

Argentine and Brazilian biodiesel Industries, an analysis for development

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Abstract

Due to strong economic growth present in the world, it began to become aware of the need to replace fossil fuels with alternative energy sources, biofuels emerging as a possible option. Following Calzada (2014), the biodiesel industry based on soybean oil in Argentina was losing the first place that held until 2012 as a producer for various reasons, such as high export duties, taxation expressed anti-dumping measures the European Union, which were driven mainly by Spain to rule the country as a seller of the product. In contrast, the production of biodiesel in Brazil has increased significantly going from just over 2.1 million tons in 2010 to 3 million in 2014. Global production of biodiesel in 2014, it shows that Argentina lost positions compared to other years occupying the 5th place with 2.58 million tons, being surpassed by the United States with 4.25 million tons, Indonesia with 2.9 million tons, Brazil with 3 million tons and Germany with 2.75 million.

It stated above, it is proposed as an objective of this paper to analyze the laws in Brazil and Argentina applied to the biodiesel industry, the economic formation of industry concentration and economies of scale in operations, to thereby understand the growth from Brazil, and the fall of Argentina in positions in this market.

Under these conditions, and also looking at what happens in Brazil, it would be reasonable to guess that there is a tendency of firms to build ever larger plants and behind it there is some evidence of economies of scale, which could lead to greater concentration of the biodiesel industry.

Keywords: biodiesel, concentration, economies of scale, legislation.

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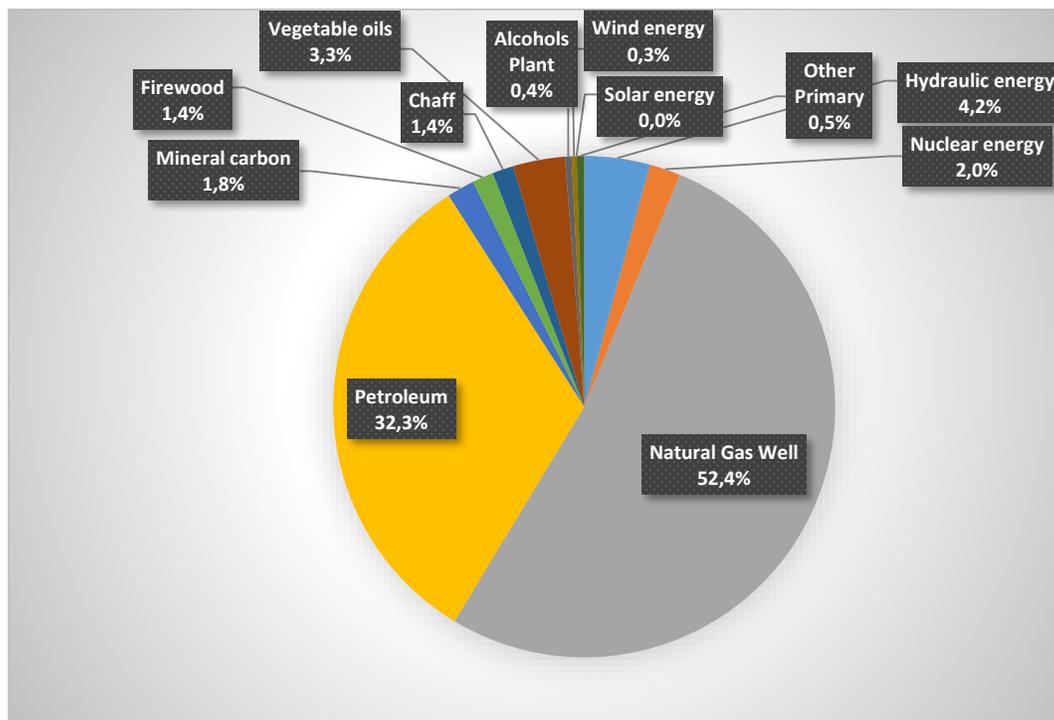
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1. Introduction

As pointed out by United States Department of Agriculture (USDA), between 2001 and 2013 the global production of biofuels is growing rapidly driven by the combination of several factors: increase in fossil fuel prices, good prices for some raw materials, and government policies that require use a certain amount of biofuels. These same factors driving the production also boosted world trade in biofuels. In some producing countries emerge as net exporters, as is the case of Argentina in biodiesel.

The analysis of the energy matrix is critical to understand the planning of the energy sector of a country and its main feature. It is for this reason that the energy matrix of Argentina and Brazil are analyzed as a first approximation to show certain differences, in terms of renewable and non-renewable, bearing in mind that is not aim of this paper to analyze the methodological differences between the two.

Figure N° 1: Participation of Domestic supply of energy in thousands of TEP. Argentina (2014)

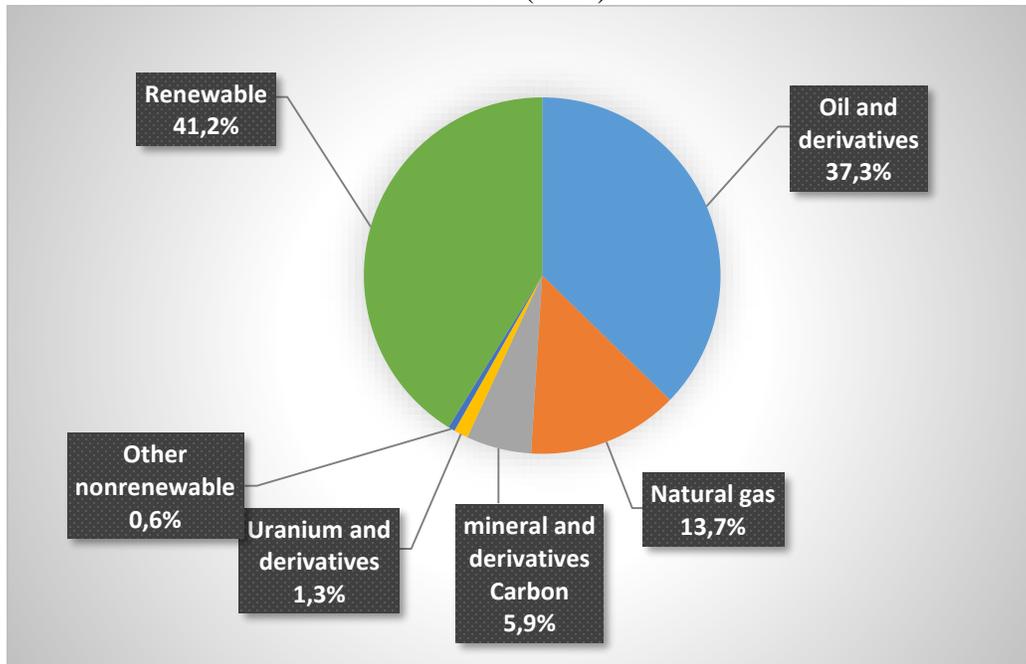


Source: Own calculations based on data from Ministry of Energy of the Nation. National Energy Balance (2014).

Argentina's energy matrix in 2014 presents a fundamentally oriented fossil fuels composition, so that the gas and oil have 52.4% and 32.3% of total energy supply respectively, while other sources like the mineral carbon has a 1.8%, and nuclear energy has a weight in the total of 2%. Non-renewable energy represent 88.5% of the Argentina structure. In turn, it shows that renewable only occupy 11.5% of the primary energy matrix. Among these is the main source hydraulics, with 4.2%; vegetable oils followed with 3.3%, wood and bagasse each with 1.4%

of the total. Biofuel production, although has shown significant growth from 2010 onwards, represents only 1.6% of the matrix, which 1.2% is biodiesel, and 0.4% is ethanol.

Figure N° 2: Participation of Domestic supply of energy in thousands of TEP. Brazil (2015)



Source: Prepared on the basis of Mines and Energy Ministry data. Brazil. Brazilian Energy Review, 2015

Brazil, unlike Argentina, has a matrix with strong participation from renewable sources, as a result of a pioneer in this type of energy, with the introduction of the ethanol from the seventies policy. Renewable sources account for 41.2% of the total energy supply, are composed of 11.3% from hydropower, 16.9% ethanol (made from sugarcane) and 8.2% of firewood and charcoal, and 1.03% of biodiesel. Meanwhile, non-renewable energy contributing 58.8% (37.3% distributed in oil, 13.7% natural gas, coal 5.9% and 1.3% nuclear energy) . Biofuels occupy a relatively important part in Brazil compared to having in the world.

While the current share of biodiesel in the energy matrix of both countries is low, they are in an advantageous position in the development of production, mainly due to the availability of raw materials and significant spare capacity in plants.

In 2012 Argentina was the third largest producer of biodiesel, computing all oils used as raw material. In 2013, he dropped to fifth place with a production of 2 million tons of biodiesel. In 2014, with a production of 2.58 million tons, ranking fifth, it is surpassed by the European Union with 11.7 million tons of biodiesel (mainly rapeseed oil processing), United States with 4.25 million tons (main raw material soybean oil), Brazil with 3 million tons (mainly soybean oil) and Indonesia with 2.9 million tons, product processing palm oil.

Brazil shows a more regular behavior, growing steadily beating Argentina in 2014. The falls in the production of biodiesel were due to difficulties in foreign markets.

Table N° 1: Major producers of biodiesel (millions of tons). Period 2010-2014

	2010	2011	2012	2013	2014
World production	18.37	22.31	24.19	27.06	29.12
U.S	1.14	3.22	3.3	4.53	4.25
Indonesia	0.68	1.38	1.99	2.63	2.9
Brazil	2.1	2.35	2.39	2.56	3
Germany	2.8	2.79	2.63	2.7	2.75
Argentina	1.82	2.43	2.46	2	2.58
Thailand	0.65	0.79	0.92	0.95	1
Holland	0.36	0.48	0.8	0.98	1

Source: Oil World Statistic Update

In this paper we will first analyze the structure of industries of Argentina and Brazil biodiesel, its production plants installed capacity, consumption in the domestic market, exports and regulations.

On the other hand, to analyze the concentration of industry in both countries the indices are analyzed: C (m) to analyze the relative share of companies operating in the market and the Herfindahl - Hirschman (IHH) according to number of relevant companies in the industry and participations in them.

It is important to bear in mind that economies of scale are an attribute versus the absence of divisibility of capacity can be achieved only operate with large commonalities such as equipment and plant installation. Although the size of the team and its indivisibilities are significant for a study of the economies of scale variables, this does not limit these variables show a certain relationship.

It is for the above, in this paper the possible existence of economies of scale will be discussed in the biodiesel industry in both countries. To this end, it analyzes, in the case of Argentina, the average production costs of a large plant and a small. It seems reasonable to think that the cost of the total investment grow by less than the increase in installed capacity, in other words, the growth rate of the cost of the investment grows at decreasing rates as you increase the productive capacity of the plant, this can be seen when the investment unit cost decreases as increases the productive capacity is observed.

Under these conditions, and also looking at what happens in Brazil, it would be reasonable to guess that there is a tendency of firms to build ever larger plants and behind it there is some evidence of economies of scale, which could lead to greater concentration of the biodiesel industry.

2. Regulation in the industry: a brief overview

Because of the rapid growth of world economies, it became necessary to be aware and look for ways to replace fossil fuels by other alternative energy sources. In addition to achieving energy security, the reasons for the emergence and development of biofuels include: the possibility of reducing greenhouse gases, improving export opportunities, and in some cases to promote rural development.

In Argentina, after intense debate in Congress, the promulgation of the National Law 26,093/2006, Regulation and Promotion Scheme for Sustainable Production and Use of Biofuels, determined the emergence of the new industry. One of the obvious purposes in the formulation of this law was to promote small and medium enterprises in the sector which would be achieved through various tax concessions and permits installation of plants, taking priority SMEs in the award of the quota for domestic sales.

Thus, the National Law 26,093 / 2006 and its regulatory decree 109/2007 constitute the legal framework of the biofuels industry in which regulations and promotions and a series of resolutions, decrees and establish additional regulatory notes.

With reference to Argentina law is important to bear in mind the regulatory regime that extends over production (through quotas), domestic prices, the percentage of compulsory content and authorization to install and to exercise the activity of production into biodiesel, bioethanol and biogas. Promotional tools acting on the authorized companies are also analyzed, which are temporary (for a period of 15 years for the federal order, with the possibility of being extended). Federal tax incentives proposed in the spirit of the law by the promotion system, to benefit those medium and small producers, seeking to develop an industry of national capital, and ensuring the supply of biofuels in the domestic market. Moreover, there are other instruments for promoting provincial character offering those provinces that adhere to the National Law.

Another aspect that contains the Law 26.093 refers to the provisions that companies must meet to enter the industry, which are different in different jurisdictions. The Department of Energy's Office is the agency responsible for law enforcement; sets standards of non-tax or fiscal nature established through the issuance of technical standards for enabling plants, cutting attachment or mixing, determining the internal reference price of biofuels and quality standards to be met by biofuels.

In recent times, the Argentine regulatory framework Biofuels sector has changed several times. In the first instance, by Resolution 1339/12 of the Ministry of Foreign Trade it was established a change in the rates of duties and export refunds biodiesel. The change reflected an increase from a retention rate of 14% effective exports to 24%. In parallel, a resolution made jointly by the Ministry of Economy and Public Finance and the Ministry of Industry and Federal Planning, Public Investment and Services, to create the "Interdisciplinary Executive Monitoring Unit", establishing the reference price is issued compulsory in the market for the month of August 2012 of \$ 4,405.30 a ton of biodiesel, 15% lower than the price prevailing in the previous month. The objective of this set of decisions was to favor the recent nationalization of YPF through low cost, being the main buyer of oil biofuel in the country, seeking thereby freeing up resources to encourage investment required by the company. This set of measures brought about an unexpected crisis SMEs producing biofuel. After that situation changed by several resolutions how to calculate domestic biofuel and export duties prices. Topics to be developed in depth in the next section.

On the other hand, the biodiesel industry was born in Brazil with the National Program for Biodiesel Production (PNPB) 2004, but the market is established in 2006 through purchases

of the National Agency of Petroleum, Natural Gas and Biofuels (ANP tax, guarantee and anticipation of market demand:), and after the enactment of Law 11,097, in 2005, various incentives were established. So that the Act is introduced biodiesel in the Brazilian energy matrix and expanded the administrative competence of the National Agency of Petroleum, Natural Gas and Biofuels (ANP). From the publication of the Act, the PNA undertook to regulate and supervise activities related to production, quality control, distribution, sale and marketing of biodiesel and blend diesel-biodiesel, called BX. Mixtures or blending rates are established with Law 13,033 in 2014, also amended by Law No. 13,263.

Production of biodiesel Brazilian industries cannot be made directly to retailers. Sales are made through auctions regulated by the ANP, which stipulates volumes and conditions of delivery of each consignment. From this, the company PETROBRAS (Petroleo Brasileiro SA), purchase biodiesel and making the distribution in the supply network, which is already mixed properly at the pump. The auctions held since 2005 have been aimed at generating market by stimulating the production of biodiesel in sufficient quantity to make the mixtures determined by law.

3. Configuration and current situation of the biodiesel industry

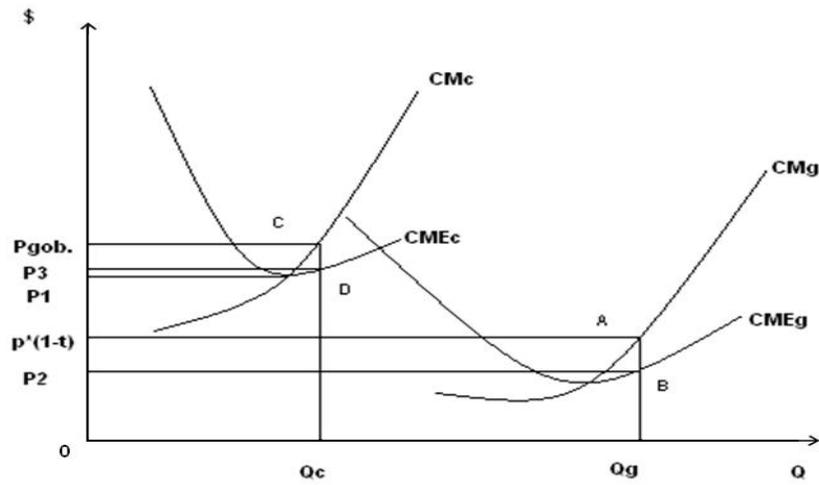
a) Industry Structure

Regarding the structure of industry in Argentina, as expressed in previous works (Sonnet et al., 2011), it is composed of a diverse group of companies, initially grouped into two categories, large firms on the one hand and small on the other. Although, as will be explained below, the regulation established by the Ministry of Energy states classification of companies into three categories initially (in 2012) and currently four categories, simplifying analysis for two categories of companies: large and small. Only large companies integrated and nonintegrated have access to foreign markets (possibility of exporting) after covering the quota (domestic demand) of biodiesel; while the other categories only access to the domestic market. It is worth mentioning that large companies have had serious difficulties in different periods when the international price of biodiesel decreases and the difference with the price of the raw material is reduced, which also reduces their profitability.

Following the simplified analysis, large firms are exporters, with access to foreign markets through the marketing of other goods. This is normally large oilers, which have their own production plants, with strategic location, access to working capital, large-scale production, logistics networks and access to raw materials; or large independent companies, not directly related to the oilers, leading to not have own raw material. Independent SMEs, manufactured with domestic technology without having network access and difficulties for commodity trading helped by economic incentives the government gives them, it is the firms that according to the Law-, production capacity up to 50,000 tons of biodiesel.

The characterization of the industry can be seen in Figure 1. Large, produced in the minimum efficient scale (EEM), i.e. a stable average costs. Given these characteristics, produce where marginal costs are equalized with the international price given (minus deductions). These multiproduct companies, the named advantages, have barriers to entry in the industry and consider the price of oil as a determining factor in deciding about its production, as this is the main cost.

Figure N° 3: Short-term equilibrium in the biodiesel market



Fuente: Own elaboration.

If a short-term analysis in Figure 1 is carried out, it appears that there may be two equilibrium prices and quantities:

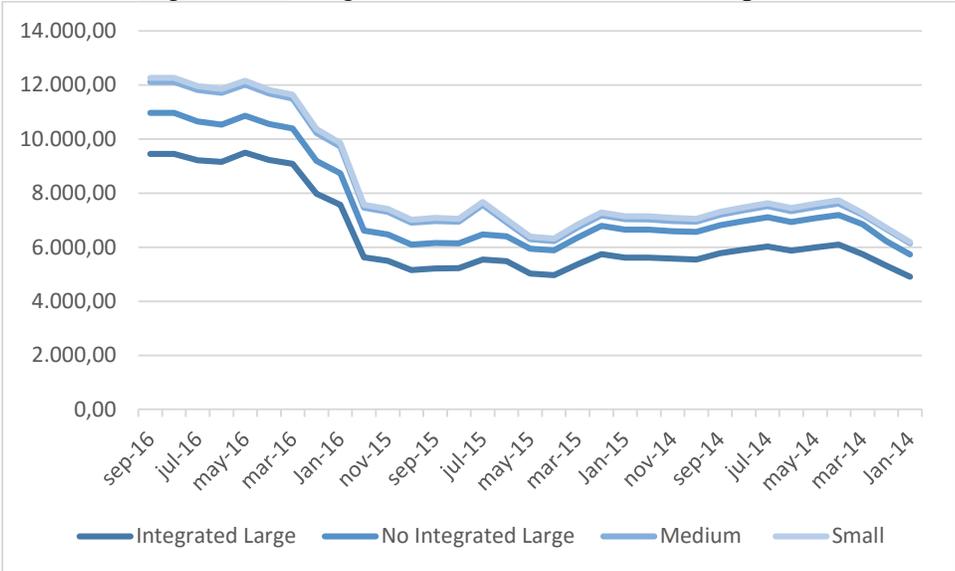
- For large companies, the reference price will be the international P^* , producing Q_g amounts, which will be the level of production resulting from equal the marginal cost of large companies (CMG) to international price minus the export tax $P^* (1-t)$. Getting an amount equal to $P^* (1-t)$ ABP2 area benefit, a situation that can not be sustained in the long term, but in the short term given the technological barriers (such as economies of scale) of existing income in the industry.
- Small firms will have a price set by the P_{gob} government and produce Q_c quantities, the level at which the marginal costs of small companies (CMC) is equal to the price named, with a profit of $P_{gob}CDP3$ that can be maintained by the legal barriers (such as authorization to companies from the Energy Department's Office to be part of the industry).

As mentioned earlier, in December 2012 it was decided to segment the market, but without endorsing the decision with a resolution between, and that because of that government intervention, SMEs had been outside the industry not to cover the main cost (raw material of biofuel) in internal set price.

In response to the problems experienced by SMEs, the Energy Department's Office decided to segment the market in November 2012, in three categories-large, medium and small-enterprises, favoring the highest value to those smaller firms, which receive a price of \$ 5484.28 per ton of biodiesel; as to the \$ 5425.89 a tonne medium and large \$ 4,660.13 (price for February 2013); This measure came a 17% difference between the price of smaller companies and larger production capacity. This type of measure was aimed at achieving profitability level between the constituent firms in the industry, with the aim of promoting a more balanced coexistence in the economy and not accentuate monopoly power. However, these three categories were not enough to recognize the heterogeneity of the companies in the sector, as large companies not integrated, they had set them the same price as the big integrated, being the first not secure and must buy oil at market price. Faced with this

problem, from August 2013 the Ministry of Energy of the Nation without issuing any resolution-decided to add the large category is not integrated with a greater than the large integrated price. The published prices for recent months seen in the following table:

Figure N° 4: Argentina: Evolution of domestic prices



Source: own calculations based on data from the Ministry of Energy of the Nation.

Figure 4 shows the evolution of domestic prices, it is noteworthy that they are published with delays in many cases, also their evolution has been less than cost. The jump in prices between December 2015 and February 2016 due to a correction by the significant devaluation of the Argentine peso relative to the dollar

It is important to bear in mind that large firms integrated and nonintegrated are the only access to sell their production to foreign markets, after supplying the domestic quota. But as seen in the graph discussed above, internal prices at which they must sell the domestic quota, and then to sell the remainder of its production to foreign markets, is not a good price, since it does not cover the costs in most periods.

The production and consumption of biodiesel in Brazil is considered one of the largest in the world, and have given priority to the use of oil to generate increased employment of skilled labor and may include regions outside (in the margin) process economic development, as with soybeans and family farming in some regions of the country. However, as expressed above, the sale of the product occurs only through standardized by the ANP since 2005 with the aim of generating market auctions.

Following Farina (2000), markets can be classified into: competitive when the market is fragmented, the product is homogeneous, there is little differentiation and no technical barriers to entry; oligopoly concentrates, has a high concentration, the product is homogeneous or differentiation low and high technical barriers; differentiated oligopoly, where there is a high concentration, the product is differentiated, there are barriers that reinforce differentiation technical barriers; competitive oligopolies are characterized by a high concentration, with the presence of competitive stripes, products are differentiated and

there are barriers to differentiation; and monopoly, the action is carried out by a single firm in the market due to high economies of scale and / or scope.

The structures that occur are related to barriers to entry, given by the differential costs to be incurred by potential entrants, but does not affect the established competitors such as economies of scale, determined by the decrease in unit production costs after increasing capacity by providing more cost competitiveness, an economy of scope, assets can be shared between different products, resulting in the advantages of multi-product cost and transaction costs and asset specificity, in which these costs operated economic system, and an asset is specific when its value is greater in a particular use compared to any alternative use.

The production structure of biodiesel in Brazil, can be characterized by a concentrated oligopoly, because it is a homogeneous product of low differentiation and high technical barriers. The evolution of production has increased due to the demand gradually by the Federal Government regulation introduced. Figure 2 shows the evolution of production with a high increase from 2006 to 2009 of 2,231%. In the period 2010 to 2014 the increase was more moderate considering the period indicated above, in 43.3%.

b) Production, domestic consumption and exports of biodiesel

In this section, the current situation of the biodiesel industry is presented based on the publication of various agencies that provide information and general data and structural.

The work draws attention to the biodiesel, as Argentina had come to position itself in 2011 as the fourth largest producer of biodiesel in the world and the leading exporter; however, in the years after that hierarchy had deteriorated and this is one of the phenomena to be explained. In Brazil, the situation is different, go climbing places like global producer of biodiesel, being in second place.

By looking at the figures for Argentina in Table No. 1, it is concluded that the annual production of biodiesel has been steadily increasing until 2012, although it was lower in that year compared to 2011, by a trade dispute with the European Union (EU), the main destination of domestic exports at that time, which led, in turn, that they fell by 7.4% in 2012. The situation worsened in 2013, with a fall on-year change in foreign sales of 25.5%. The production has two peaks downward in 2013 and 2015, in 2014 highest levels of biodiesel, encouraged by the opening of new foreign markets are manufactured.

If sales to the domestic market are analyzed, they have been continuously increasing, which has eased to reduced sales abroad already mentioned. It is important to bear in mind that domestic sales are directly related with the mixture or blending rate is set by the government.

Table N° 2: Argentina: Production, export and demand in the domestic market, annual

Year	Production		Domestic sales		Exports	
	Tons	Annual change	Tons	Annual change	Tons	Annual change
2008	711.864		0		680.219	
2009	1.179.103	65,6%	426		1.142.283	67,9%
2010	1.820.385	54,4%	508.566	119281,7%	1.342.318	17,5%
2011	2.429.964	33,5%	748.742	47,2%	1.649.352	22,9%
2012	2.456.578	1,1%	874.794	16,8%	1.543.094	-6,4%

2013	1.997.809	-18,7%	884.976	1,2%	1.149.259	-25,5%
2014	2.584.290	29,4%	970.141	9,6%	1.602.695	39,5%
2015	1.810.659	-29,9%	1.014.361	4,6%	788.226	-50,8%

Source: Author's calculations based on INDEC.

Thus, that to understand the behavior of domestic sales, it is necessary to study what happens in conjunction with the blending rate, i.e., the percentage of biofuel mixed with diesel. In 2010, biofuel use is considerably increased in the domestic market by the entry into force of the quota B5² (5% blend of biodiesel with 95% diesel), that changed in the same year to B7. Currently, the quota is set at 10%, but the actual (or operational) blending rate is less. Referring to blending rate precisely Resolution 1125/2013, in the first article, states that the companies charged with mixtures of fossil fuels with biodiesel must comply from January 2014 first one blending rate B9, B10 passing the first day of February of this year. In fact, the quota is not exceeded 4% in March, due to difficulties in both large firms, which lost to the domestic price was less than the price of soybean oil, its main input-output, and the girls, if well have a higher domestic price, they cannot absorb the high fixed costs. That is why, since government intervention in August 2012, is not presented as a good business selling price of the domestic biodiesel quota to the structure of large enterprises.

In Brazil, sales of hydrous ethanol by distribution volumes totaled 10.5% higher compared to 2013, while domestic production of biodiesel increased by 17.12%. With a strong appeal for the use of renewable sources in the Brazilian market, the federal government was determining increases in the percentage of biodiesel mixture to diesel.

In the table below, you can see how the production of biodiesel every year for the period in which data are published by official bodies increases.

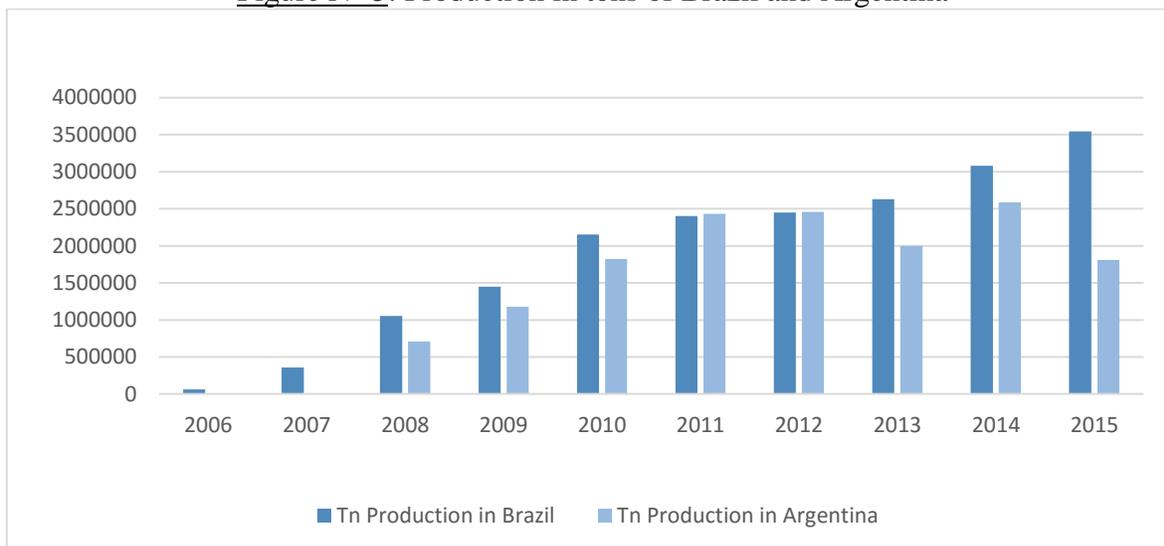
Table N° 3: Brazil: Production and percentage changes

Year	Tons	Annual change
2005	0	-
2006	63000	-
2007	360000	471,43%
2008	1053000	192,50%
2009	1449000	37,61%
2010	2151000	48,45%
2011	2403000	11,72%
2012	2448000	1,87%
2013	2628000	7,35%
2014	3078000	17,12%
2015	3543300	15,12%

Source: Prepared based on data from the Brazilian Statistical Yearbook of oil, natural gas and biofuels, 2015.

² It was agreed worldwide nomenclature to identify the concentration of biodiesel in the blend. For biodiesel is BXX, where XX is the percentage by volume of biodiesel in the mix. For example: B2, B5, B20 and B100 are fuel with a concentration of 2%, 5%, 20% and 100% biodiesel, respectively.

Figure N° 5: Production in tons of Brazil and Argentina



Source: Prepared based on data from the Brazilian Statistical Yearbook of oil, natural gas and biofuels 2015 for Brazil; and INDEC for Argentina.

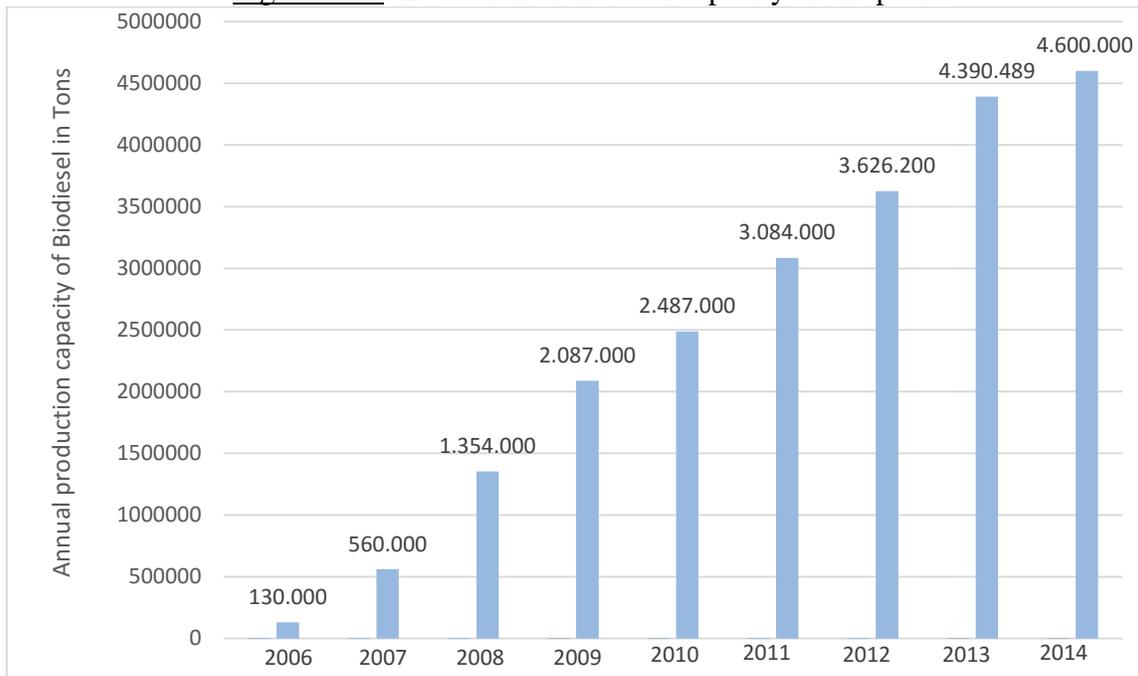
By not exported biodiesel in Brazil, but its production was destined only for domestic consumption, to analyze changes in the quantities manufactured, it must analyze what happened with the court. Until 2007, the mixture of 2% biodiesel (B100) gasoil was optional. From 2008, it became mandatory. Between January and June 2008, the addition of diesel oil B100 was 2%; between July 2008 and June 2009 was 3%; and between July and December 2009 it was 4% and between January 2010 and June 2014 was 5%. Between July and October 2014, the mixture of oil it biodiesel content was 6% and increased 7% from November 2014, by volume, according to Law 13,033 / 2014.

Increases in the proportion of biodiesel in diesel fuel, were also amended by Law No. 13,263 Law of 23 March 2016, reaching 8% in the 12 months after the enactment of the law and 9 % up to 24 months, and 10% in 36 months after its enactment, thus providing a gradual increase biodiesel in diesel fuel throughout the territory of Brazil.

c) Installed capacity and raw materials used in the production of biodiesel

In Argentina the biodiesel is produced exclusively based on soybean oil. So the industry records data from plants manufacturing biodiesel feedstock having soybeans or soybean oil. If the average size of plant capacity in Argentina is analyzed it has been growing steadily: in 2007 the average size was 70,000 tons / year; for 2009 increased to 130,400 tons / year average; in 2010, it decreased by 17% after the addition of six plants with less capacity to 50,000 tons; in 2012 there was a slight increase with the addition of new plants, Renova S.A. and T6 Industrial S.A. (The largest in the industry, with 481,000 and 480,000 tons per year respectively). It is important to clarify that no more recent data published by 2015, although it is known that the rate of investment in the sector has stopped in 2014 (growing just installed a very small plant capacity, not you are in the records of the Ministry of Energy), it is estimated that this year the average plant capacity was 124,324 tons / year. Notwithstanding this, they have reactivated investments, existing today three plants under construction that will add an additional 150,000 tons annually to Argentina biodiesel production.

Figure N° 6: Evolution of the total capacity of the plants



Source: Prepared based on CADER and Secretary of Energy of the Nation data.

If the geographical distribution of installed capacity in Argentina is analyzed, it can be observed that almost 80% is located in Santa Fe, most especially the major, in the vicinity of the port.

Table N°4: Distribution of biodiesel capacity in tons per province. Argentina. 2016

Province	Number of plants	Capacity (tons)	Percentage of capacity
Buenos Aires	11	391,600	8.6%
Santa Fe	18	3,618,200	79.3%
Entre Ríos	3	75,089	1.6%
San Luis	1	96,000	2.1%
La Pampa	2	100,000	2.2%
Neuquén	1	80,000	1.8%
Santiago del Estero	1	200,000	4.4%
Total	37	4,560,889	100.0%

Source: Prepared based on data from ABH

Regarding the rated capacity for the production of biodiesel (B100) in Brazil in 2014 was about 5,724,000 tons (21,200 m³ / day, considering 300 operating days in the plant in the year). However, domestic production was 3,060,000 tons, which corresponds to 53.46% of the total capacity. Compared with 2013, the production of biodiesel (B100) was higher by 17.2%. The fall in production in the Northeast was more than offset by the rise in the North, East, South and Midwest, of respectively 35.9%, 3.6%, 20% and 24.4%.

The Midwest region remained the largest producer of biodiesel, with a volume of about 1,350,000 tons, equivalent to 43.1% of domestic production. Then follows the South, with a production of 1,260,000 tons, 39.7% of the national total. The state of Rio Grande do Sul remained the largest producer of biodiesel, with a volume of 874,170 tons, equivalent to 28.4% of the national total, after an increase of 10%. Followed Goiás, with 579.420 tons (18.8% of the total, an increase of 11.8%).

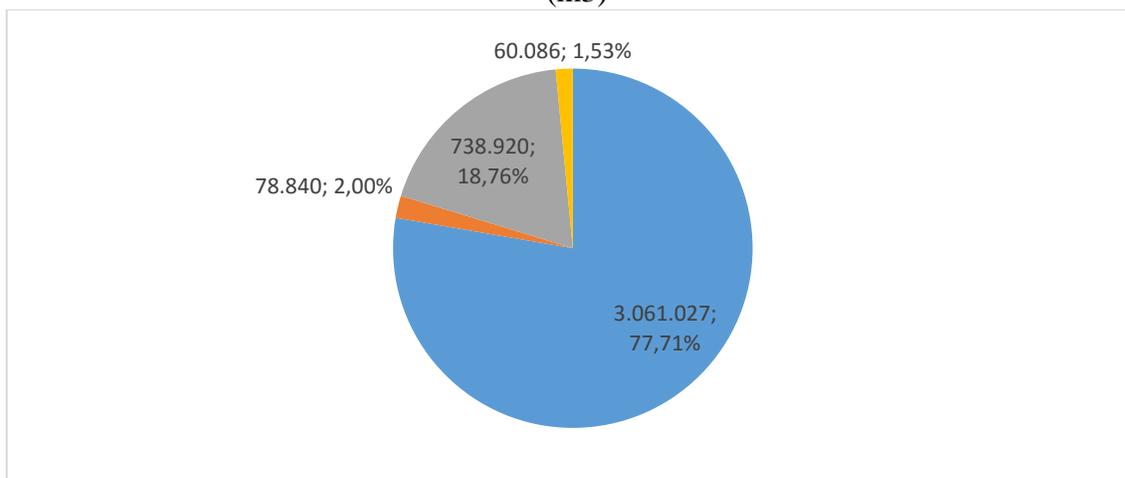
Table N° 5: Distribution of biodiesel capacity in tons per region. Brazil. Year 2014

Region	Number of plants	Capacity (tons)	Percentage of Capacity	Production
North Region	11	17,208	0.26%	76122.9
Northeast region	18	409,860	6.12%	209858.4
Southeast region	3	869,220	12.97%	243801.9
Southern region	1	2,365,290	35.29%	1223054.1
Central West Region	2	3,040,470	45.37%	1325017.8
Total	37	6,702,048	100.00%	3077855.1

Source: Prepared based on the Brazilian Statistical Yearbook of oil, natural gas and biofuels, 2015

In Brazil, soybean oil is the main raw material for the production of biodiesel (B100), equivalent to 76.9% of the total, an increase of 17.7% compared to 2013. The second raw material ranking production plant was animal fat (19.8% of total), an increase of 16.8% compared to 2013, followed by cottonseed oil (2.2% of total) and other fatty materials 1.1% (including palm oil, almond, sunflower, sesame, used frying oils, etc.).

Figure N° 7: The raw materials used in the production of biodiesel (B100) in Brazil in 2015 (m3)



Source: Prepared based on the Brazilian Statistical Yearbook of oil, natural gas and biofuels, 2016

Therefore, except soybeans, the importance of oil production remaining oil (rapeseed, palm, sunflower, jatropha, crambe, macaúba, canola, linseed, sesame, etc.) is very small, although they represent a higher oil content (30 to 50%, against 18 to 20% of soy). (Biodiesel, 2016). The following table shows the evolution of each raw material production in the total production of biodiesel: soybeans remains the main input, but loses place against production based on animal fat.

Table N° 6: Brazil: Evolution of the participation of each raw material in the total production

Total	Soybean Oil	Cottonseed oil	Animal fats	Others
2006	95.29%	0.00%	1.18%	3.52%
2007	86.58%	0.47%	8.44%	4.52%
2008	82.14%	2.05%	13.12%	2.69%
2009	77.44%	4.37%	15.84%	2.34%
2010	82.94%	2.39%	12.67%	2.00%
2011	81.23%	3.68%	13.42%	1.67%
2012	77.40%	4.29%	16.84%	1.46%
2013	76.39%	2.20%	19.80%	1.60%
2014	76.87%	2.25%	19.79%	1.09%
2015	77.71%	2.00%	18.76%	1.53%

Source: Prepared based on the Brazilian Statistical Yearbook of oil, natural gas and biofuels, 2016

Finally, this product is still in full development and changes in the production structure with the use of new raw materials that can be developed by promoting changes to this structure, considering it is a still new and the prospect of expanding market to a market wider in the international arena, which while emerging as alternative marketing for bidders, requires a higher degree of efficiency for a different way of competitiveness in order to achieve the promising international markets such as Europe, China and India .

d) Evolution of exports and prices

At this point the work focuses on the analysis in Argentina. as previously explained Brazil does not export biodiesel.

Argentina is the only country that taxes its exports of biodiesel. By Decree No. 1719/2012 scheme mobile aliquots of export duties to biodiesel were established. which takes into account the evolution of international prices of the product and local production costs.

The export duty formula (DE):

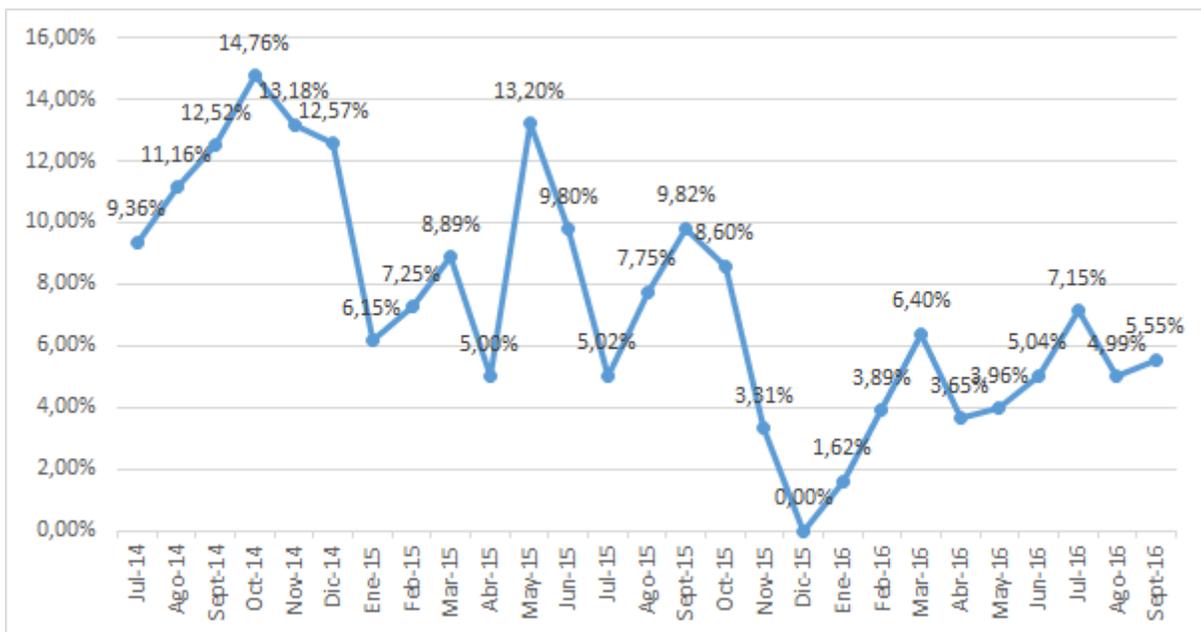
$$DE (\%) = \{(PR - CRCTE) * 100 / CRCTE\}$$

Where:

CRCTE = Total costs plus the return on total capital employed: average total cost per ton of biodiesel produced more return on total capital).

PR = Reference Price.

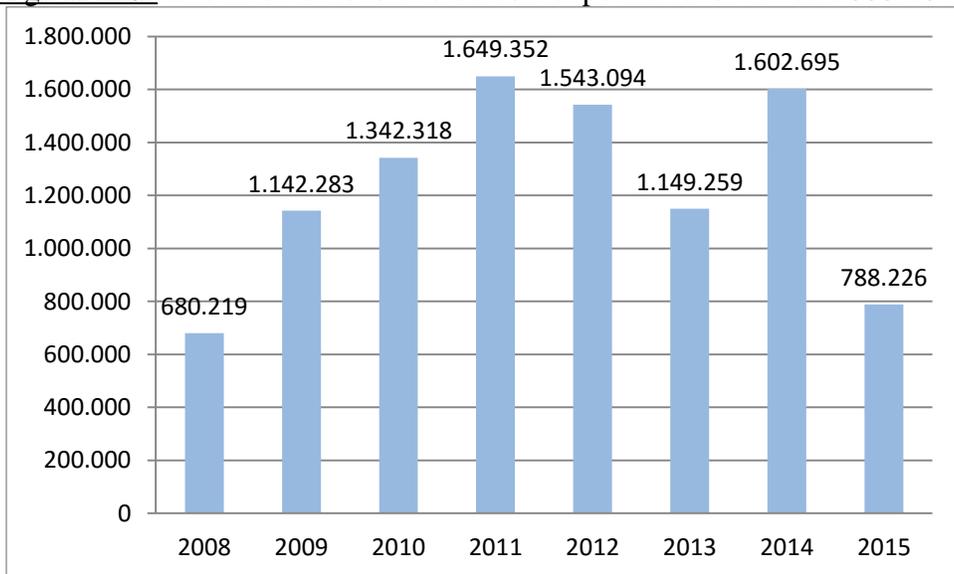
Figure N° 8: Evolution effective retention rate. July 2004 - September 2016



Source: own calculations based on data from the Ministry of Energy of the Nation.

As a result of the application of rates mobile retention. varying abruptly (between 0% and 14.75% in the period analyzed). and the problems that caused the closure of some markets they led to there being great uncertainty in the industry. particularly for large companies that are authorized to export.

Figure N° 9: Evolution of tons of biodiesel exported tons. Period 2008-2015



Source: Prepared based on data from INDEC.

Observing the participation of biodiesel export destinations. the almost absolute predominance of the European Union (with Spain as the main country) is observed until

2012. With a significant drop in exports to the European Union result that end of 2013 applied to the Argentine biodiesel average dumping duty of 24.6%; this caused a collapse in export prices of biodiesel. The Argentine government increased withholdings on a rate of 21.75%. which led to aggravate the situation.

Table N° 7: Main export destinations participation in quantities.

Top Destinations	2010	2011	2012	2013	2014	2015
Undeclared		9.9%	19.3%	20.8%	17.0%	32.6%
European Union	91.3%	77.6%	88.7%	32.3%	60.3%	2.4%
Peru	4.7%	9.7%	11.3%	14.7%	11.2%	13.5%
U.S.				27.7%	6.0%	50.8%

Source: own calculations based on AFIP data. Tariff position 3826.00.00.100L

From 2013. Argentina exported significant quantities to the United States. becoming the year's first biodiesel supplier with exports U \$ S 360 million and 406 thousand tons. but its use was as heating fuel (heating oil) and not for automotive transportation. because it had not obtained the agreement of the Agency for Environmental Protection of the United States (EPA).

On January 27. 2015. Argentina got the EPA to approve the application for automotive use biodiesel exported to the United States. It is important to note that the market for biodiesel in the United States depends on the volume of blending rate determined annually by the EPA on the basis of the mandates established by the Energy Independence Act of 2007. which for 2014 was 7.3 million tons. Argentine exports to the US market compete with biodiesel from Indonesia (one of the world's largest producers) and Canada.

The participation of Peru in exports grow until 2013 and then kept in similar values. However. in February 2016 the National Institute for the Defense of Competition and Protection of Intellectual Property (INDECOPI) of Peru established a countervailing duty to Argentine biodiesel for 5 years. Argentine biodiesel exports to Peru were US \$ 223 million in 2014 and US \$ 150 million by 2015.

It is clear that in early 2016 the World Trade Organization (WTO) issued a favorable ruling to Argentina in the dispute with the European Union. it considered that the European bloc had not complied with the rules in conducting its investigation into the alleged Argentine dumping. That does not mean the situation has been resolved completely. but sees favorable prospects for a re-opening of the market of the European Union in the next year.

However. the Council of the European Union decided to limit the consumption of biofuels from food crops³ in transport by 2020. when it is expected that at least 10% of the fuel for this sector comes from renewable sources. Energy Ministers of the 28 countries agreed to set a ceiling of 7%-called "first generation biofuels".

From the above analysis. first it observed a marked dependence on Argentina to acceptance of biodiesel by the European Union until 2014. as purchases the country under analysis in some years exceeds 80%. Second. for the year 2013 begins to grow significantly the share of

³ First generation biofuel

exports to the United States. and after obtaining authorization from the EPA in 2015 to 2016 is expected to increase significantly their participation; while. on the other hand. is expected to lower participation of Peru in purchases from Argentina. Finally. para-tariff barriers such as cases of dumping. joined the few countries to which it exports its biodiesel Argentina. causing significant declines in exports and consequently in production. Also. a difficulty the country is reflected under study to diversify its export destinations.

The difficulties to export could have been largely resolved with increased mandatory blending rate for the domestic market.

4. Analysis of concentration and economies of scale in the industry

To analyze this point. it considers what happens in Argentina. because Brazil data are not available at company level. Also. in the case of Argentina. are data published at the level of the firm for the years 2006 to 2012. the research team getting data for 2016.

When speaking of concentration in the industry of Argentina biodiesel. it is not associated with a power to fix prices of the largest companies. as the price for export operations biofuel is determined by the game supply and demand of the international market. while the price associated with the internal market is fixed by resolution.

To analyze the concentration in the industry. and generally defining a market is concentrated when it is composed of few companies and large. 2 concentration indices are used:

1. Concentration index:

$C(m) = \sum C(i)$ to $C(i)$ relative share of companies operating in the market (production capacity of the firm relative to the total).⁴

2. Index Herfindahl - Hirschman (IHH)

$HHI = \sum [C(i)]^2$ and $V = \sum [C(i) - 1 / N]^2$. for $C(i)$: participation of enterprises in productive capacity; N : number of leading companies in the industry.

For interpretation it is important to note that the rate increases as the number of relevant companies in the industry is lower. and when the shares therein are very different.⁵

Table N° 8: Enterprises by size and their representation in the total number of companies for 2016

Category	Quantity	Participation in Total
Large	8	21.62%
Large unintegrated	3	8.11%
Median	17	45.95%
Small	9	24.32%
TOTAL	37	100.00%

Source: Prepared by the authors.

⁴ For its calculation, the units from highest to lowest were ordered, and then determine a number of leading companies in the industry (with installed production capacity increased to 50 thousand tons).

⁵ It can express the index as: $HHI = 1 / N + V$. Here, if V goes to zero or it is reduced, coexist companies with shares that are not very different, and if it increases the number of members N , would diminishing concentration and the HHI down.

Table N° 9: Number of relevant companies and Concentration indices⁶

Year	Number of relevant companies	Index C (m)	IHH	IHH variance
2007	2	71%	2711	1463
2008	6	85%	1405	636
2009	10	94%	1247	1235
2010	11	87%	956	521
2011	12	84%	812	442
2012	12	86%	832	461
2016	14	83%	700	430

Source: Prepared by the authors.

As shown in the table, although the index C(m) decreases in the years 2010 and 2011, it remains at high levels, which shows a high concentration in the industry, which remains at similar values to 2016. The high growth rate in 2009 can be explained by the increase in the number of companies considered relevant. On the other hand, in the case of the HHI index it shows that the concentration has been declining; vision that can be misleading because their calculation was taken to each company as an independent not allowing the phenomenon of the formation of the associated economic groups, overestimating thereby N (which should be less), and considering thus is captured more similar holdings.⁷

We can also talk of concentration in terms of sales on the domestic market (quota allocated to compulsory blending rate). Following this line, in 2010, about 45% of the domestic quota (859.820 tons) was covered by UnitecBio, Viluco, Explore and Diaser, reallocating the rest among other 15 firms, representing so, the quota assigned to 35, 7% of the installed production capacity of biodiesel in the country (2.41 million tons). While for 2012, 6 companies cover 41.5% of the quota and the rest is allocated among 21 other firms, with the quota of 41% of the installed production capacity (3.2 million tons).⁸⁹

In the same vein, it is worth recalling what was expressed in the preceding paragraphs regarding the incorporation of plants in the industry for 2012, in which a large agro-industrial complex of the Terminal companies 6 S.A., Ecofuel and T6 Industrial SA was incorporated. In that year, the allocated quota accounted for 41.05% of the installed capacity of domestic production of biodiesel constitutes a significant increase compared to 2010. Between 2012 and 2016, two large plants are incorporated, with slightly more than 50 thousand tons of production capacity, expand plants and large number of small companies are incorporated.

⁶ By 2006, with the selected criteria, there are no relevant companies.

⁷ If they had known the shares of the related groups (information not available), the stakes had been higher which would result in a higher HHI. Thus the results of both indices indicating a high concentration would correspond.

⁸ In 2012, an industrial complex consisting of Terminal 6 S.A., Ecofuel and T6 Industrial SA, occupying the place of leading exporter of Latin America was incorporated.

⁹ They are not published data for periods after 2012, but the girls know that plants are incorporated, it is expected that the concentration in terms of sales to the domestic quota has even increased for 2016.

but the participation of large in total production is not altered significantly. demonstrating again the concentration in the industry.

Following the same line of analysis. you can see the concentration in the industry. by analyzing the percentage of small businesses in the market for the definition of the Act. they are those that meet the condition of having a capacity production exceeding 50.000 tons of biodiesel.

Table N° 10: Percentage of production and amount of small and large companies in the industry

Year	Data	Large companies	Small companies
2007	Number	2	6
	% production	71%	29%
2008	Number	6	7
	% production	85%	15%
2009	Number	10	6
	% production	94%	6%
2010	Number	11	12
	% production	87%	13%
2011	Number	13	13
	% production	89%	11%
2012	Number	12	15
	% production	86%	14%
2016	Number	14	23
	% production	83%	17%

Source: Made by myself.

To analyze the economy of scale in Argentina industry. enterprise data in two sizes. large and small are compared. for 2012. It is important to note that the analysis for that year. given that visited companies is done to request data from installed capacity. investment and costs. since these data are not published by any official body of the country for any year.

The situation of costs between being or not integrated also deserves some analysis. Having as warning the difficulty of harmonizing data costs. while acknowledging that entered values are taken from various original sources. we can see that it is more profitable to work with a plant large unintegrated when compared with the margins of work with any other integrated plant. be it small (19.600 mt/year) or large (1.390.000 tons/year) processing or crushing. Indeed. the biodiesel plant¹⁰ exclusively dedicated to a net income of \$ 98 per tonne. while others develop the whole process. just above \$ 60 per ton. (See Chart).

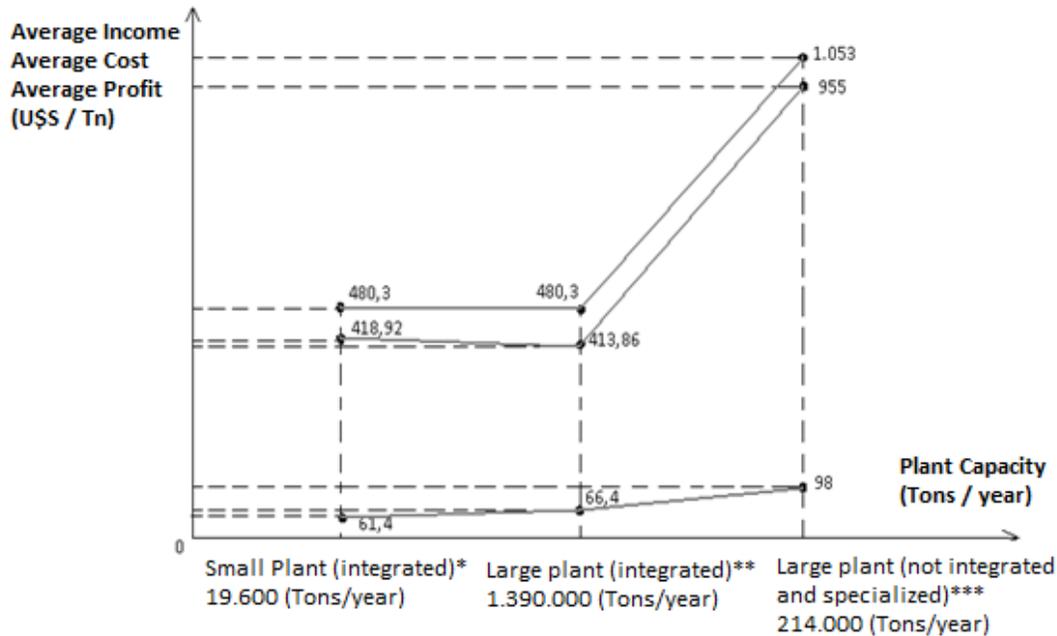
¹⁰ For this type of plant the methodology of the article published by the Rosario Board of Trade in Information Week BCR of 23/09/2011, page 6. The data followed the girls and large integrated plants they were taken from an analytical report cost and revenue prepared by the Chamber of Biofuels of the Province of Cordoba.

Table N° 11: Determination of revenues. costs and profits for two processors integrated biodiesel plants and other non-integrated exporter. with different levels of ability crushing or biodiesel. Year 2012.

Determinants	Small Plant (integrated)	Large Plant (integrated)	Elaboradora exporting biodiesel plant (not integrated)*
a. Soybean processing capacity (tons / year)	19.600	1.390.000	
Biodiesel processing capacity (tons / year)			214.800
b. Oil yield (13.5% of the weight of raw material) Volume of soybean oil (tons / year)	2.646	187.650	
c. Biodiesel Production Cost			
c.1. Biodiesel yield (95% by weight of soybean oil) (tons / year)	2.514	178.267	
c.2. Processing and manufacturing cost (U \$ S / Tm)	50.42	45.36	150
c.3. Cost of raw material (U \$ S / Tm)	368.5	368.5	805
d. Total cost without taxes	418.92	413.86	955
e. Income from biodiesel (U \$ S / Tm)	158.8	158.8	1048
f. Income from expeller (U \$ S / Tm)	320.2	320.2	-
g. Income from glycerol (U \$ S / Tm)	1.3	1.3	5.9
h. Total Revenues (U \$ S / Tm)	480.3	480.3	1053
i. Utility	61.4	66.4	98
* Buy oil to make biodiesel.			

Source: Made by myself.

Figure N° 10: The average income, average cost and the average profit of Production of Biodiesel for different alternatives of plan capacity.



Source: Made by myself.

References:

* And ** A plant is integrated when performing all stages of the production process. from the start with milling soybeans to production of biodiesel and its byproducts.

*** A large non-integrated plant is a plant that if built, would have a capacity of 1.675.000 tons milling / year; not being integrated its equivalent is to buy the other integrated oil and make biodiesel. Hence its biodiesel production capacity is 214.800 tons of / year.

In calculating the average cost they have been considered the following cost items: includes the raw material, the operating cost of the operation (energy, labor, depreciation, maintenance) including complementary inputs to oil (alcohols, caustic soda, catalysts, water), administration and marketing costs, profit rate of the refinery and distribution.

If the case of Brazil is analyzed, in 2014 there were 59 production units belonging to 46 business groups, with the installed 19.468 tons / day capacity, with the top 10 groups account for 57.70% of the entire production, it became evident that there is a concentration of production of biodiesel, as shown in the following Table.

Table N° 12: Installed capacity of biodiesel (B100) of the 15 largest industries in 2014

Production unit	Installed capacity Ton / day
Granol	2093.67
ADM	1837.80

Oleoplan	1269.00
Petrobras Biocombustiveis	1195.02
Caramuru	1125.00
Bsbios	858.60
Bianchini	810.00
Cargill	630.00
Bionasa	587.70
Camera	585.00
TOTAL	10991.79

Source: Adapted by authors from Brazilian Statistical Yearbook of oil, natural gas and biofuels, 2015

The characterization of the concentration means both ownership and control of a large share of aggregate economic resources or activities by a small proportion of the units that own or control the aggregate, or by a small number of them. In the definition of Labini 1980, the concentration is characterized as a process aimed at finding a growing technical and economic efficiency.

The biodiesel market structures lead organizations to determine the relationships between agents, which is an important part of the competitive business environment, to influence the pattern of competition. Making the characteristics of the market structure exert strategic influence on the nature of competition and pricing in the market.

5. Reflections and conclusions

This paper has sought to show a snapshot of the recent situations experienced by the biodiesel industry in Argentina and Brazil, considering the influence of two main players in front of its development: the regulation of the national government by implementing regulation in each country, which gives strength to the birth of this industry on the one hand; and secondly, the international market conditions, in the case of Argentina where companies must support protectionist measures.

The international scene shows that biodiesel is an input of strategic importance in the search for alternative energy sources; moreover, it is an energy fuel arising from the application of other, alternative to fossil fuels fundamental and available resources: the use of land for food, implementation of industrial waste and optimizing the use of biomass as a target sustainability crucial for the future.

After analysis of each individual country, you can see the great growth in Brazil as a producer of biodiesel, although allocate their production, so far, the domestic market. While Argentina, with less favorable for the domestic development of biofuels policies, lost places as a world producer, the hand of the loss of foreign markets to target your product. Situation to be reversed after the approval of environmental credits (RIN) that are approved by the Environmental Protection Agency (EPA) certified to the US market opens. Also, it is clear that in early 2016 the WTO ruled in favor of Argentina in the dispute with the European Union, it considered that the European bloc had not complied with the rules in conducting its

investigation on the Argentine alleged dumping. That does not mean the situation has been resolved completely, but sees favorable prospects for a re-opening of the market of the European Union in the next year. However, the Council of the European Union decided to limit the consumption of biofuels from food crops in transport by 2020, when it is expected that at least 10% of the fuel for this sector comes from renewable sources. Energy Ministers of the 28 countries agreed to set a ceiling of 7%-called "first generation biofuels".

Everything expressed, suggests the need for Argentina seek new markets, such as Sweden, are participating in the World Bioenergy 2014, in order to promote projects for the development of products with high potential from biofuels and bioenergy; commercial partnership agreements.

Moreover, following the example of Brazil, it is necessary to Argentina to work on the utilization of solid waste from agriculture and forestry, animal wastes, municipal wastes and other provided biomass as alternative raw materials in the biodiesel production. As well as improve some regulatory issues, to include:

- Set domestic prices to market biodiesel in Argentina in a timely manner and represent the actual costs of enterprises.
- Set clear rules, promotional items industry and transparency measures and data publications.
- Finally, achieving an increase of mandatory court. It would be possible to carry up to 27% as estimated in Brazil. On this point it is important to note that Brazil has made functionality trials demonstrating the feasibility of carrying out the change.

It has been observed that the installed capacity of biodiesel is continuous and rapid increase in both countries. When analyzing business costs, we found evidence of the existence of economies of scale in Argentina industry. Location not studied in Brazil for lack of data (it is important to note that the data in Argentina to make this analysis are not published, but arise from own research team).

Finally, the concentration was analyzed by analyzing the percentage of small and large market of the two countries under study companies. In both cases you can see both a regional concentration of production. In the central and southern Brazil and eastern Argentina, and at the level of firms.

In addition, two concentration indices were studied for the case of Argentina (again it leaves out Brazil in the analysis of the indexes for not having firm-level data). Using the index C (m), it was concluded that, although decreases in 2010 and 2011, remains at high levels, expressing a high concentration in the industry, which remains at similar values to the 2016. The high growth rate by 2009 can be explained by the increase in the number of companies considered relevant, and therefore with great productive capacity. Finally, the HHI indicates that the concentration has been declining; however, this view can be misleading, because by taking each company as an independent, has not grasped the index formation associated economic groups. If they had considered, however, the HHI would have a higher value, which would correspond with the results of the first index indicating a higher concentration. With all observed, one can think of the possibility of extending both markets, taking into account the advantages of each country: Argentina with a high availability of your premium to produce biodiesel and Brazil with trials in the diversification of feedstock material, and strongly committed to increase domestic consumption to reduce dependence on fossil fuels.

6. Annexes

Table No. A: Biodiesel production companies in Argentina 2016

LARGE	LARGE NOT INTEGRATED	MEDIUM	SMALL
Cargill S.A.C.I	Explora S.A. (***)	Advanced Materials S.A. Organic	Agro M y G S.A.
L.D.C. Argentina S.A.	Patagonia Bioenergía S.A. (***)	Agrupación de Colaboración San Antonio	BH Biocombustibles S.R.L.
Molinos Rio de la Plata S.A.	Unitec Bio S.A. (***)	Aripar Cereales S.A.	Colalao del Valle S.A.
Noble Argentina S.A.		Biobahia S.A.	Doble L Bioenergias S.A.
Renova S.A.		Biobin S.A.	Energías Renovables Argentinas S.R.L.
T 6 Industrial S.A.		Bio Madero S.A.	Hector A. Bolzan y Cia. S.R.L.
Vicentin S.A.I.C.		Bio Nogoya S.A.	New Fuel S.A.
Viluco S.A. (***)		Bio Ramallo S.A.	Prochem Bio S.A.
		Cremer y Asociados S.A.	Soyenergy S.A.
		Diaser S.A.	
		Diferoil S.A.	
		Energía Renovable S.A. (ENRESA)	
		Establecimiento El Albardon S.A.	
		Latin Bio S.A.	
		Maikop S.A.	
		Pampa Bio S.A.	
		Rosario Bioenergy S.A.	

Source: Ministry of Energy and Mining of Argentina Nation. 2016.

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