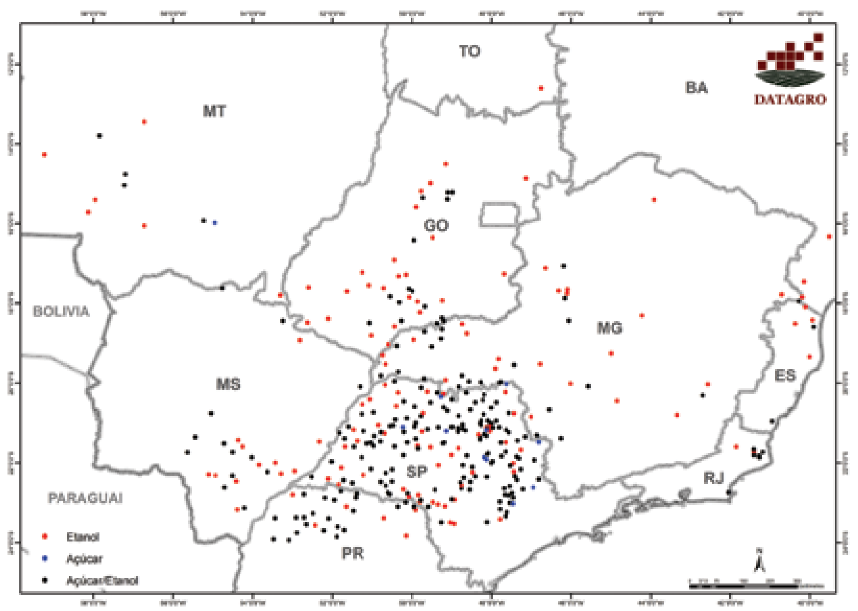
When taken into account the interests on avoided foreign debt, evaluated in a conservative manner by a rate equal to the Prime Rate plus 200 basis points, the value of the savings provided by the use of ethanol fuel, in replacement to gasoline, reached US$ 266.02 billion during the same period . This is a highly significant value, considering that, in January 2012, the Brazilian international reserves, in the concept of international liquidity, were valued at $ 352.6 billion.

2.1.8 Number of companies operating in the sector in Brazil

Today there are 441 sugar and ethanol processing plants in Brazil, of which 153 are exclusively designed to produce ethanol, 20 only produce sugar, and the other 268 are combined plants, producing both sugar and ethanol.

There are 354 plants installed in South-Central region of Brazil, with an estimated capacity to crusg 620 million tons of sugarcane. The state that concentrates the greater number of plants is São Paulo, with 190 units.

FIGURE 2. DISTRIBUTION OF PLANTS AND DISTILLERIES IN THE SOUTH-CENTRAL REGION, 2011/12

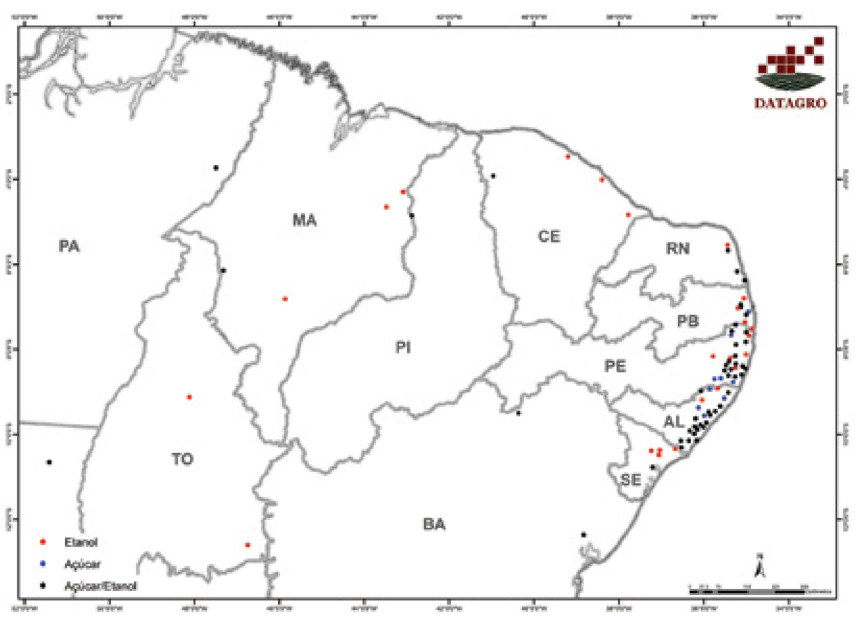


Source: Datagro.

The sugarcane crushing capacity in the Northeast region is 72 million tons. In the 2011/12 harvest, there is an estimate of 68.2 million tons crushed. In this region, there are 87 plants in operation, of those, 47 produce sugar and ethanol, 31 produce only ethanol, and only 9 units manufacture sugar.

Of the 117 new processing units that went in operation since 2005, only one was installed in the North-Northeast region. The largest number of new plants to come into operation on a given harvest was in 2008/09, with 30 units out of a total of 35 that were originally planned. However, the 2008 financial crisis reversed the investments on sugarcane plants, and on the next harvest, out of the 45 planned projects, only 23 were carried out. Since then, the number of new plants reduced drastically.

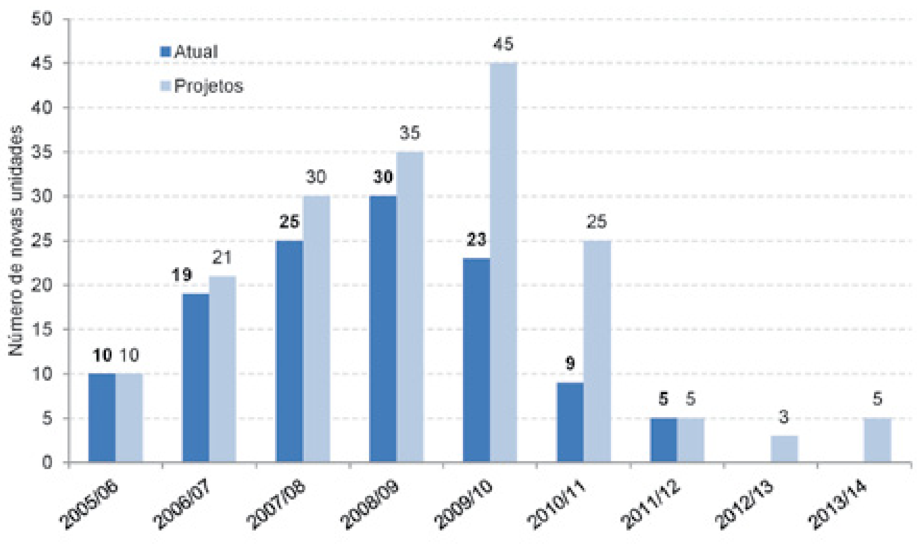
FIGURE 3. DISTRIBUTION OF PLANTS AND DISTILLERIES IN THE NORTH-NORTHEAST REGION, 2011/12



Source: Datagro.

Further to the financial crisis, uncertainties related to public policies recently applied to the sector can be the cause for the lack of investment. Some of the new policies are: the discretionary changes in the blending percentage of ethanol in gasoline, the prices fixation of the gasoline at refinery plus CIDE (the Contribuition for the Intervention of Economic Domain) lagged behind that of the international market and legal uncertainty regarding the implementation of the Forest Code.

CHART 10. NUMBER OF NEW SUGAR AND ETHANOL MANUFACTURING UNITS, BRAZIL



Source: Datagro.

2.1.9 Size of companies (level of concentration)

The increase in operation scale of the sugar-energy sector can be assessed by observing the state of São Paulo alone, which is responsible for more than 60% of the national production. In 1992, the state had 147 productive units that crushed 176 million tons of sugarcane, an average of 1.20 million tons per unit. Eight years later, in 2000/01, the total crushing of sugarcane increased to 244.22 million tons, while the number of plants in operation decreased to 133 units, with an average of 1.84 million tons per unit. In 2010/11, 190 plants were operating, crushing 556.88 million tons, with an average of 2.93 million tons per unit.

TABLE 2. NUMBER OF OPERATING PLANTS AND AVERAGE CRUSHING PER UNIT, STATE OF SÃO PAULO

Informação	Safras		
	1992/93	2000/01	2010/11
Nº de unidades	147	133	190
Moagem total (mil tons)	176.218	207.099	556.880
Moagem média (mil tons)	1.199	1.557	2.931

Source: Datagro.

It is possible to observe an intraregional deconcentration on the production of sugar and ethanol when considering the ten largest sugarcane-processing plants in the South-Central region. In 1992, the ten largest units were responsible for crushing of 39.4 million tons of sugarcane, or 22.35% of the total crushing in the region. In 2010, they were responsible for crushing of 60.3 million tons of sugarcane, representing 10.82% of the total crushing.

TABLE 3. THE TEN MAJOR SUGARCANE PROCESSING UNITS, IN 1992/93 AND 2010/11, IN THE SOUTH-CENTRAL REGION

Usina		UF	Safra 1992/93			Usina		UF	Safra 2010/11		
			Cana Moída	Açúcar Produzido	Álcool Produzido				Cana Moída	Açúcar Produzido	Álcool Produzido
Unidade			000 tons	000 tons	000 m³	Unidade			000 tons	000 tons	000 m³
1º	Da Barra	SP	6.286,08	357,62	281,20	1º	Sao Martinho	SP	8.004,22	445,90	411,99
2º	São Martinho	SP	5.532,10	285,00	270,00	2º	Da Barra	SP	7.378,41	499,77	315,80
3º	Santa Elisa	SP	4.003,15	201,03	200,09	3º	Equipav	SP	6.518,13	289,89	347,30
4º	São João	SP	3.805,59	146,77	230,67	4º	Colorado	SP	6.103,41	426,43	276,94
5º	Barra Grande	SP	3.580,40	207,24	189,20	5º	Itamarati	MT	6.043,39	250,17	318,49
6º	São José	SP	3.541,81	197,80	178,96	6º	Vale do Rosario	SP	5.922,94	359,73	245,26
7º	Bonfim	SP	3.445,62	169,01	184,73	7º	Santa Elisa	SP	5.585,37	324,97	246,59
8º	Santa Cruz	SP	3.144,61	130,00	175,96	8º	Colombo	SP	5.152,19	394,07	200,09
9º	Costa Pinto	SP	3.104,10	131,27	165,27	9º	Bonfim	SP	4.785,97	371,41	193,03
10º	Iracema	SP	2.940,64	108,36	169,45	10º	Alta Mogiana	SP	4.751,58	354,50	164,92
TOTAL Centro-Sul			**176.218,40**	**6.188,42**	**10.064,19**	**TOTAL Centro-Sul**			**556.880,30**	**33.497,65**	**25.380,93**
% das dez maiores			**22,35%**	**31,25%**	**20,32%**	**% das dez maiores**			**10,82%**	**11,10%**	**10,72%**

Source: Datagro

Initially, some other concepts about the industrial economy should be considered. There are three types of industrial concentration: the technical type, which consists on the merging of production units; the economic type, which is the unification of ownership of companies into a single company without merging their production units; and finally the financial type, that indicates the joining of companies and groups with differentiated goods through shareholding (Labini, 1984). Given this conceptual differentiation, it is clear that the industrial concentration on the sugar-alcohol sector should be analysed on the participation of business groups, given the limitations of the technical concentration of the factories.

The difficulties in increasing technical concentration cause, therefore, an increase in the economic concentration in the sugar-alcohol sector, which means that two or more plants began to be managed by the same company or group. This strategy has resulted in the reduction of administrative costs and, at the same time, in a better bargaining power for the negotiation of inputs, in addition to the trade integration and logistics.

According to evaluations from the independent consultancy Datagro, in 2002, there was 321 million tons of sugarcane crushing; the 10 largest business groups, from a total of 179, were responsible for 78 million tons (24% participation), and the 25 largest groups were responsible for 118 million tons (37% participation). In 2010, the total crushing totaled 620 million tons, of which the 10 largest business groups were responsible for 212 million tons (34% participation), and the 25 largest groups were responsible for 328 million tons (53% participation). In 1992, the largest group had a participation of 8%, whereas in 2010, its participation increased to 9%.

At the same time that there was an increase in the production scale, the sugar-energy sector has been undergoing a consolidation process involving inflow of foreign capital. Datagro estimates that, in 2011, 25.5% of the crushing belonged to foreign groups, and estimate are that this number might reach 37% by 2020.

2.2 Social and environmental charcterization

2.2.1 Use of resources

2.2.1.1 SOIL OCCUPATION AND CONSERVATION

The sugarcane in Brazil occupies 9.14 million hectares, approximately 1% of the territory. This is not very significant if we consider, for example, that Brazil has nearly 160 million hectares of pasture (IBGE, 2006), and 23 million hectares of soybean.

Sugarcane is grown mainly in the Northeast and Central-South regions of Brazil, the latter accounting for about 90% of total production. Both regions are significantly far from the Amazon rainforest. Moreover, while the area occupied by sugarcane has grown in the last years, data from the National Institute for Space Research (INPE) show that deforestation in the Amazon has declined significantly every year, and, in 2010, deforestation presented the lowest rate since 1988, with no relationship between them.

Data from INPE also show that over 60% of the recent expansion of sugarcane in the South-Central region occurred in pastures, mostly degraded, and the rest occurred over other cultures[10]. This proves that the new sugarcane plantations are growing on areas that are already consolidated, such as those used by livestock, that present low productivity and that have been experiencing an intensification process.

10 National Institute for Space Research (INPE). Data relating to the 2009/2010 harvest.

An example of this trend is the Low Carbon Agriculture Plan from the Federal Government, which provides, in its regulations, to recover 15 million hectares of degraded pastures by 2020[11]. This measure allow for this area to be used with new crops, such as for sugarcane expansion, which represents about one quarter of the land currently occupied by the agriculture in Brazil.

The sugarcane expansion in Brazil is also guided by the Sugarcane Agroecological Zoning, launched in 2009 by the Federal Government. This regulation indicates the areas that are suitable for cultivation, taking into account aspects such as climate and water availability, and also excludes any expansion into areas of native vegetation and sensitive biomass, like the Amazon and Pantanal. The zoning garantees an area equivalent to 7.5% of the Brazilian territory, or about 65 million hectares, as suitable for the sugarcane cultivation, excluding 93.5% of the territory[12]. VIt is important to note that today only 0.9% of the Brazilian territory is occupied with sugarcane. In addition to the federal zoning, some states, such as São Paulo, have similar regulations.

The Brazilian sugarcane plantations have relatively low levels of soil loss due to the semi-perennial characteristic of the sugarcane, which allows several cuts over the period of 5 to 7 years before replanting. It is likely that the ability to conserve and retain the soil in the sugarcane areas increase significantly in the coming years, because of the sugarcane straw that is left in the field as a result of the adoption of mechanical harvesting and of the minimum tillage system.

The use of pesticides in the Brazilian sugarcane plantations is low, considering kilograms per hectare. A significant proportion of pests and diseases that threaten sugarcane are managed by biological control and by advanced traditional breeding programs that help to identify disease resistant varieties. Since the cane is harvested annually for the period of five or more years before the need to be replanted, the use of mineral fertilizers is low. Moreover, much of it is replaced by the use of organic fertilizers produced from industrial waste, such as vinasse and filter cake. The vinasse is a residue naturally rich in potassium, which is the chemical element used in the formulation of chemical fertilizers in which Brazil is dependent of in terms of imports. Other natural nutrients that are extracted from the soil by the sugarcane are also present in the vinasse, as well as in the filter cake and in the ash from the boilers, which are returned to the soil.

This is one of the most interesting and distinguishing features of the sugarcane cultivation and its processing by the sugar-energy sector in relation to other crops and their agribusinesses. The sugar-energy sector only “exports” out of its agro-industrial system carbohydrates, sugar and ethanol. The sugar and ethanol molecules contain only carbon atoms (C), hydrogen (H) and oxygen (O). All of the other chemicals, such as nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulfur (S) and other micronutrients are, most of it, recycled (Nastari, 2012b.) A comprehensive study on the biochemical nutrient cycle in the sugar-energy complex was developed by Barbosa (2007). Many sugarcane plants in Brazil have already monitored the bal-

11 Action included in the regulation of the National Policy on Climate Change (PNMC), IV, Paragraph 1, Article 6, Decree No. 7390 of December 9, 2010.

12 Agroecological Sugarcane Zoning in Brazil. Approved by Decree No. 6961 of September 17, 2009.

ance of nutrients that are returned to the soil because of the nutrients contained in the waste generated by the sugar-energy sector. This recycling is possible because of the proximity of the crop fields to the plants, due to the natural logistics involving the sugarcane. Other crops do not allow the same macro and micronutrients recovery: soybean, corn, wheat, citrus, cotton and all of the other crops that export the nutrients extracted from the soil. This is one of the main characteristics of the long-term sustainability present in the sugar-energy sector, which is enhanced by the system and experience developed in Brazil, because it determines the ability to reproduce to the greatest possible number of generations in the future the appropriate conditions of production through the use of natural resources, by using well-conducted sugarcane cultivation systems. The intercropping of sugarcane with other crops in crop rotation systems in areas of renewal and cultivation of vegetables and other species have accelerated the process of incorporation of nitrogen and organic matter in soils.

These practices have enabled a low use of industrialized fertilizers in the Brazilian sugarcane plantations, contributing to the reduction of greenhouse gas, considering that fossil fuels are used in the manufacture of mineral fertilizers. In many cases, since the sugarcane cultivation has expanded to soils that are low in phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg) and organic matter, its effects have contributed to the “manufacture” of the soils, improving, in the course of time, fertility characteristics and the soil water holding capacity.

2.2.1.2 WATER RESOURCES

Although Brazil possess 15% of all freshwater in the world, the total irrigated area in Brazilian agriculture, is limited to only 3.3 million hectares, or 4.3% of the total cultivated area with annual and perennial plants, which is only a fraction of the 227 million hectares irrigated worldwide, representing 15.1% of the total cultivated area.

The Brazilian sugarcane plantations hardly need irrigation, because the rain is abundant and reliable, especially in the Central-South of Brazil, which is the main producing region. The irrigation of sugarcane is only applied in specific cases, in the form of salvage irrigation to help regrowth, in the drier regions and in a restricted manner, as supplementary irrigation.

The environmental risks associated with the use of water for irrigation and for the industry are rarely associated with the cultivation and processing of sugarcane. The Brazilian Agricultural Research Company – Embrapa classifies sugarcane as a risk 1 crop, which means that there is no impact on water quality. There is enough scientific evidence, based on several experiments, indicating that the risk of contamination of water reservoirs and groundwater is minimum, and the potential soil salinization, when the application of vinasse in fertirrigation is limited to 300 cubic meters per hectare.

In fact, the discovery that the vinasse could be a substitute for chemical fertilizers emerged from empirical experiments performed in a sugar plant located in region of Sertãozinho, in the state of Sao Paulo – Usina Santa Elisa, currently controlled by the LDC-SEV group. The vinasse has been used as fertilizer for over 35 years in extensive areas. The Campão Farm, in the city of Sertãozinho/SP, was one of the first to receive the application of vinasse in fertirrigation, since 1950. On this farm, the increase in organic matter exceeded by 2%.

The responsible use of water resources for industrial purposes has been optimized in this sector. In the state of São Paulo, the consumption of water specifically for industrial use decreased from an average of 5.0 cubic meters per ton of crushed cane (m3/tc), in 1992, to 1.89 m3/tc, in 2007/08, and to 1.49 m3/tc, in 2009/10 (ANA; UNICA; FIESP, CTC, 2009, p. 183). In the new and more efficient plants recently installed, the observed water consumption is 0.5 m^3 per ton of crushed cane and, in some cases, reaching 0.3 m^3 per ton of crushed cane. There is, however, available technology to transform the water consumption by the industry in a negative figure. Instead of having abstraction of water, the industry will return the water extracted from the sugarcane delivered in the plants, after its treatment.

2.2.1.3 ENERGY – STEAM

The steam consumption in the industrial processing of sugarcane has been one of the factors that advanced the most in the last 20 years, shifting from an average level of 620 kg of steam per ton of cane, in 1992, to average levels of 320 kg of steam per ton of cane, in 2010.

The increase of energy efficiency of the plants is directly related to the process of optimization of the industrial processes, associated with the development of cogeneration (the production of energy through the use of bagasse in high pressure boilers). The ethanol from sugarcane also presents a very favorable energy balance. More than nine units of renewable energy are generated for each unit of fossil energy consumed in the process (Seabra, Macedo, 2008).

2.2.2 Major environmental aspects

2.2.2.1 CLIMATE CHANGE

The total emissions of greenhouse gas in Brazil, in 2005, according to the Second National Inventory of Anthropogenic Emissions, totaled 2.2 billion tons of CO_2 equivalent[13]. The sugar-energy sector is an important tool in fighting climate change. Several studies show that, when compared to gasoline, the Brazilian ethanol, when consumed in Brazil, reduces the greenhouse gas (GHG) emissions by approximately 90% (Seabra, 2008)..

All international regulations on the subject recognize the superior performance of sugarcane ethanol in relation to other commodities, such as corn, wheat or sugar beet. This applies to the U.S. Environmental Protection Agency, EPA, and also to the Euro-

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13 The sugar-energy sector is an important tool in fighting climate change. Several studies show that, when compared to gasoline, the Brazilian ethanol, when consumed in Brazil, reduces the greenhouse gas (GHG) emissions by approximately 90% (Seabra, 2008)..

pean Union and its Policy for Renewable Energy[14]. Both consider the entire life cycle of the product, from the planting of the raw materials until the use of the fuel in automobiles. In 2010, the EPA also classified sugarcane ethanol as an advanced biofuel capable of reducing GHG emissions by 61% to 91%, when compared to gasoline consumed in the U.S[15], depending on the production technique used. No other biofuel currently produced on large scale has such a performance.

According to Meira Filho and Macedo, without the production and consumption of ethanol and bioelectricity, Brazil's emissions related to transport and energy would have been 22% higher than they were in 2006. This reduction can reach 43% in 2020 (MEIRA SON; Macedo, 2010).

In absolute terms, the annual reduction resulting from the use of ethanol and the associated bioelectricity is of 46 million tons of CO_2 equivalent and, with the expansion projected by the Ten Year Plan for Energy Expansion (PDEE), from the Energy Research Company (EPE), for the sector (which would then produce 1.2 billion tons of cane), it would rise to 112 million tons of CO_2 equivalent, in 2020. This additional reduction, of 66 Mt CO_2 eq, would account for 30% to 40% of the Brazilian goals for reducing CO_2 emissions, established by the National Policy on Climate Change for the energy sector.

2.2.2.2 ATMOSPHERIC EMISSIONS AND PUBLIC HEALTH IN URBAN CENTERS

A study conducted by the University of São Paulo (SADIVA, 2010) shows that large-scale substitution of oil/petroleum by-products by ethanol has significant positive impacts to public health. According to the study, in a scenario that predicts the total replacement by ethanol of gasoline and diesel in the buses fleet in the city of São Paulo, more than 12,000 hospitalizations and 875 deaths would be avoided in one year. Furthermore, the reduction of the annual public and family spending with health would be of US$ 190 million.

2.2.2.3 NEW TECHNOLOGIES – BIOELECTRICITY, SECOND GENERATION, BIOPLASTICS, BIOREFINERIES, ETHANOL USE IN BUSES AND AIRPLANES

Further to ethanol, the bioelectricity production, is one of the most significant activities and with the greatest growth potential in the sugar-energy sector. Through the burning of bagasse in boilers, the 440 sugar and ethanol plants existing in the country, generate electricity to supply their own activities and, thus, are energy self-sufficient. A part of them – currently about 120 plants – still generate marketable surpluses. In 2010, more than 1,000 MW of bioelectricity, in average, were produced

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14 Directive 2009/28/EC from the European Parliament and EU Council about the promotion of energy use from renewable sources, that amends and subsequently revoke the Directives 2001/77/EC and 2003/30/EC.

15 Therefore, it considers the emissions of the transportation of the product to that country.

from sugarcane bagasse, correspondinf to around 2% to 3% of the Brazilian energy matrix. Estimates indicate that, by 2020, this share will reach 18%, reducing the need for thermal power plants fueled by fossil energy[16]. The bioelectricity from sugarcane is also strategic because it is extremely complementary to the Brazilian hydroelectric system. The cane is harvested and the bioelectricity is generated exactly in the driest months of the Central-South region (from April to November), when the water reservoirs are low and the hydroelectric production is lower.

Moreover, with the sector mechanization, this potential will increase further, because, in addition to the bagasse, the straw will also be used for the production of bioelectricity. There is an enormous potential of energy that is latent in the Brazilian sugarcane plantations. Less than 30% of the plants in the sector are connected to the electrical grid as power generators.

The sugarcane potential, with new uses and products, continues to grow. Ethanol, for example, is already used in flex motorcycles, small planes and urban buses. In São Paulo, 60 ethanol-powered buses are in circulation since 2011. Ethanol, in the near future, will also be used in trucks, farm equipment and generators.

Bioplastics made from sugarcane are already available in the market and are commercialized by large companies. Biorefineries annex to sugarcane plants are also already producing various products derived from sugarcane, such as fragrances, renewable kerosene, sugarcane diesel, etc. There is still great effort from the aircraft manufacturers (such as Embraer and Boeing) for the use of renewable fuels derived from sugarcane in aviation. Several tests were already carried out by companies in this sector (such as Virgin, Lufthansa and Azul). There already is production and marketing of an agricultural aircraft powered exclusively by ethanol: the Ipanema, produced by Embraer.

Lastly, there is also the second-generation biofuels. This technology, which exists already, but is not yet commercially viable, allows for the production of ethanol from any biomass. Today, ethanol is produced from sugarcane juice. With the development of this technology, sugarcane bagasse and straw will also become raw materials for the ethanol production. The productivity per hectare, which is already higher than any other biofuel, should be doubled. Finally, there still is a great potential to be explored in the sugar-energy production chain, contributing to the replacement of oil and to the reduction of the global warming. This is true not only through its energy potential, but also on other fronts, such as bioplastics and the "alcochemicals"(alcohol equivalent to petrochemicals).

16 UNICA, Cogen, MME, EPE (2012)..

3 ECONOMIC REGULATIONS AFFECTING THE INDUSTRY

3.1 Major agreements and international regulatory aspects relevant to the sector: characterization of the international regulatory environment of interest to the sector

Some bilateral initiatives have been adopted in promoting the use of biofuels.

- **Brazil and the United States**

  In 2006, Brazil and the United States launched a protocol in partnership with the InterAmerican Development Bank for the creation of the Interamerican Ethanol Commission, aiming to promote the use of ethanol in the American continent, as the evaluation of investments for development of agriculture.

  In 2007, the following year, the two countries signed a Memorandum of Understanding on Biofuels with a view to prepare a basis for establishing standards that allow for the specification of biofuels, and encourage partnerships in research and development of renewable sources of other generations, such as the cellulosic ethanol.

- **Brazil and European Union**

  In April 2011, the European Union and the National Council for Scientific and Technological Development (CNPq) officiated the launch of projects to promote activities of international cooperation on biofuels. Earlier, in July 2010, Brazil and the European Union announced an agreement to collaborate on projects on the production of biofuels in Mozambique. In this collaboration, Brazil would offer its expertise and technology. The European Union, in turn, would guarantee the purchase of biofuel at competitive prices to meet its goal that by 2020, 10% of all energy consumed by their transportation sector be of a renewable source.

3.2 Leading national legal instruments (mandatory and voluntary) in force in major foreign markets of the sector (consumer demands, requirements for licenses etc.) that impact the industry

The Brazilian sugar-energy industry is facing a favorable moment, at the same time the foreign market also becomes more promising. Because of the conjunction of several factors, such as the need to reduce greenhouse gas emissions and the development of agriculture, there is a tendency of increase in world consumption of ethanol. In addition, fluctuations in oil prices have brought up the debate about the energy dependence. Thus, countries are more willing to introduce policies to encourage the consumption of renewable fuels, such as ethanol. Several countries have already approved the use of ethanol as a gasoline additive and others are in the process of doing the same.

3.2.1 The United States

In the United States, the main on-going program for the development of the domestic ethanol is the Renewable Fuel Standard (RFS), which was included in the Act of Independence and Energy Security, in 2007. The RFS is a set of rules governing the production and use of biofuels in the U.S. and that determines, among other things, the consumption of 136 billion liters of clean fuels by 2022, of which 56 billion gallons of corn ethanol. It is also important to mention that, from January 1, 2012, the rate of US$ 0.54 per gallon for the imported product ceased to exist, and also the grant of US $ 0.45 per gallon given to ethanol blended with gasoline came to an end. The American program also has a strong environmental bias, as it differentiates the various types of biofuels according to their performance in reducing emissions. Ethanol from sugarcane in Brazil, for example, is classified as advanced biofuel and falls into a different category to that of corn ethanol. Finally, in order to achieve the goals, it is also necessary to prove that the biofuel in question has not been produced in area of deforestation.

RENEWABLE IDENTIFICATION NUMBER (RIN) IN USA

The RIN, or Renewable Identification Number, is a serial number assigned to a batch of biofuel in order to track its production, use and comercialization as required by regulations of the Agency for Environmental Protection in the United States (U.S. EPA).

According to the Energy Policy Act of 2005, the EPA is authorized to establish annual quotas determining the percentage of the total fuel consumed in the United States to be represented by biofuels blended in fossil fuels.

Companies that refine, import or mix fossil fuels are required to meet certain individual quotas of use of renewable fuels, RFS-2, based on the volume of fuel sold in the market.

By fulfilling these requirements, the EPA seeks to make the industry meet collectively the overall national quota established every year. To ensure compliance, the parties involved are required to periodically demonstrate that they have reached their quota of RFS-2, presenting a certain amount of RINs to EPA. Because each of these RINs represents the amount of biofuel that is mixed to fossil fuels, these RINs submitted to EPA are a quantitative representation of the amount of biofuels blended to fossil fuels, used in the United States.

The RINs can be generated for ethanol produced in plants from the list approved by EPA, but only in batches of renewable fuel produced and sold after the date on which the plant was approved by EPA. The RINs have become a mode through which different renewable fuels produced from different raw materials, began to be valued, by means of a market premium, based on their ability to reduce greenhouse gas emissions, having as reference the emissions from burning fossil fuels.

The RIN value for sugarcane ethanol produced in Brazil began to be traded for US $ 0.60 per gallon in early 2011, reaching US $ 1.20 per gallon in the end of the same year (equivalent to US $ 317.01 per cubic meter). In early 2012, this number had dropped to a range between US $ 0.80 and US $ 1.00 per gallon (from US $ 211.34, and US $ 264.17 per cubic meter). Anyhow, it is still a significant value when taken into account the value of the exported product.

n 2011, the average price of ethanol exports from Brazil to all destinations was US $ 758.19 per cubic meter – FOB. But this average includes shipments of anhydrous and hydrated alcohol for fuel, industrial, refined and neutral markets. The average price of Brazilian ethanol exported to the

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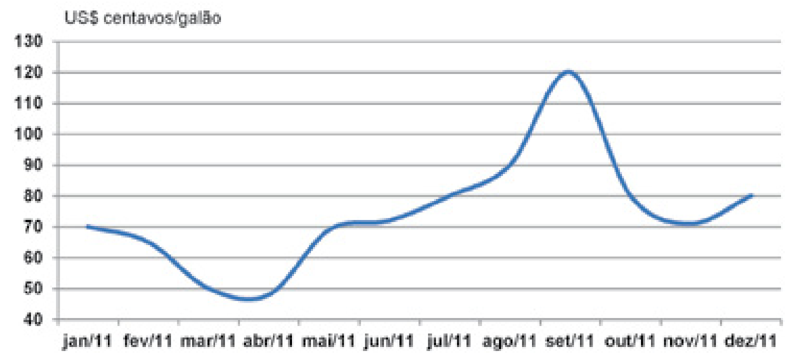
United States, which is essentially anhydrous ethanol to be used as fuel, was US $ 864.40 per cubic meter.

Up to January 2012, 98 sugarcane-processing plants in Brazil have been accredited by the Environmental Protection Agency of the United States (US EPA) as accredited suppliers of sugarcane ethanol for the purposes of generating RINs (Renewable Identification Numbers). Of this total, 75 are located in the state of São Paulo, 8 in the state of Paraná, 8 in the state of Minas Gerais, 4 in the state of Mato Grosso do Sul, 2 in the state of Goiás, and 1 in the state of Rio Grande do Norte[17].

The RINs have proven to be an extremely effective public policy to promote the best types of renewable energy, as it identifies the positive externalities, generating competitive advantages for biofuels with superior performance.

CHART 11. ADVANCED BIOFUELS – RINS



Source: Opis.

17 Refe to www.epa.gov/otaq for an updated list of accredited plants.

3.2.2 The European Union

In the European Union, a 2003 non-binding European Commission policy suggested to the EU countries to replace 2% of the vehicle fuel demand with biofuels by the end of 2005 and 5.75% by 2010. In 2007, a new policy, now obligatory, called European Renewable Energy Directive (RED-I), drew up a plan for the use of renewable energy. According to this policy, the EU should have 20% renewable energy in its headquarters by 2020, with 10% renewable fuel consumption in their transport sector. Under the policy, biofuels can be produced using raw materials originating from inside or outside the European Union, but cannot be produced from raw materials produced on soils with high biodiversity or high carbon stock (forest). The biofuels have to contribute to at least 35% reduction on greenhouse gas emissions in order to qualify for entry into the EU. To prove all these criteria, the EU requires sustainability certifications recognized by the European Commission.

SUSTAINABILITY CERTIFICATION WITHIN THE EU RED

Policies of the European Parliament and of the European Union Council (Directives 2009/28/EC and 2009/30/EC, or simply RED, Renewable Energy Directives) state common rules for the use of renewable energy in order to limit the greenhouse gas emissions and promote cleaner transport. These policies set a goal for the use of at least 10% of renewable fuels as a proportion of final energy consumption in the European Union´s transport sextor, between 2011 and 2020. It is estimated that this goal will reduce the carbon dioxide emissions in 500 million tons in 2020. However, this goal must be fulfilled with the proviso that the renewable fuels qualify as "sustainable" according to the criteria defined by these same policies. Therefore, they must be certified by bodies recognized by the European Commission.

In the case of biofuels and bioliquids produced by any facility (the term "facility" includes any processing unit used in the production process that has not been intentionally added to the chain of production to qualify for the exemption) which was in operation on January 23 2008, the minimum of 35% reduction in greenhouse gas emissions should be effective beginning April 1, 2013, and may also apply before this date.

According to the methodology defined in Annex V RED, greenhouse gas emissions due to any change in the use of land occurring after January 1, 2008 shall be taken into account when calculating gas emissions.

From 1 January 2017, the proportion of reduction in baseline emissions ought to increase to 50%.

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The Directive 2009/30/EC favors the ethanol blend in gasoline as it allows up to 10% ethanol in the mixture, and provides the possibility for Member States to request a pardon to fulfill the maximum limits allowed by the steam pressure of the fuel mixture. The declared justification for these measures was to ensure that the EU combats climate change and air pollution effectively.

It is clear in the European standards that the Fuel Quality Directive (1998/70/EC) as amended by Directives 2009/28/EC and 2009/30/EC, require that the European Commission submit a report reviewing the impacts of indirect use of land on greenhouse gas emissions, suggesting ways to mitigate this impact, based on best possible scientific evidence.

On July 19, 2011, the European Commission has recognized seven out of the 25 independent institutions that submitted applications, as qualified to certify the compliance with the sustainability criteria set out in Article 17 (3) of Directive 2009/28/EC, as well as the application of mass balance approach in line with the requisites set out in Article 18 (1) of that same policy. This decision was enforced 20 days after its publication, which occurred on July 21, 2011, for a 5-year period.

The seven institutions that received accreditation from the European Commission were:

- **Bonsucro EU** (a special version of the criteria for achieving the goals of RED – Renewable Energy Directives) is an international roundtable with voluntary membership, founded in 2008, formerly known as Better Sugarcane Initiative, which aims at establishing a standard certification of responsible practices in the sugarcane industry. Parties involved in the initiative: producers in Brazil, Central America, Sudan, India and Australia, large consumers and intermediaries in sugarcane trade, like Coca-Cola, Shell, ED & F Man, British Sugar and Cargill; civil society representatives such as Ethical Sugar, Solidaridad and WWF (World Wildlife Fund) and international institutions such as international Finance Corporation (IFC), World Bank. Includes all features of the RED, except for fields with high biodiversity.
- **International Sustainability and Carbon Certification** (ISCC), supported by the German Federal Ministry and the Agency for Renewable Resources (FNR), the ISCC is a global initiative with 55 members that certifies all types of biofuels. Includes all the features of RED.

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- **Abengoa RED Bioenergy Sustainability Assurance:** is an industry initiative developed by Abengoa. It covers all types of biofuels worldwide and includes all RED criteria, except for fields rich in biodiversity.
- **Greenergy Brazilian Bioethanol Programme Verification:** is an industry initiative developed by Greenergy, with focus on sugarcane ethanol produced in Brazil. It includes all RED criteria, except for fields rich in biodiversity.
- **Biomass Biofuels Sustainability Voluntary Scheme (2BSvs):** this is a French initiative, which is composed of a consortium of companies covering all different types of biofuels around the globe. It includes all RED criteria, except for fields rich in biodiversity.
- **Roundtable on Sustainable Biofuels (RSB EU RED):** it sets standards for the soy-based biodiesel, and its main focus is soybean production in Argentina and Brazil. Members include Conservation International, IUCN, UN Foundation and WWF. Includes all RED criteria.
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3.2.3 Other Countries

The Japanese government has announced a set of guidelines for reducing fossil fuel consumption. Their plan aims at reducing greenhouse gas emissions by 30% compared to the levels emitted in the 1990s. Currently, Japan allows the use of direct mix of ethanol in gasoline of up to 3%, and intends to increase this amount to 10% in the near future. However, the mixture is not yet obligatory in the whole country. Despite the authorization, the use of direct ethanol blending is not yet widespread in the Japanese market because of the continuous resistance of the oil industry..

From 2001, China has been promoting the use of ethanol in pilot projects in five cities in the Central and Northeast regions of the country (Zhengzhou, Luoyang and Nanyang in Henan Province, and Harbin and Zhaodong, Heilongjiang province). China has approved a mixture of 10% ethanol in gasoline in six provinces and regions. Its goal was to blend 2.5 billion liters of ethanol in gasoline by 2010 and 12.5 billion liters by 2020. However, its ethanol production capacity is only around 1.9 billion liters per year, with 1.6 billion liters using grain as input.

The use of ethanol is also encouraged in other countries such as Argentina and Canada. The Argentine government approved a mandate of 5% blend of ethanol and biodiesel throughout the country, starting January 2010. In Canada, from December 15, 2010, it became mandatory to blend 5% ethanol in gasoline. With this new ruling, it is estimated that the Canadian demand for ethanol stands at around two billion liters a year.

The Indonesian government decided that in 2030 the share of biofuels in the country's energy matrix will have to be 5%. From 2007, Thailand established the mixture E10, which represents a demand of 1.5 billion liters per year. In Colombia, since 2006, E10 is already used in cities with more than 500 000 inhabitants: Bogota, Cali, Medellin, Barranquilla, Bucaramanga and Cartagena.

3.3 Key regulatory issues (legislation) and regulatory instruments (mandatory and voluntary) that affect the industry in Brazil

Government intervention often occurred in times of crisis inside or outside the sugar-energy industry. However, in 1990, with the extinction of the old IAA, a new structure emerged in the industry presenting organizational aspects more closely aligned with a competitive market. Since then, these new practices extinguished the need for regulatory instruments similar to those used when the existence of IAA, such as production and export quotas, control over prices, control on new factories constructions, and subsidies. Today, state intervention in the sugar-energy sector has been minimized, but is still able to exert direct and indirect influence.

After the deregulation period in the 1990s, the most important ruling that came about in the industry resides in regulatory determinations of ANP (National Agency of Oil, Natural Gas and Biofuels). These allow the mixture of anhydrous ethanol in gasoline and determine the producer's obligation to deliver ethanol to authorized distributors with the purpose of only distributing ethanol to gas stations accredited by ANP (Resolution No. 5/06).

In Brazil, ethanol is mixed with gasoline since 1931, when Decree 19717 of February of that year, enforced the mixture up to 5% in gasoline. The mandatory blending is currently ruled by Law No. 8.732/93, which provides that the Executive should determine the percentage of the mixture of anhydrous ethanol in gasoline. Law No. 12490 of 9/19/11 has defined that the mixture can range from 18% to 25%. The Interministerial Council for Sugar and Alcohol (CIMA), which is chaired by the Ministry of Agriculture, Livestock and Supply (MAPA) has the legal competence to set the percentage of ethanol in gasoline. From October 2011, the mixture of 20%i is in force in the country, as defined by Resolution MAPA No. 01 of 31/8/11. However, the percentage of 25% in volume is still recognized as the market standard.

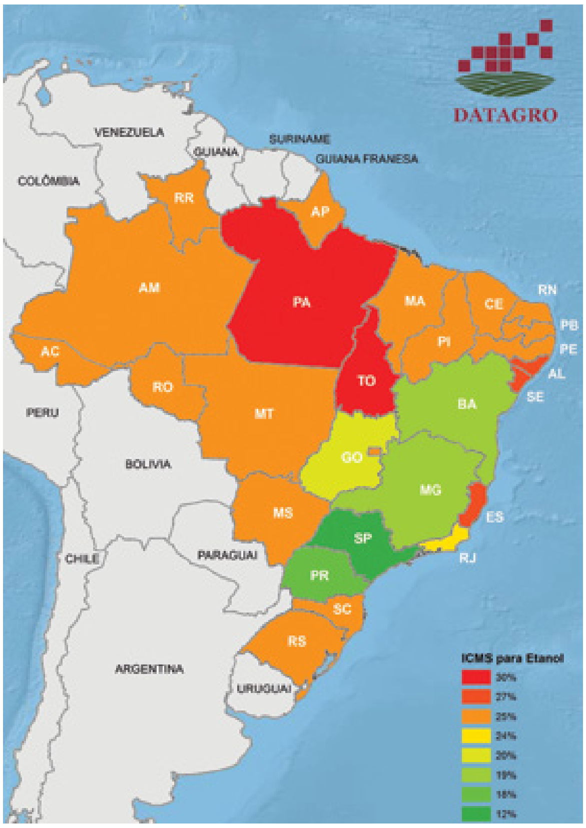
Given the volatility of ethanol prices in the domestic market, the government decided by the Provisional Measure No. 532, later converted into Law No. 12.940/11, to delegate the power of regulation and inspection of the ethanol market to the National Agency of Oil, Natural Gas and Biofuels (ANP). At the same time, the new ruling introduced the term "biofuel" into the Law No. 9.478/99, which, in turn, created the National Energy Policy, which means that, from then on, ethanol was to be considered as an energy product rather than an agricultural good. The new measure also amended Law No. 9.847/99 to include biofuels in the rulings of the ANP for the supply, transportation, storage, sale and marketing of fuels in the country, as well as in conformity assessment and certification.

With new responsibilities, ANP issued Resolution No. 67 in December 2011, and started to regulate the comercialization and storage of anhydrous ethanol by Brazilian plants and distributors. One of the key measures is the creation of the link between the purchase of gasoline A and anhydrous ethanol by the distributor, which means, that when the distributor buys the gasoline, he should previously demonstrate the purchase of the amount of anhydrous necessary for the required mixture in force in all supply contracts.

As for stocks, the distributors will have to retain, on March 31 of each year, anhydrous ethanol in a volume equivalent to 15 days of their average gasoline C commercialization for the month of March in the previous year. As for the plants, on January 31 of the year following the harvest, they should demonstrate a stock equivalent to 25% of the volume traded in the previous year.

In regards to tax, the rates of ICMS (tax on the comercialization of goods and services) on ethanol varies in each Brazilian state. This has undermined the competitiveness of biofuels when compared to gasoline, especially given the predominance of the high rates of ICMS. Today, ICMS ranges from 12%, in the case of the state of São Paulo to 30% in the state of Pará, and this influences heavily the final price at gas stations.

FIGURE 4. ICMS ON ETHANOL IN BRAZIL



Source: Datagro.

In addition to ICMS, PIS and COFINS tax rates are also collected in the whole pricing chain, from both the producer and the distributor. However, unlike gasoline, there is no incidence of CIDE for ethanol, although the Federal Government has issued Provisional Measure No. 556, amending Article 5 of Law No. 10.336/01, which concerns the collection of CIDE in all imports and comercialization of fuels in Brazil. The initiative raised the highest possible rate of CIDE on fuel ethanol from R $ 37.20 to R $ 602.00 per cubic meter. This is not yet valid, lacking for it to become a reality, only the publication of a decree. The last published Decree was Decree 5.060/2004, which exempted the collection of CIDE on ethanol, for now. This measure represents a risk to the industry as it can drastically affect the competitiveness of the product, in confrontation with gasoline. Additionally, it is perceived as an action in the opposite direction to that of other countries that have sought to favor clean and renewable fuels, by internalizing its positive externalities in the economic, social and environmental fields to their price market.

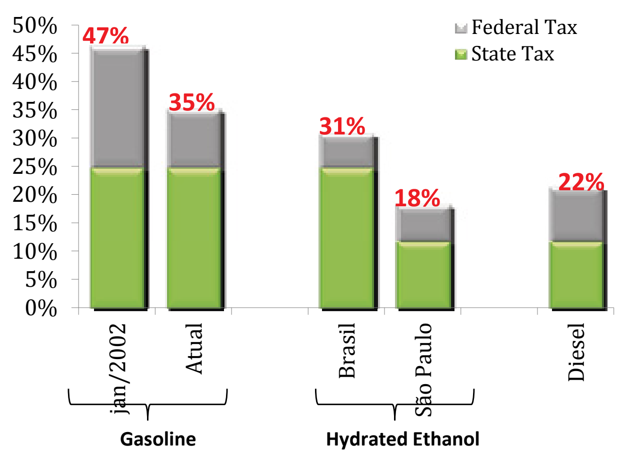
While the CIDE tax rate on ethanol is likely to increase significantly, by decree, the Federal Government has, in recent years, considerably reduced the value of the CIDE and other taxes levied on gasoline. Between January 2002 and November 2011, the participation of CIDE on gasoline C average price (gasoline containing ethanol) in gas stations dropped from 14% to 2.6% (Jank, 2011).

CHART 12. CIDE PARTICIPATION ON THE AVERAGE PRICE OF GASOLINE C (GASOLINE CONTAING ETHANOL) SOLD IN GAS STATIONS

Source: JANK, 2011.

When considering all taxes on fuel, state and federal, between January 2002 and November 2011, the total taxes on gasoline dropped from 47% to 35%, bringing it closer to rates on hydrated ethanol, which is 31%, in Brazil. The total level of taxation is lower (18%) only in the state of São Paulo, where the tax rate on hydrated ethanol is lower (12%).

CHART 13. LEVEL OF TAXATION ON GASOLINE, HYDRATED ETHANOL AND DIESEL IN BRAZIL



Fonte: JANK, 2011.

Even so, the tax on hydrated ethanol at national level is higher than that levied on diesel fuel, a fossil fuel.

It is important to notice that the regulation on the price of gasoline in Brazil also affects directly the sugar-energy industry. Keeping prices misaligned with respect to those on the international market has proven to a fundamental limit the competitiveness of hydrated ethanol in the domestic market. In order to avoid the impact on the price at the pump, all price adjustment of gasoline in the refinery is accompanied by changes in CIDE, which, in turn, functions as a mechanism for restraining the variations in fuel prices.

In regards to foreign trade, the Brazilian government decided to reduce the tax rate from 20% to 0% on imported ethanol. This exemption was first approved in April 2010 and then was renewed in December 2011, by Resolution No. 94, to extend its expiration date to December 31, 2015.

Concerning funding policies, late in December 2011, the government issued Provisional Measure No. 554, which created funding program for ethanol storage, offering better and more accessible interest rates to the plants. This measure created an integrated package that included, in the beginning of January 2012, the launch of ProRenova, a funding program via the National Bank for Economic and Social Development (BNDES) of R$ 4 billion for renovation and expansion of sugarcane plantations.

4 BUSINESS PRACTICES FOR SUSTAINABLE DEVELOPMENT (1992-2011)

n recent years, alongside with the expansion brought about by numerous and relevant technological advances, the greatest achievement was the strengthening of the conditions for a sustainable production. Several initiatives on sustainability, self-regulation, voluntary certification, disclosure and transparency were encouraged and developed, in order to provide information on the progress made to society.

4.1 Major technological innovation and changes in management incorporated into the production sector

The Brazilian sugar-energy industry is known as a world leader in research and development in production and processing of sugarcane.

Before the 1970s, sugarcane research was conducted largely by experimental stations linked to the Federal Government, stations such as the Institute of Sugar and Alcohol (IAA), an independent agency responsible for regulating the private sector, from which originated the Planalsucar (National Program of Improved sugarcane).

In 1969, Copersucar, a co-operative of important producers in the sector, created the first private sugarcane research center, CTC – Copersucar Technology Center. CTC has become the major research center of the industry, operating both in agriculture and in the industry itself, with emphasis on genetic improvement of sugarcane, biotechnology and new industrial processes

In the mid-2000s, CTC became an association composed of the main sugar and alcohol groups in the country, accounting for about 60% of national production. CTC was then renamed as the Sugarcane Technology Center. Another agency, Planalsucar, created in 1971, aimed at improving the sugarcane quality, given the low levels of agricultural and industrial yield obtained with the local raw materials when compared with other producing countries.

Planalsucar´s activities were directed at creating modern technologies for the sector. Planalsucar had various laboratories located in different sugarcane regions throughout the country and it developed several improved varieties of sugarcane, which were used until its extinction in 1990.

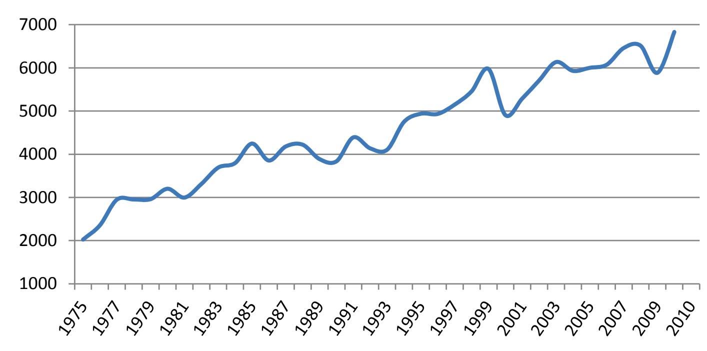
With the extinction of the IAA in 1989 and the deregulation in the sector that occurred between 1990 and 1999, Planalsucar was also extinguished. Additionally, research and development actions were carried out almost exclusively by the CTC, with also an industrial emphasis, but still focusing mainly in agriculture. A number of universities involved in sugarcane research, such as the Federal University of São Carlos, the Federal University of Alagoas and the University of State of Parana, among others, who later joined the Ridesa (Interuniversity Network for the Development of the sugar-energy industry), were also involved.

In the industrial field, several technological developments were made during this period, mainly by the capital goods industry, which manufacture equipment and processes for the sugar-energy industry. These are mainly located at the poles of Piracicaba and Sertãozinho in the state of Sao Paulo. A few companies stand out such as Dedini Equipametnos Pesados S/A, located in Piracicaba, Zanini and Heavy Equipment S/A in Sertaozinho, both in the state of São Paulo.

These companies based their decision-making on results obtained from production only, as they lacked scientists and laboratories for research. After its establishment, CTC, with its labs and testing processes, was able to provide these companies with scientific basis for sizing. Despite the remarkable efficiency gains, investment in research and development has been below levels considered adequate by international standards, which makes it difficult to maintain the pace of the efficiency expansion that the agribusiness sector observed during the diversification of production process in sugar and ethanol, which began in 1975.

Between 1975 and 2010, the agro-industrial yield in the sugar-energy sector had a compound growth rate of 3.5% per year. It may also be assessed by changes in the number of liters of hydrated ethanol equivalent produced per hectare. In 1975, the average agro-industrial yield was 2024 liters of hydrated ethanol per hectare. In 2010, this index had reached an average of 6831 liters per hectare. Furthermore, there are records of several companies operating in the sector with average harvest yields of above 8,200 liters of hydrated equivalent per hectare. Estimates are that, in 2011, the average productivity of the sector has been of 9,700 liters per hectare.

CHART 14. EVOLUTION OF AGRO-INDUSTRIAL YIELD IN LITERS OF HYDRATED ETHANOL PER HECTARE BETWEEN 1975 AND 2010



Source: NASTARI, 2012b.

Studies conducted by CTC indicate that by simply adapting the already developed sugarcane varieties to differente types of soil and production environments, would allow an increase in agroindustrial yield of more than 20%.

The following changes and innovations can be identified as being most relevant to the agricultural development of the Brazilian sugar-energy sector.

a) Research into new and more productive varieties, which are resistant to drought, pests and diseases. These studies have taken into account the intercropping with other food crops (grains) and complementary crops (sorghum) in renewal areas. These researches are conducted through regional agreements and direct investments from the sugar-energy industry through the following institutions and private companies: Ridesa (Interuniversity Network for the Development of Sugar and Alcohol Sector), CTC (Sugarcane Technology Center), IAC (Campinas Agronomic Institute) Embrapa (Brazilian Agricultural Research Company), Sugarcane Biotechnology Center of Mato Grosso do Sul, Canavialis / Monsanto, Syngenta, Ceres and others. Several of these plants act as regional centers of technological development, facilitating the adaptation of new varieties, products and processes to the specific conditions of each region.

b) Biological pests control such as the use of the wasp Cotesia to control the borer, and fungus to control the leafhopper

c) The rational use of vinasse in fertirrigation and the expertise on the limits on its use to prevent contamination of soil and groundwater. Different compositions of vinasse, depending on the plant´s production mix – sugar and ethanol. Studies on dispersion material, taking into account their high corrosiveness.

d) Mechanized planting equipment for minimum tillage.

e) Mechanized harvesting equipment eliminates the burning of the sugarcane straw, a practice previously applied in the manual harvesting.

f) More efficient sugarcane transhipment and transport systems and controls.

g) Mechanized sugarcane bud planting technology, instead of stalk.

h) New crop protection products/molecules (fungicides, insecticides, and herbicides), adapted and specific for sugarcane cultivation.

i) Development of product or molecules to induce maturation and inhibit flowering.

j) New techniques for the rational utilization, as fertilizer, of sugarcane industrial by-products, such as the filter cake and boiler ash.

k) Streamlining the irrigation processes with a goal to reducing use of water. .

l) Private management and maintenance of the forests natural reserves, safeguarding the protection of APP (Permanent Protection Areas) and ecosystems of each microregion.

In regards to the industry, technological developments can be explained by six drivers of development: (1) the increase in equipment capacity, (2) the increase of efficiency and of the overall return of the systems, (3) the best use of sugarcane energy (4) the diversification of products and by-products obtained from sugarcane, (5) full implementation of the concept of a sugar-energy plant, producing both food and energy, liquid and electric, and (6) sustainability development of the plant and its products (Oliverio , 2006).

During this period of evolution, the following changes and innovations can be identified as being the most relevant in the industrial development of the Brazilian sugar-energy sector.

a) The crushing capacity of a set of six sugarcane 78 inches crushing equipment went from 5,500 to 15,000 tons of sugarcane per day. Development of modular diffusers, that were able to monitor the supply of sugarcane at the mill (Oliverio, 2006)

b) Fermentation time reduced from 24 hours to 6 to 8 hours. .

c) Increase of the alcoholic content in wine, from 6% to 12-16%.

d) Increased efficiency of extraction (from 93% to 98%), fermentation (from 80% to 91.5%) and distillation recovery (from 98% to 99.7%)

e) Reduction of steam consumption in the industrial process, and the increase of the operating pressure and temperature of the boilers, leading to the increase of its energy efficiency.

f) Increase the bagasse surplus, aiming at selling it to other agro-industries for the replacement of oil fuel and for the generation of surplus energy.

g) Reduction vinasse/stillage produced per liter of ethanol.

h) Substantial reduction in the consumption of process water (10 x).

i) Increase production and recovery of ethanol per ton of sugarcane.

j) Development of alternative processes of dehydration, different to the old process of azeotropic distillation using benzene.

k) System for collection and separation of straw delivered with cane harvested mechanically.

l) IIntroduction of filters to eliminate particulate emissions in the atmosphere generated by boilers.

m) Development of a “thermocompensated” densimeter for quality control of ethanol distributed on consumption level.

The table below, extracted from Olivério (2006), summarizes the evolution of the main indicators of industrial performance in the sugar-energy sector.

TABLE 4. PARAMETERS AND PERFORMANCE INDICATORS

DESCRIPTION	Start	Current / Near Future	NOTES
	1st Stage	6th Stage	
1. Increased production capacity			
• Milling: 6x78 "- ton. Sugarcane/day	5,500	15,000	6 crushers + knives + grinder
• Fermentation time: hours	24	6 a 8	Traditional fermentation-Batch/ Continuous
• Alcohol content in wine: No GL	6	12 a 16 (*)	* Use Ecoferm – Dedini/Fermentec
2. Efficiency Increase			
• Extraction of the broth:%	93.0	97 (98)	6 crushers + knives + grinder
• Fermentation yield:%	80.0	91.5	Stoichiometric
• Distillation Recovery: %	98.0	99.7	
3. Optimizing energy consumption			
• Steam consumption sugar/ethanol	600	320	kg vapor/ton. Crushed sugarcane
• Consumption anhydrous ethanol vapor	5	2	kg vapor/liter anhydrous ethanol
• Pressure boilers – bar	21	100 to 120	
• Steam Temperature – Celsius	300	540	
• Energy efficiency boiler:%	66	89	
• Biomethane from vinasse	nil	0.1	Biomethane Nm3/liter ethanol
4. Global Parameters			
• Leftover bagass p/ energy: %	nil	Up to 78	100% ethanol production
• Sale of energy to the network	purchase	yes	Standard sugarcane: 12.5% fiber
• Vinasse/Stillage produced	15	< 1	Vinasse liter / liter ethanol
• Solid biofertilizer: kg/ton. sugarcane	nil	50 to 60 (*)	(*) BIOFOM
• Integrated biodiesel production	no	yes (*)	(*)Barralcool Plant- Dedini / 2006
• Use of the straw as a source of energy	no	initial	Initial stage of use
• Electricity for sale	nil	Up to 90	kW / ton. sugarcane
• Water consumption: liters/l ethanol	260	nil/exports	Capture water sources
• Ethanol Production, liters/ton. sugarcane	66	87	

Source: OLIVÉRIO, 2006.

Please note that in these developments, the plants provided tha data, which was obtained by analytical developments and of process, particularly of CTC.

4.2 Initiatives to disseminate information and transparency on the social and environmental performance of the sector

4.2.1 Sustainability Reports

The transparency in social and environmental actions undertaken by the sector has been of increasing value. The sustainability reports have been the most widely used tool for the dissemination of this information. In 2008, Unica was the first agribusiness association in the world to develop and publish a sustainability report in accordance to the standards of the GRI (Global Reporting Initiative) – internationally recognised standards for sustainability reporting. The second report, released in 2011, attained GRI´s A+ level of application and it was underwritten by PWC in the standard AA 1000AS, which assess the service concerning the principles of inclusion, materiality and responsiveness of the organization to the demands of its stakeholders. The GRI report is a result of the continuous improvement of monitoring and follow-up of the social, environmental and economic indicators. This model of report is a reference that is currently being used by the industry. Today, more than 70 plants are preparing their own sustainability reports. The topics presented in this chapter are some of the subjects of interest addressed by the industry in the sustainability reports.

Unica's report indicates that, out of 93 members that are respondents, 65% claimed to have significant investment agreements that include human rights clauses or that have undergone appraisals related to human rights. Furthermore, 96% of the companies claimed to include in their evaluation and/or research of suppliers, criteria on child and/or slave labor and other principles associated with human rights.

According to Unica´s report, out of 93 members respondents, 79% reported to have purchasing and investments practices aiming at improving the socio-economic development of the community where it operates. Furthermore, 89% reported to have programs to employ the largest possible number of residents of where they are installed. Working in cooperation with unions, NGOs, community associations and public authorities, they provide the locals with training, hoping to increase the level of skills of the communities.

4.2.2Code of conduct

In 2010, Unica published its Code of Conduct, which contains a set of standards for directors, executive officers and employees. They are assumptions that enhance the organization´s decision-making processes and serve as better guide to general behavior. In order to meet code, an Ethics Committee was created, which is composed of one member of the Board and representatives from the administrative, legal, human resources and social responsibility departments.

The efforts to raise awareness on the importance of the codes of conduct have proven effective: 70% of Unica members already have their own code.

4.2.3 Product Liability

To ensure the production of sugar for food purposes, producing industries have adopted, in recent years, the criteria described in the legislation of ANVISA – the National Agency of Sanitary Surveillance (Ordinance No. 326 of July 30, 1997, Resolution RDC No. 275, October 21, 2002) on Good Manufacturing Practices (GMP) in schemes such as Hazard Analysis and Critical Control Points (HACCP) and, more recently, the requirements of the Brazilian Association of Technical Standards (ABNT) ISO 22000: 2006. This International Standard includes management requirements for the production of safe food, allowing association with the ISO 9001.

On the other hand, the plants only sell their products to large food and beverages companies after third-party audits, which are contracted by the buyers. The audits verify the system implemented by the plant to ensure that all sugar is being produced under conditions suitable for human consumption.

The product packing in the plants is made on 50 kg bags or in big bags, of up to 1,200 kg, except for those that pack products for the consumer market, which are in bags of 1 kg or 5 kg. The labeling in the first case is very simple: it contains necessary information to enable traceability of the product, but contains no nutritional information, as it is directed to the industries. Those who use packaging in bags of 1 kg and / or 5 kg adopt the ANVISA legislation, which requires nutritional information, lifetime and others.

4.2.4 Guidelines/Manual for Conservation and Water Reuse in the Sugar-Energy Agroindustry

This manual was a result of the Technical Cooperation Agreement signed by the National Water Agency (ANA), Federation of Industries of São Paulo (Fiesp), Sugarcane Technology Center (CTC) and Unica. It was developed by experts of CTC, coordinated by the researcher André Elia Neto. It provides detailed information on best practices in water resources management for the sugar-energy sector.

Its publication in December 2009 is in line with the commitment made by the plants signatories of the Environmental Protocol, to implement a program on quality control and reuse of water used in the industrial processes in São Paulo.

4.2.5 Project Agora (Now)

The Agora, a marketing and communications integrated project, involves several business entities and representatives of various sectors of the sugar-energy industry. The project´s goal is to clarify, to strengthen the relationship with various stakeholders of the sugar-energy industry and to inform the public about the benefits of production and use of clean renewable energy from agricultural sources.

In 2009, the Agora carried out, in partnership with the states Departments of Education, the Climate Change Challenge, a project aimed at teachers and students from primary education in local public schools, which aims at arousing ecological awareness in children by disseminating information on the causes of global warming and on ways to mitigate climate change. It reached 12,000 schools, 47,000 teachers and 2.3 million students. 3,500 term papers were received and 24 winners were awarded.

In 2010 and 2011, the second and third editions of the educational project, the Study on Sugarcane Municipalities took place. The Study focuses on the importance of the sugarcane industry to the communities in which it is installed, from the viewpoint of sustainability. The project, in partnership with their respective Departments of Education, havs reached state and municipal public schools in the states of São Paulo, Paraná, Minas Gerais, Mato Grosso, Mato Grosso do Sul and Goiás, which concentrate 90% of the sugarcane production in Brazil. In the project´s third edition, the Northeastern region was also involved, through the states of Pernambuco, Alagoas and Paraíba.

The Bioelectricity Program, launched in 2011 aimed at spreading the benefits of bioelectricity to the public, carries out activities to provide information to decision makers and opinion formers. Seminars held in Congress and in the Legislative Assemblies of the state of Paraná, Minas Gerais, São Paulo, Mato Grosso do Sul, Mato Grosso and Goiás, presented various studies on the positive externalities of ethanol and bioelectricity in the Brazilian energy matrix, from the social and environmental perspective and of public health. These studies raised the debate about the importance of establishing regulatory public policies for the sector.

Launched in 2010, the Sugar-Energy Industry Improvement Program aims at increasing the knowledge of journalists – reporters or editors, in economics or politics, national or international – on issues related to the sugarcane agroindustrial system, such as new technologies, supply chain, growth trends and the existing efforts to transform ethanol into a global commodity.

The Award TOP Ethanol can be considered another highlight. In its first edition, it distributed more than R$ 60,000 in prizes for 13 works selected out of 220 enrolled in the categories such as Photography, Journalism, Term Papers and Academic Works covering the theme “Agro-energy and the environment”. Moreover, the event paid tribute to various representatives from the sugar-energy industry.

Aiming at increasing the knowledge on sustainable production of biofuels, the sugar-energy industry has been involved in events such as Challenge Bibendum, the Bioenergy Sector Trade Show (Feicana Feibio), Sustentar, BBest, IndyCar races, International Trade Show of the Sugar and Alcohol Industry (Fenasucro), the Motor Show and International Symposium and Exhibition of Sugarcane Energy and Technology (Simtec).Project Agora is supported by numerous companies such as Amyris, BASF, BP, Dedini, FMC, Itaú, Monsanto and Syngenta, as well as entities like Alcopar (Bioenergy Producers Association of the State of Paraná), BIOSUL (Bioenergy Producers Association of the State of Mato Grosso do Sul), Siamig (Union of the Ethanol Industry in the State of Minas Gerais), SIFAEG (Union of the Ethanol Industry of the State of Goiás), SINDALCOOL / MT (Union of Sugar and Alcohol industries of the State of Mato Grosso), SINDALCOOL / PB (Union of the Alcohol Industry in the State of Paraíba), Sindaçúcar / PE (Union of the Sugar and Alcohol Industry in the State of Pernambuco), Sindaçúcar / AL (Union of the Sugar and Alcohol Industry in the State of Alagoas) Orplana (Organization of Sugarcane Producers in the South-Central Region), Ceise Br (National Center for the Sugar-energy and Biofuels Industry) and Unica (the Sugarcane Industry Association).

4.3 Voluntary initiatives on certification and self-regulation developed by the sector

4.3.1 Agri-environmental Protocol of the States of Sâo Paulo and Minas Gerais

The agri-environmental Protocol of the State of São Paulo, launched in 2007, established more restrictive policies and goals than those in the presentl legislation, with a view to minimizing some of the major impacts of sugarcane production on the environment and for society. Some of these are: bringing forward the deadline for eliminating the burning of the sugarcane straw, protecting springs and riparian forests and reducing water consumption in industrial stage. The State of Minas Gerais did the same starting in 2008.

Because of its voluntary nature, the protocol was been largely supported from the beginning, and the number of signatory industrial plants is increasing every year. In 2011, there were 173 signatory companies in the State of São Paulo, and 30 in the state of Minas Gerais. In addition, there were also several institutional memberships, from financial institutions, cooperatives and traders. This contributed strongly to further strengthening the initiative.

In order to accede to the São Paulo Protocol, the plants must prepare an action plan with detailed measures, targets and timeframes for the compliance with 10 technical guidelines of the protocol, which are:

1. For lands with slopes of up to 12%, bring forward the deadline for eliminating the sugarcane burning, from 2021 to 2014, and increase the percentage of unburned sugarcane in 2010, from 30% to 70%.

2. For lands with slopes higher than 12%, bring forward the deadline for eliminating the sugarcane burning, from 2031 to 2017, and ncreasethe percentage of unburned sugarcane in 2010, from 10% to 30%.

3. It is not allowed use the sugarcane burning practice for harvest purposes in the sugarcane expansion areas. .
4. Protect riparian forest areas in sugarcane properties due to their contribution to environmental preservation and biodiversity protection.
5. Protect springs and water sources in rural areas part of sugarcane property, thus helping to recover the vegetation around it.
6. Take measures to avoid any open-air burning, of bagasse or any other by-product of sugarcane.
7. Implement a Technical Plan for Soil Conservation, to include fighting erosion and stormwater containment in the internal roads and trails.
8. Implement a Technical Plan for Conservation of Water Resources, promoting the proper functioning of the hydrological cycle, including control program for water quality and reuse of water used in industrial processes.
9. Adopt best practices for disposal of pesticide packaging, through triple washing, proper storage, proper training of operators and compulsory use of individual protective equipment.
10. Adopt best practices to minimize air pollution from industrial processes and enhance recycling and appropriate reuse of waste material from sugar and ethanol production.

The action plans are then assessed by a tripartite committee composed of technicians from the Departments of Environment and Agriculture and from Unica. After its approval, the plant receives a certificate of compliance, which is renewed annually. To ensure that the approved plan is actually being executed, the management committee should organize a schedule of on-site visits to all signatory units. From 2008 until now (2011), more than 90 plants throughout the state were visited. Until 2011, more than 95% of ethanol produced in the states of São Paulo and Minas Gerais came from plants certified by the project, which is known as "Green Ethanol".

The deadline to eliminate the burning of sugarcane straw was reduced from 2021 to 2014, in the mechanized areas (with slopes of less than 12%) and from 2031 to 2017, in areas considered the non-mechanized (with slope higher than 12%). It is important to note that the mechanized areas, which represented 79% of the area managed in 2007, increased to 84% in 2010.

From 2008 to 2010, because of the Agri-environmental Protocol, in the state of São Paulo alone, 785,000 hectares of sugarcane were preserved from the burning, avoiding 427,000 tons of CO2 emmission. Additionally, the straw that remained in the field after harvest represents great potential for energy and can enhance carbon stocks in the soil. Using it as a fuel increases the ability to export energy and mitigate carbon emissions through power generation. This energy, then, is no longer produced by ordinary electrical network, whose sources are power plants fired by fossil energy.

4.3.2 Bonsucro (Better Sugarcane Initiative) Certificate

In order to continuously enhance the social, environmental and economic effects of productive activities of sugarcane and its products, as well as to meet various market demands and international biofuels regulations, the sugar-energy industry has taken part in developing a voluntary certification system, which establishes standards for responsible practices throughout the production process, for both sugar and ethanol.

Unica and other companies in the sector participate actively in Bonsucro, an international forum involving "multistakeholders", which presents an exclusive certification for sugarcane considering various aspects of sustainability.

Through a comprehensive and participatory process – which united international NGOs, financial institutions, producers, consumer companies, traders – Bonsucro developed some environmental, social and economic criteria and indicators applicable to the entire production process of sugar and ethanol, certifiable by independent third parties, which is organized around five principles:

- Law enforcement;
- Respect to human and labor rights;
- Efficiency management of inputs, production and processing for the intensification of sustainability;
- Active management of biodiversity and ecosystem services, and
- Commitment with the continuous improvement in key areas of the business .

These are some of the members of Bonsucro: WWF, Solidaridad, Coca-Cola, Unilever, Kraft, BP, Shell, Petrobras, Braskem, Cargill, IFC, and several associations of sugarcane producers in Australia and Colombia.

In February 2012, the companies members of Bonsucro from the Brazilian sugar-energy industry were: Adecoagro, Agrovale, Bunge Brazil, Cevasa, Copersucar, ETH, Guarani, LDC SEV, Raizen, Renuka, Sâo Martinho, Sâo Manuel, Santa Adélia, São Luiz, and USJ Zilor.

This certification has become operational in mid 2011 and after only 7 months, 12 plants were granted with certification, confirming the high level of sustainability management of the companies in the industry.

4.4 Initiatives coordinated by sectorial association/institution

4.4.1 National Commitment to Improve Working Conditions in SugarCane Production

This commitment resulted from a pioneering experience in Brazil of tripartite dialogue and negotiations, on a national level, between employers, workers and the Federal Government. This is is the background of scope and diversity in which this historic commitment was negociated to recognize best labor practices adopted in the manual operations of sugarcane production. The rounds of negotiations began in July 2008 and 17 meetings in almost one year of dialogue and cooperation were needed to build consensus.

Businesspeople were represented by the National Sugar-Energy Forum and by the Sugarcane Industry Association (Unica). The workers were represented by the Federation of Rural Workers in the State of São Paulo (Feraesp) and the National Confederation of Agricultural Workers (Contag). The Federal Government was represented by the Secretary-General and Civil House of the Presidency of the Republic and the ministries of Labor, Agriculture, Livestock and Supply, gricultura Development, Education, Social Development and Fight Against Hunger.

On 25 June 2009, during the National Commitment´s inauguration, in the presence of the President, most of the companies associated to the producers´union decided to join voluntarily and committed themselves to comply with a set of about thirty labor practices that goes beyond what the law requires. The Commitment´s original duration was two years, extendable. The companies that joined promised to respect the practices established in the Commitment and would be subjected to results monitoring by the National Dialogue and Evaluation Commission, consisting of representatives from government, Contag, Feraesp, the National Sugarcane Forum and Unica.

Immediately upon its launch, the program had more than 50% compliance of the sugarcane industry, with about 300 sugarcane processing plants, which represents over 80% of Brazilian production of ethanol and sugar. The main focus of the National Commitment is to boost, amongst an increasing number of companies, the appreciation of best labor practices through instruments that acknowledge these practices as examples to be followed.

In regards to employment contract, for instance, the Commitment provides for the direct hiring of workers in the manual activities of the planting and harvesting of sugarcane, completely eliminating the use of intermediaries, so-called “gatos” (cats). The Commitment also covers other points, such as: the elimination of compensation tied to the workers earnings for transport services, administration and inspection, increase transparency in the work´s assessment and payment on production; a wide range of best management practices in health and safety, such as workplace excercise, breaks, rehydration and emergency care, transport of workers, and the dissemination of best practice guidance for sugarcane suppliers, providing services to migrants employed elsewhere, the strengthening of trade unions and collective negotiations, as well as the appreciation of corporate responsibility activities of companies in the sugarcane communities.

The Federal Government, in turn, is also committed to public policies that support and encourage actions aimed at the adequacy of the Personal Protective Equipment (PPE), strengthening the Public Employment System – literacy, education and qualification of workers, as well as the sustainable organization of production, health, sanitation, access to water, infrastructure and territorial and fiduciary management in less developed areas, where there is hiring of seasonal workers.

Following the voluntary compliance to National Commitment, member companies must undergo an assessment, carried out by an auditing firm enabled by Federal Government´s public call, to verify compliance with the practices adopted.

The member companies are responsible for the selection, hiring and all expenses of any of the five qualified audit companies: (i) Audilink & Co. Auditors, (ii) Deloitte Touche Tohmatsu, (iii) Ernst & Young Terco Independent S/A (iv) KPMG and (v) UHY Moreira Auditors.

In order to make these inspections possible, the National Commitment was extended by one year, with effect until June 25, 2012, whereby at the end of the inspections, if the company is attested to full compliance with the terms of the National Commitment, the company will be entitled to the following recognition mechanisms: (i) stamp, (ii) having its name inserted on the site of the General Secretariat of the Presidency of the Republic, where all the official information on the Commitment can be found.

4.4.2 Retraining Program for Sugarcane Rural Workers – "RenovAção"

The Retraining Program for Sugarcane Rural Workers (RenovAção), the largest retraining program of Brazilian agribusiness, began to be created at the time of signature of the Agri-environmental Protocol in the State of Sao Paulo in 2007. The industry´s commitment to anticipate the legal framework and reduce the timeframe for the elimination of the burnings, with the mechanization of the harvest, provides enormous environmental benefits (eg reducing emissions, reducing the impact on biodiversity, etc), and improves the working conditions in the field. On the other hand, it brings, as an inevitable consequence, a decrease in the number of workers on the manual cutting of sugarcane.

Each of the equipment replaces the work of eighty men. This will generate impacts on jobs currently available in the field and will also impacts the communities surrounding the plantations, which often have in the sugar production, its main source of employment and income. On the other hand, each equipment needs 18 skilled workers. This is also true in other sectors of the economy, thus the importance of retraining the rural workers, as it is the only option for their reintegration into other jobs.

Launched in 2010, it has an ambitious goal: to train and retrain every year, 3,000 workers or former workers, manual sugarcane cutters, so that they can begin to operate equipment that will replace them in the field, and so that they will be able to work in other operations in the plants or even be absorbed by other sectors of the economy. RenovAção´s work began with the establishment of a committee composed of members of Unica with the objective to identify the demand for labor in various sectors and also in their own industrial plants. This was due to the significant growth in the number of jobs related to mechanization. The second step was to engage the Federation of Rural Workers of São Paulo (Feraesp), which is co-organizer of the project.

The retraining was defined in two categories or modules:

1. For the industry itself: training for sugarcane driver, harvester operator, harvester electrician, tractor driver, electrician and mechanical for automotive maintenance

2. For other sectors: retraining of rural workers for jobs in activities outlined as agricultural, industrial and urban services. Availability of posts took into account the regional and economic caracteristics and needs. Feraesp was responsible for the articulation work with local governments to ensure that the training courses were created where there was demand for labor.

After designing the program, Unica went for after new engagements, this time with supply chain stakeholders, that benefit the most with mechanization: agricultural and industrial input industries.

It was then that RenovAção acquired important allies, such as Case IH, John Deere, Syngenta, Iveco, FMC and Solidaridad Foundation, which became sponsors of the program. Other important partner is the Inter-American Development Bank (IDB) acting as a supportive financial institution. This project is an evidence of great coordination and commitment from the sugar-energy industry´s production chain, with activities including social responsibility and continuous improvement of working conditions.

UNICA representatives, Feraesp and other business partners make up RenovAção´s executive committee, which is responsible for the following initiatives:

- Define and approve, in a decentralized manner, the proposed courses,

- Select participating companies, accredited public and private institutions to carry out the activities of training and retraining,

- Continuously, monitor and evaluate the program.

On a daily basis, Unica and Feraesp are responsible for coordinating activities and advertising the project. The plants and the unions, in turn, refer students, provide training rooms for the courses, facilities and equipment for the practical training (areas to be cut or planted, laboratories, workshops, etc) and also provide transportation and food. The partner companies take part in internal meetings and collaborate with funds, while the National Service of Industrial Learning (Senai) and FAT/Paula Souza Center

– winners of the bidding contracts – provide instructors, teaching resources, conduct training, evaluate learning and certify course participants.

The courses are taught in six main geographical regions, which represent the major production areas of sugarcane in the State of São Paulo. Since February 2010, the Program RenovAção has been responsible for the retraining of 3,800 beneficiaries. 56% of the individuals retrained are already employed and executing new functions. The improvement of the skill profile of workers, which benefited from the program RenovAção has a direct influence on their compensation profile. It is estimated that the new activities related to mechanization generates a salary increment of around 50%.

4.4.3 Buses that run on ethanol and diesel from sugarcane

In 2009, the Bioethanol Project for Sustainable Transport (Best) launched ethanol-powered buses in the transport fleet in the city of Sao Paulo. In November 2010, Unica, the São Paulo City Hall and several businesses and partner organizations signed a letter of intent with a view to increasing the number of buses that run on ethanol in the city. Today, there are 60 ethanol buses in circulation in São Paulo.

Furthermore, a partnership between the City of São Paulo, the multinational Amyris, Viação Santa Brígida and Mercedes-Benz made possible that buses run on a mixture of 10% diesel from sugarcane in diesel fuel. By the end of 2012, it is expected that 500 buses will be running on diesel with a mixture of sugarcane in São Paulo. These efforts run in parallel with São Paulo´s climate change policies, which have specific goals with regards to urban transportation and renewable energy.

4.5 Other business initiatives related to sustainability and social responsibility

The initiatives mentioned in this chapter are added to the projects of sectorial character, described in the previous chapter. It is impossible to describe all of the various individual initiatives of companies in this sector. For more detailed information, please research the several sustainability reports published by each of the companies.

Analyzing the sustainability practices adopted by the major sugar-alcohol groups in Brazil, the efforts made by this industry in the last years to optimize the use of inputs at all stages of production, while reducing the impact of waste, are remarkable. Regarding the use of water, the Cosan Group, for example, work with closed system in at least 19 of its plants, where 90% of the water is condensed during the industrial processes and remain recirculating in the whole process. A volume of 0.7 m^3 to 1 m^3 of water is used per ton of crushed sugarcane. In 2009/2010, out of the total water captured, 19,000 m^3 were treated and properly returned to the environment as effluent.

The main wastes from operations are: vinasse, filter cake, boiler ash, bagasse and straw and tips. Until recently, these residues were not valued or seen as a potential source of income. Due to technological innovations and scientific knowledge, these wastes, that before were underused and had no economic usage, started to be used intensively.

With the exception of the bagasse, which is burned for cogeneration of energy, a practice adopted across the industry, the other inputs are reused as organic fertilizers in planting. This is a very common practice among companies in the sector. The LDC-SEV recycles around 88% of the total amount of waste and agricultural by-products and the Cosan Group estimates that they avoided to consume 45,000 tons of chemical fertilizers in the 2009/2010 harvest with the use of vinasse and filter cake. The Renuka implements selective collection of recyclable waste, which is sent to recycling cooperatives. The hazardous wastes are sent to waste management companies for a proper disposal. Furthermore, Equipav and Revati´s Solid Waste Management Plans (SWMP) are in progress.

Still considering the environmental aspect, in a complementary way, several groups are engaged in the preservation of the Permanent Preservation Areas (APP), as well as reforestation and the preservation of riparian forests. As examples, Bunge, which incorporated the Moema Group and the Pedra Group, initiated, in 2005, Programs for Forest Restoration of APPs in partnership with ESALQ/USP, aiming to plant, each of them, more than a million native trees by 2016; Guarani plant, from Tereos Group, is engaged in the Program for Reforestation and Preservation of Riparian Forests, and is responsible for six nurseries that produce 480,000 seedlings of native trees; the Renuka Group was responsible for more than 258 hectares of revegetation, which is equivalent to 431,000 native tree seedlings planted in riparian forests; the Columbus Group has a native area of approximately 9,000 hectares and conducts reforestation programs; and the Tercio Wanderley Group, which keeps an area of more than 8,000 hectares to the preservation and reforestation of native vegetation. Of this area, 288.56 hectares have been transformed into two Private Natural Heritage Reserves (PRNP) by IBAMA. In regards to emissions, some plants have already obtained certificates of carbon credit, such as the Forest Unit of the Alto Alegre Group.

Another significant example is the use of the UN's Clean Development Mechanism (CDM) for generation of carbon credits derived from projects that reduce emissions in the industry. Brazil is the third country in number of CDM projects, after China and India. About 50% of these projects are related to the production of renewable energy, mainly projects related to hydroelectrics and to the generation of bioelectricity from the burning of sugarcane bagasse. Under CDM, around 500,000 tons of CO2 equivalent in carbon credits are generated each year by the Brazilian plants through cogeneration. Therefore, the sugarcane industry is one of the main Brazilian sectors using the CDM as a financial tool for investment in low carbon technologies (SOUSA, AMARAL, 2009). The LDC-SEV group, for example, has already obtained more than 403,000 carbon credits certificates, which corresponds to a reduction of more than 403,000 tons of CO2 in the atmosphere, recognized by the UN.

Currently, the strategies for managing impacts on biodiversity from the sugar-energy sector focuses on the following actions:

- identification of priority areas to increase the diversity of fauna and flora;

- Protection and/or recovery of the priority area;
- Implementation: protection and/or recovery;
- Continuous or on-demand monitoring of the biodiversity (biomonitoring)..
- The estimated investment in environmental protection put together by the members of Unica alone is estimated at more than R$ 1.2 billion invested in the 2009/2010 harvest.

TABLE 5. INVESTMENTS IN ENVIRONMENTAL PROTECTION BY THE MEMBERS OF UNICA			
	2007/08	2008/09	2009/10
Mecanização	378	485	1.220
Levantamento, proteção e reflorestamento	15	15	16
Fechamento circuito de águas	7	15	21

Source: Unica.

Considering the working conditions, the sugar-alcohol sector has advanced greatly, as demonstrated by the National Commitment to Improve the Sugarcane Working Conditions, mentioned in topic 4.4.1, which establishes practices that go beyond the law. The professionalization, which initiated in the last decade is a process still in progress that contributes to the constant evolution of labor relations in the areas of health and safety, with the implementation of the Regulatory Norm 31 and other proactive measures originating from the companies. Most groups pay much attention to aspects related to human rights, focusing mainly on the eradication of child and slave labor.

As signatories of the National Pact for the Eradication of Slave Labor, several companies from this sector are committed to respecting human rights throughout their working practices. The federal pact also covers the whole supply chain and requires full compliance with all labor legislation, with a view to preventing practices of forced, slave or child labor in the agribusiness production chain.

The Carlos Lyra Group has also developed actions to respect human rights, and the group´s five plants were recognized by the Abrinq Foundation for Children's Rights as a Child-Friendly Company. The term of commitment with this organization was signed in December 2001.

Of the 440 sugarcane processing plants in operation in 2011, 117 units were implanted during the industrial expansion process that occurred in the years between 2000 and 2010. During the installation of all the new production units, located in the states that were part of the sugarcane expansion, such as Minas Gerais, Mato Grosso do Sul, Goiás, Mato Grosso and Tocantins, the Ministry of Labor was imperative that all plants fully complied with all of the strict human rights criteria in order to get licensing or access to any financial request.

Considering certification, although it is just beginning, more and more plants are being certified for their sustainability criteria, which is a trend in the sector. Probably, the main certification applicable to the sector will be Bonsucro. In January 2012, six companies, including 12 subsidiaries or affiliated production facilities, were certified by the criteria of Bonsucro:

- Copersucar: Quatá, São Manoel, Santa Adélia and Zillo Lorenzetti plants;
- Zillor: Barra Grande plant;
- Raízen: Maracaí, Bom Retiro and Costa Pinto plants;
- Renuka: Equipav plant;
- Bunge: Moema and Frutal plant, and
- ETH Bioenergia: Conquista do Pontal plant.

However, there are several other certification applicable to the sector. There are certified plants in the following schemes: Rainforest Alliance, ISO 14000, Greenergy, Ecosocial Stamp, among others. Finally, since its creation, in 2001, Unica´s Center for Social and Environmental Responsibility and Sustainability, with support from organizations such as the World Bank, the Ethos Institute and GRI, among others, has conducted seminars and lectures for its associates to raise awareness to the importance to promote more sustainable and less welfare measures and actions.

It is clear that the specific actions and the donations of welfare nature, which prevailed in the sector, are being replaced by projects that are more focused on robust and comprehensive actions, taking into account the demands from the surrounding communities and from the employees, the main beneficiaries. The table below shows the total number of projects submitted by 93 Unica associates.

TABLE 6. SOCIAL AND ENVIRONMENTAL PROGRAMS / UNICA ASSOCIATES

Área	Projetos	Beneficiados	Investimento
Cultura	22	91.333	R$ 1.564.432,66
Ambiental	43	69.243	R$ 8.596.047,34
Esporte e lazer	12	23.645	R$ 1.743.830,28
Qualidade de vida	53	80.982	R$ 7.005.617,57
Saúde	36	28.698	R$ 2.975.886,53
Educação	46	26.988	R$ 6.618.190,76
Qualificação	61	88.718	R$ 3.851.518,39
Total	**273**	**409.607**	**R$ 32.355.523,53**

Source: Unica.

TABLE 7. INTERACTION WITH COMMUNITIES / UNICA ASSOCIATES	
Iniciativas	**Empresas**
Participam de Fóruns Locais	61 empresas
Internalizam este relacionamento na própria empresa.	51 empresas
Atuam em parceria com a comunidade na construção de redes para a solução de problemas locais, oferecendo suporte técnico, e/ou espaço físico, ou outros tipos de apoio.	48 empresas
Participa na formulação de políticas públicas, se engajando na resolução dos problemas do local em que está inserida.	41 empresas
Reconhecem a comunidade em que está presente como parte interessada importante em seus processos decisórios.	67 empresas
Contribuem com melhorias na infraestrutura ou no ambiente local que possam ser usufruídas pela comunidade (habitações, estradas, pontes, escolas, hospitais, etc.).	83 empresas
Têm programa para empregar, na medida do possível, o maior número de moradores do local em que está inserida, dando-lhes formação, com o objetivo de aumentar os níveis de qualificação daquela comunidade em cooperação com sindicatos, ONGs, representantes da comunidade ou autoridades públicas.	89 empresas
Têm práticas de compras e de investimentos para aprimorar o desenvolvimento socioeconômico da comunidade em que está presente.	71 empresas

Source: Unica.

5 CHALLENGES AND OPPORTUNITIES FOR THE SECTOR ON THE PATH TO SUSTAINABILITY

5.1 Main international trends for the sector within the framework of sustainability

It's possible to identify a strong international trend toward valuing alternative energy sources that are proven to be produced and marketed in a sustainable manner.

Permanent tensions and the escalation of militarization and nuclearization in the Middle East, where most of the world reserves of oil and natural gas are concentrated, and the recognition that the exploration of new deposits outside the traditional areas of supply will require the development of new and expensive technologies for exploration and extraction, in a safe manner, and not yet fully mastered, are important factors to keep great interest in alternative energy sources.

In the field of alternative energies, the recognition that the technology of photovoltaic cells is far from being economically viable without the help of massive subsidies; that the wind generation is technically and economically viable, but should be seen as a complement, for it doesn't represent firm energy; the fear on which are the limits to the biofuel production from grains, without creating distortions in the markets for food and animal feed production, are general trends that favor the biofuel production from sugarcane.

Perhaps the greatest accomplishment achieved by Brazil in the field of biofuels produced from sugarcane has been the demonstration that cane is a source of biomass that makes the biofuel production on large scale physically feasible, without causing unwanted distortions in food production. This happens simply because sugarcane occupies relatively little space to develop.

Brazil has demonstrated this by showing itself able to replace 44.6% of all its automotive gasoline consumption in 2010, occupying with sugarcane dedicated to ethanol production only 4.9 million hectares, which represents only 1.4% of farmland in the country. However, the international trend goes more and more intensively in the direction that it isn't enough that the biofuel production: (i) be economically viable; (ii) be capable of reducing in high proportions (in the case of USA and EU, above 50%) greenhouse gases emissions; (iii) can achieve a relevant and minimally viable scale in relation to existing fuel systems; and (iv) can be used in transport systems with adaptations not extremely expensive (as demonstrated by the introduction of the mixture of anhydrous ethanol in gasoline, and the introduction of flex-fuel vehicles, able to use various mixtures of ethanol and gasoline).

The evidence that biofuel production takes place in a sustainable manner, in its environmental, social and economic aspects, tends to become the main item for this production to keep growing, and tends to become selectivity criterion for funding new projects, and access to markets.

5.2 Challenges for the sector within the framework of sustainable development (market, technology, regulation)

The Brazilian sugar-energy industry is in a transition stage. Although it should be considered the most successful program in the whole world to the economically and environmentally viable biofuel production on large scale, there are still important hurdles to be overcome in the context of markets, technological aspects and issued related to regulation.

The Brazilian sugar-energy industry should be considered the most successful among the initiatives around the world because, even no longer being the largest bioethanol producer in the world (as in volume it was surpassed by the United States), has succeeded in replacing the highest proportion of gasoline, reaching the mark of 44.6% in 2010, in equivalent gasoline.

The United States, currently the largest world producer of ethanol from corn, was able to replace about 9.5% of its gasoline in 2010 and aims to achieve a degree of replacement of 20% by 2022[18]. The European Union has already replaced 3.4% and aims to achieve a level of 10% of renewable fuels (bioethanol plus biodiesel) on the total fuel consumption in 2020[19].

Despite reaching a very high level of fuel replacement, the transition stage is justified by the following factors. The technology used in bioethanol production, both in agricultural and industrial areas, isn't yet optimized. This brings up the perspective of capturing high productivity and competitiveness gains. The ethanol commercialization in the domestic market isn't properly structured in contracts between fuel producers-suppliers and distributors (the Brazilian regulation doesn't allow direct sales

18 *EEnergy Independence and Security Act (EISA), of 2007, which set the target of 136 billion Liters of biofuels, estimated at 20% of the total, until 2022.*

19 *Policy of the European Parliament and the Council of the European Union 2010/31/UE.*

of ethanol from the producer to retail stations), based on most modern tools of price protection, such as the use of future contracts for ethanol. Public policies for the sugar-energy industry don't provide conditions that stimulate the necessary investments in expansion of agricultural production and processing capacity. Examples of policies that discourage investment are:

- maintaining the base prices of automotive gasoline in the oil refineries often below equivalent price levels on the international market, discouraging the bioethanol production, besides causing severe reduction of resources generation for investment in exploration, drilling, extraction and refining, in the oil sector;
- the recent rise of CIDE's roof for ethanol to the limit of R$ 602 per cubic meter (even though the value of CIDE kept at zero for ethanol), while the value of CIDE gasoline was reduced to R$ 92 per cubic meter. This represents a very high risk for the sector, and is clearly against the policies of other countries which seek to internalize in market prices the positive externalities of biofuels production and use;
- the frequent changes in the percentage of anhydrous ethanol blend in gasoline, often motivated by government strategies to influence indirectly the formation of market prices for anhydrous and hydrated ethanol.

The sugar-energy industry is suffering the effects of increased costs resulting from its adaptation to more sustainable new production patterns. The optimization of these new production modes and processes, with consequent cost reduction and competitiveness recovery, will still take some time.

Currently, the major challenges are:

- At market level:
    - ◊ Keep alive the interest of vehicle owners by fuel-flex technology, and the use of ethanol. The fuel-flex fleet is a great market estate conquered and built by the sector, and must be preserved because of its very relevant regulator and strategic character to the sector as a whole. The fuel-flex fleet acts as a "sponge", able to absorb surplus production, acting as the great regulator agent of bioethanol and sugar markets.
    - ◊ Expand bioelectricity generation and distribution, eliminating the current barriers and difficulties to connect the plants to the grid, and valuing, via marketing taxes and costs for Access to the interconnected distribution system, the complementarity between cane bioelectricity and the hydroelectric system already installed.
    - ◊ Set an international specification for bioethanol fuel that is generally accepted in key markets (Brazil, United States, European Union and major potential consumer countries in Asia) and don't represent technical barrier to the product transport over long distances, contributing for the formation of a global market, and not regional market niches.
    - ◊ Consolidate ethanol as international commodity.

- At technological level:
    - ◊ Encourage and reward private technological development, in order to improve the agricultural and industrial production, and systems that use bioethanol. .
    - ◊ Refine and optimize productivity, and losses reduction, of mechanized planting and harvesting systems.
    - ◊ Increase the speed of implementing new technologies, in order to produce more with the same area and lower environmental impacts.
    - ◊ Optimization of mechanized cropping and cutting systems.
    - ◊ Promote the correct adjustment of sugarcane's varieties already developed to production soils and environments identified in production regions.
    - ◊ Promote public policies that stimulate increasing of vehicles efficiency for the use of bioethanol. In 1992, the average relative price of indifference between hydrated ethanol and automotive gasoline (gasohol) for the existing fleet was 80.67%. Currently, with the advent of the fuel-flex fleet, the relative price of indifference dropped to about 70%.

- At regulation level:
    - ◊ Develop a strategic plan of the Brazilian fuels matrix, defining the goals of the desired growth in the medium and long term fuel supply, avoiding excess capacity and economic inefficiencies.
    - ◊ Build a regulatory framework for biofuels which provides legal security for investments and recognizes the externalities of these products for society, for example, permanent tax measures.
    - ◊ Reverse the direction of the current fiscal policy applied to fuels, which can penalize bioethanol in relation to fossil fuel.
    - ◊ Unify the fiscal policy applied to fuels, and make it recognize the environmentally benign, developmental and sustainable character of sugarcane ethanol, and not vice versa. There are currently eight different ICMS tax regimes applied to ethanol, in Brazil.
    - ◊ Provide legal and institutional security on land use, with the approval of a new Forest Code.
    - ◊ Make the requirements related to sustainability certification clearer, more transparent and adapted to local conditions, in its economic, social and environmental aspects, in order to be actually legitimate and don't configure new barriers to markets access.
    - ◊ Encourage bioelectricity, especially through auctions differentiated by energy source, which recognize the many advantages of bioelectricity generation: complementarity with the hydroelectric park; lower investments and transmission losses; recognition that it's firm and renewable energy.

5.3 Opportunities for the sector within the framework of sustainable development

The main opportunities for the sector, within the framework of sustainable, are:

- consolidation of the sector model, with maximum waste utilization, optimization, higher agroindustrial yielding and water reuse;
- increase in cogeneration and production of bioelectricity surplus, reducing the cost of ethanol and sugar, through the generation of additional income from the same agricultural production base;
- ethanol logistics: maturation of investments in alcohol pipelines, and development of water transport, to reduce current transportation costs;
- production derived from sugarcane from the second and third generation (cellulosic ethanol, biogas, biogasoline, biodiesel from sugarcane, aviation biokerosene and other special oils);
- capturing potential productivity gains, which can double the average agroindustrial yield in the next decade;
- increasing awareness and recognition that cane's energy, especially when fully and environmentally correct used, and all its elements, is equally or more sustainable than the so-called second and third generation biofuels;
- expansion and transfer of production and large-scale use system, developed by Brazil to the integrated production of sugar, bioethanol and bioelectricity to other countries, mainly in Africa, Latin America and Southeast Asia. This transfer will only be effective and materialize if regulatory frameworks are appropriately built for the implementation and development of these initiatives, which may contribute decisively to mitigate, in the coming decades, the effects of increasing energy demand in developing and least developed countries and their impacts on global warming.

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