

THE BIODIESEL MARKET IN BRAZIL AND THE PROSPECTS FOR THE SECTOR

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ABSTRACT

This article aimed to study the biodiesel market in the country and the future prospects for the sector. Thus it was held a bibliographical research on the subject, addressing the concept of biodiesel, the main raw materials used for their production and a brief history of biodiesel in Brazil. The methodology applied in this article was qualitative and exploratory research. Still, in the qualitative phase, was used the strategy of bibliographical research, which according to Marconi and Lakatos (2006), includes bibliography ever published in relation to the subject of study. Data were obtained concerning the advantages and benefits generated by the implementation of the program of biodiesel in Brazil; growth potential of the Brazilian consumer market; future demand based on prospects for national and international economic growth and development and evolution of the biodiesel industry in different regions of the country. At the end one concludes the immediate need of the increase in the percentage of biodiesel in the diesel oil by the Government to keep the industry's progress.

Keywords: Biodiesel, Perspectives, Development, Future projections, Brazilian consumer, Production.

Contribution/ Originality

The results of this paper showed the need to establish immediate policies to increase the percentage of biodiesel in the diesel oil. The originality of the work developed is the identification of advantages and benefits generated by the implementation of the program of biodiesel in Brazil and growth potential of the Brazilian consumer market.

1. INTRODUCTION

Over the past three decades, intensified research into the development of fuels based on renewable agricultural materials as raw material (Woinaroschy, 2014). This activity is driven by the search for self-catering as well as fuels by reducing emissions of particulate pollutants (Woinaroschy, 2014). In this context, the research focus on biodiesel, seen this demonstrated engine performance similar to that of conventional fuels.

The negative environmental consequences of fossil fuels and the reduction of its reserves has stimulated the search for fuels from renewable sources (Hill, 2006). Thus, the use of biodiesel has stood by this can be easily mixed with petroleum diesel (Kralj, 2008), as well as, "can be used in engines with little or no modification of compression-ignition (diesel). Biodiesel is simple to use, biodegradable, nontoxic, and essentially free of sulfur and aromatics "(Kralj, 2008).

The sector in the years 2010 and 2011 had its period of greatest euphoria with very favourable demand and prices, the question now is the future with respect to the increase in the percentage of biodiesel in the diesel oil. In this context, this article aims to carry out an analysis of the current capacity of production and consumption, the growth and development of the biodiesel plants in the five regions of the country and the social and environmental benefits generated by biodiesel.

As well as identify the data concerning advantages and benefits generated by the implementation of the program of biodiesel in Brazil; growth potential of the Brazilian consumer market; future demand based on prospects for national and international economic growth and development and evolution of the biodiesel industry in different regions of the country.

2. THEORETICAL FRAMEWORK

This section has three steps, defined as the concept of biodiesel; the raw materials used in the production of biodiesel and a brief history of biodiesel in Brazil.

2.1. Concept of Biodiesel and its Emergence in Brazil

Biodiesel is a biodegradable fuel, namely, non-toxic and virtually free of sulphur and aromatics from oleaginous plants or chemical processes from animal fat. It can be used in whole or in part in the replacement of the diesel fuel used in diesel engines.

Biodiesel has emerged at the beginning of the last century in Europe. Historical records report that the creator of Dr. Rudolf Diesel engines in 1900 showed for the first time to the world a motor running for peanut oil and stated "the diesel engine can be powered by vegetable oil and will help considerably the development of agriculture in countries that use".

In Brazil the first surveys took place in 1970 at the Federal University of Ceará. The country managed to patent for the manufacture of biodiesel, however, she ended up expiring without that biodiesel was adopted in its production

2.2. Raw Materials used in the Production of Biodiesel Brazil

Currently, soy is the flagship in the production of biodiesel. The Brazil is the second largest producer of soybeans in the world and extractor and the third in exports of soybean oil. According to a survey conducted by the Brazilian supply Company (CONAB) in may 2012 had a planted area of soybeans that reached approximately 25.08 million hectares. The Ministério of the Agricultura, Pecuária and Abastecimento designs for the crop of 2021/22 the country will plant

approximately 29.08 million hectares of soybeans and will have a production that will reach 88.9 million tons.

Vegetable oils are currently the main inputs in the manufacture of biodiesel, among them the soybean oil is the only one that is available in large quantities. According to data from the Ministry of agriculture livestock and supply the Brazil produced 2011/12 harvest about 7.42 million tons of soybean oil, of 1.55 million were exported. Of the total produced an estimated 2 million tons of soybean oil to biodiesel production namely 27% of the total produced was used in the production of biodiesel.

Of all the raw materials used in the manufacture of biodiesel 78.60% comes from soybean oil, so we understand the importance that this input has for the sector. However, the great addiction, causes there are concerns with the current prices of soya bean practiced in domestic and international markets.

Currently, the country exports greater quantity of unprocessed grain, thus reducing the amount of soybean oil on the market, driving up the price of this raw material for biodiesel production.

As Brazil has a favorable climate and fertile land, has a wide range of oilseeds and legumes to be grown and used in the manufacture of biodiesel:

- palm: has an economic life of up to 30 years;
- peanuts: short cycle, used as crop rotation;
- castor: fits very well in semi-arid region;
- canola oil: can be planted in winter;
- sunflower: has a great resistance to cold and heat;
- bovine fat: is a byproduct of livestock production chain and currently represents 15.95% of all raw materials used in the manufacture of biodiesel. In Figure 1, shows the type of raw material used in the production of biodiesel.

We can analyze that soybean oil represents 78.60% of all raw materials used in the production of biodiesel. This number is not surprising since soy is the most oleaginous produced in the country. Bovine fat also has a good portion of contribution, seen the great creation of the flock in all regions of the country and primarily by the low cost in turn animal fat into biodiesel. Of all the raw materials, which has been growing more impactful then obviously soybeans for biodiesel production is cotton.

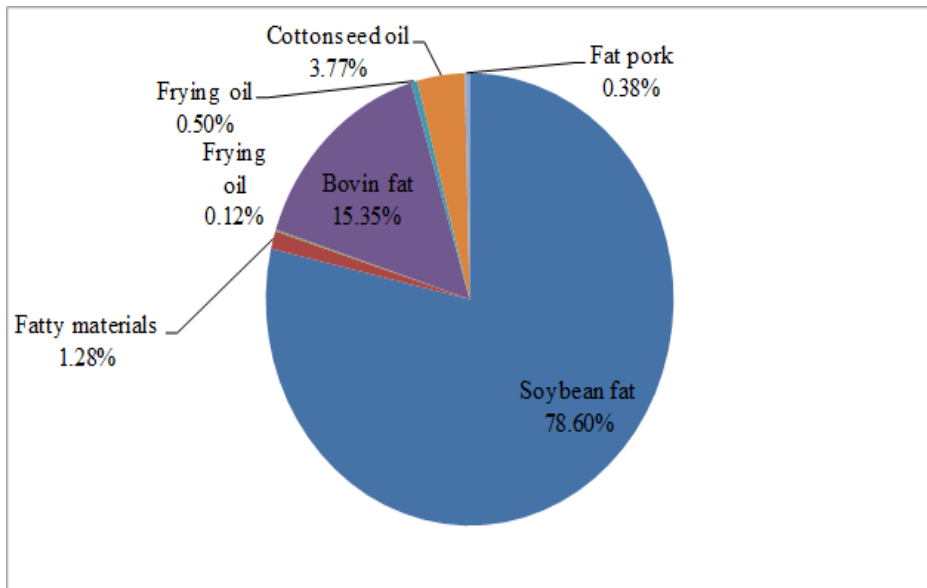


Figure-1. Types of raw materials used for the production of Biodiesel

Source: ANP - Agência Nacional do Petróleo (2012).

For the northeastern region this oleaginous already represents 16.41% all raw material used, for other regions of the country growth is still a bit slow, however, in the national context, the cottonseed oil already represents 3.77% in manufacturing of biodiesel.

2.3. The Growth of the Market (Industry) of Biodiesel in Brazil

The biodiesel market has grown from a spectacularly since its creation by law 11.097/2005 where required the addition of biodiesel in the diesel oil 2% in mid-2005. There were uncertainties regarding the operation of this project in terms of production capacity, processing of raw materials and also to put a new product on the fuel chain in the country.

However, the industry has responded in a positive way. The federal Government anticipated the implementation of compulsory mixture of B3 (3% of biodiesel in diesel fuel), B4 (4% of biodiesel in the diesel oil) and B5 (5% of biodiesel in the diesel oil) in three years. According to the National Agency of petroleum, Natural gas and biofuels (ANP) between the years 2009 to 2011 the production increased in 66.17%, seen the mandatory 5% into the mix of biodiesel and diesel oil by the diminishing mistrust of the market. In the year 2005 there were in the country only 8 biodiesel production plants. Production that year was 736 m³. In the year of 2011 the production was 2,672,760 m³, a growth of almost 303% thousand times in six years. Currently there are 64 biodiesel-producing plants authorized by ANP to operation, with a total production capacity of 19,933 .95 m³ day. Brazil has remarkable potential not only as a producer of raw materials, but also of the biofuel itself, because it has favorable public policy and holds the necessary technology. In the country, the main raw material for the production of biodiesel is soybeans. This supply

chain is extremely organized and has been one of the large-scale agribusiness activities most successful of Brazil (Bergmann *et al.*, 2013).

Due to the fact that biodiesel be a product of the energy sector, oil production should be cheap and available in large quantities (Bergmann *et al.*, 2013). To increase the availability of oil and better use the country's regional resources, alternative crops to soybeans began to be considered in addition to the demands of energy grain processing systems. In view of what has been mentioned, the study aims to understand whether the main productive chains of materials – materials, alternatives to soy for biodiesel production are competitiveness and economic efficiency in the Rio Grande do Sul.

3. RESEARCH METHOD

In this item are indicated the methods and techniques that have guided the study, showing how the work was developed in order to achieve satisfactorily, the objectives proposed.

We used the method of qualitative nature. The qualitative method seeks to "investigate a phenomenon, understand it in its depth. Is addressed in order to build an intervention, a proposition, relations regarding a particular topic (Roesch, 2005). So, we used the strategy of bibliographical research, which according to Marconi and Lakatos (2006), includes bibliography ever published in relation to the subject of study. The bibliographical research uses primarily the contributions of several authors about a particular subject. Composes the bibliographical research, occasional publications, specialized sites on the subject, articles, newsletters, newspapers, magazines, books, research papers, monographs, theses, among others. Also, part of this research, published materials at events, seminars and congresses. For this study, the bibliographical research has particular scope, the survey of theoretical and empirical studies on the biodiesel market in Brazil, its benefits and the prospects for the sector. Also, part of this research, in more detail, the study of advantages and benefits generated by the implementation of the program of biodiesel in Brazil; the growth potential of the Brazilian consumer market; future demand based on prospects for national and international economic growth, and finally, the development and evolution of the biodiesel industry in different regions of the country.

4. DEVELOPMENT OF RESEARCH

From the literature search strategy, this section presents the data collection and information about both the advantages and the benefits generated by the implementation of the program of Biodiesel in Brazil; the evolution of the production of biodiesel and the future projections; future demand based on prospects for national and international economic growth and, finally, the development and evolution of the biodiesel industry in different regions of the country.

4.1. Advantages and Benefits Generated by the Implementation of the Program of Biodiesel in Brazil

The creation of the national programme for the production and consumption of biodiesel has led to the knowledge of its advantages and benefits society generating wealth, social inclusion and quality of life for people.

The burning of fossil fuels generates different particles in the atmosphere. We have hydrocarbons (HC) which contribute to global warming, the sulphur dioxide (SO_x) main component of acid rain, nitrogen oxide (NO_x) that makes up the acid rain in the form of nitric acid and carbon dioxide (CO₂) which is the main cause of the greenhouse effect. All these particles are thrown together in the atmosphere primarily by the predominance of the country road leading to modal a vast pollution more visible in major centers in the country. According to data from [Ubrabio - União Brasileira do Biodiesel \(2010\)](#) if they replace fossil fuel today by lower biodiesel around 43% the emission of pollutant gases in the atmosphere, in addition to this we decrease monetary advantages in carbon credits. Figure 2 shows an analysis of the reduction of the principal pollutants emitted by biodiesel.

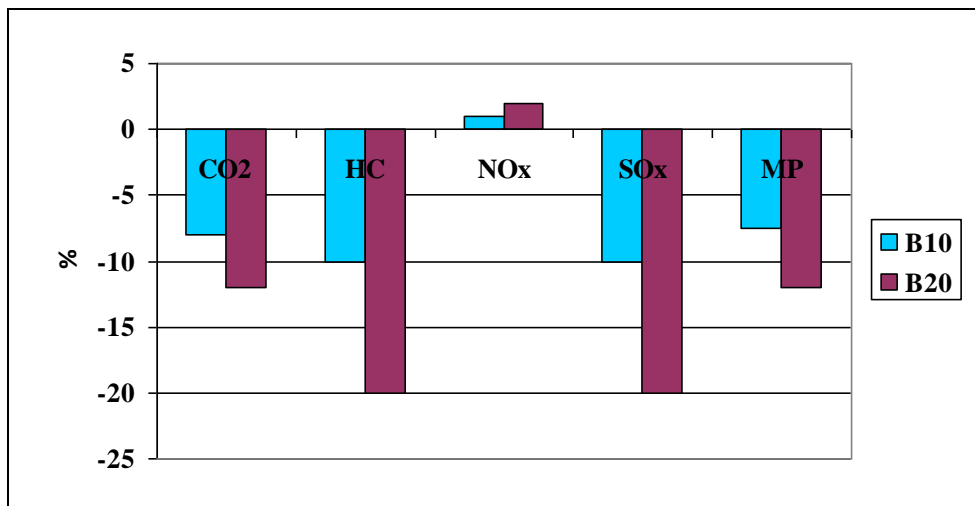


Figure-2. Average Emission of Pollutants Generated by the Biodiesel in Comparison to Fossil Oil

Source: [Ubrabio - União Brasileira do Biodiesel \(2010\)](#), EPA - Environmental Protection Agency, FGV Projetos

It can be observed that out of 10% to 20% compulsory blending of biodiesel in the diesel oil the lower the concentration of pollutants in the environment. Pollutants that would have further reductions would be the hydrocarbons and sulphur dioxide (SO_x) from -10% to -20%. Nitrogen oxides have already a slight increase from 1% to 2%, this increase could be controlled by catalysts and adaptation of technology in engines.

For Director General of the NPA, Chambriard (2012) "technically the PNA does not see any obstacle" to increase the percentage of biodiesel mixture causing a very palpable reduction in reducing the pollutants in the environment.

The emission of pollutants into the atmosphere are detrimental to health, according to the World Health Organization (who). The emission of pollutants emitted by the burning of fuel killed prematurely about 2 million people around the world. Research conducted by the International Fuel Quality Center (IFQC) in 2009, ranked Brazil as 68th place in the ranking of a total of 100 countries surveyed as the diesel that has highest percentage of sulfur in its composition.

See how pollution affects people's quality of life. Research conducted in the seven largest Brazilian capitals shows the hospitalizations, costs and deaths that occurred in 2007 resulting from the burning of fuels (Table 1).

Table-1. Hospitalizations, Costs and Deaths Arising from Pollution by Burning of Petroleum Diesel by Capital

Cities	Hospitalization	Costs (R\$)	Deaths
Belo Horizonte	4.078	4.521,933	579
Fortaleza	5.352	4.587,265	760
Brasília	4.332	2.745,502	615
Salvador	2.378	2.275,672	338
Rio de Janeiro	4.555	3.907,131	647
São Paulo	16.514	17.957,506	2.345
Total	37.209	35.995,009	5.284

Fonte: Ubrabio - União Brasileira do Biodiesel (2010)

In table 1, noted the large number of deaths resulting from the pollution caused by the burning of petroleum diesel, that number well above the deaths caused by car accidents throughout Brazil that in 2011 turned around 31,000 deaths.

It can be observed that among the capitals surveyed São Paulo is the city with the highest number of hospitalizations: 16,514. Has the largest number of deaths: 2,345. Capital with the largest economy in the Brazil, becomes that which has the greatest concentration of motorized fleet in the country. Salvador was already the capital with the lowest number of hospitalizations and deaths, and 2,378 338, respectively. Even with the high number of hospitalizations in Sao Paulo when we analyze the cost for hospitalization, Belo Horizonte surprises and has a cost of R\$ 1,108.86 for hospitalization. Brasilia has the lowest cost already R\$ 633.77 for hospitalization. The average cost for hospitalization was in R\$ 967.37 per patient.

In table 2, shows itself as if it could reduce hospitalizations, deaths and cost reduction if it increased the percentage of biodiesel passing from the current 5% to 10% or 20%.

Table-2. Using 10% biodiesel in diesel oil

Cities	Hospitalizations prevented	Costs avoided (R\$)	Deaths prevented
Belo Horizonte	326	361.754,65	46
Fortaleza	428	366.981,22	61
Brasília	347	219.640,18	49
Salvador	190	182.053,74	27
Rio de Janeiro	364	312.570,49	52
São Paulo	1321	1.436.600,45	188
Total	2977	2.879.600,73	423

Fonte: Ubrabio - União Brasileira do Biodiesel (2010)

Table-3. Using 20% biodiesel in diesel oil

Cities	Hospitalizations prevented	Costs avoided (R\$)	Deaths prevented
Belo Horizonte	530	587.851,31	75
Fortaleza	696	596.314,48	99
Brasília	563	356.915,29	80
Salvador	309	295.837,32	44
Rio de Janeiro	592	507.927,04	84
São Paulo	2147	2.334.475,84	305
Total	4837	4.679.351,19	687

Fonte: Ubrabio - União Brasileira do Biodiesel (2010)

You can see how significant would be the reduction of deaths, getting around 62.41% if we spent from 10% to 20% percent of biodiesel and would save almost R 1,800,000 .00 to public coffers with medicines, examinations, doctors, among other costs. Would be 1,860 hospitalizations unless in Brazilian hospitals.

Under biodiesel has a high social capacity to generate jobs, according to the President of the Board of Governors of the Brazilian Biodiesel Union (Ubrabio) Ferrés (2012) "so far are around 100 thousand family farmers benefit.

In 2014, the projection is of 150 thousand families. And in 2020, this number would go for 510 thousand families, involved in the production of raw materials intended for biodiesel "number that high if we compare the cultivation of sugarcane that today is nothing more than 35 thousand families benefited in the family agriculture project.

Worth pointing out that these numbers are related with the mixture of biodiesel 5, however if this mixture to increase to 20, according to Fundação Getúlio Vargas (FGV), uses in the entire production chain indirectly or indirectly, would arrive around 6 million jobs

4.2. The Evolution of the Production of Biodiesel and the Future Projections

The Brazilian consumer market of biodiesel is growing annually since 2005, the year of its implementation. The biodiesel plants have increased their production as we can observe in the graph below supplying the need of the domestic market.

From 2008, the mixture of biodiesel to the diesel fuel became mandatory. Between January and July 2008, the mixture of biodiesel to the diesel oil was 2%, between July 2008 and June 2009 was 3% and between July and December of 2009 was 4. From 2010, the percentage of mixture went for 5%.

Advances the goals of biodiesel mixture was one of the most important milestones for the increase in the production of biodiesel, we can observe that every time the Government increases the percentage of biodiesel in the diesel oil, production rises, because we must remember that the mixture is compulsory making thereby the market necessarily increase their consumption.

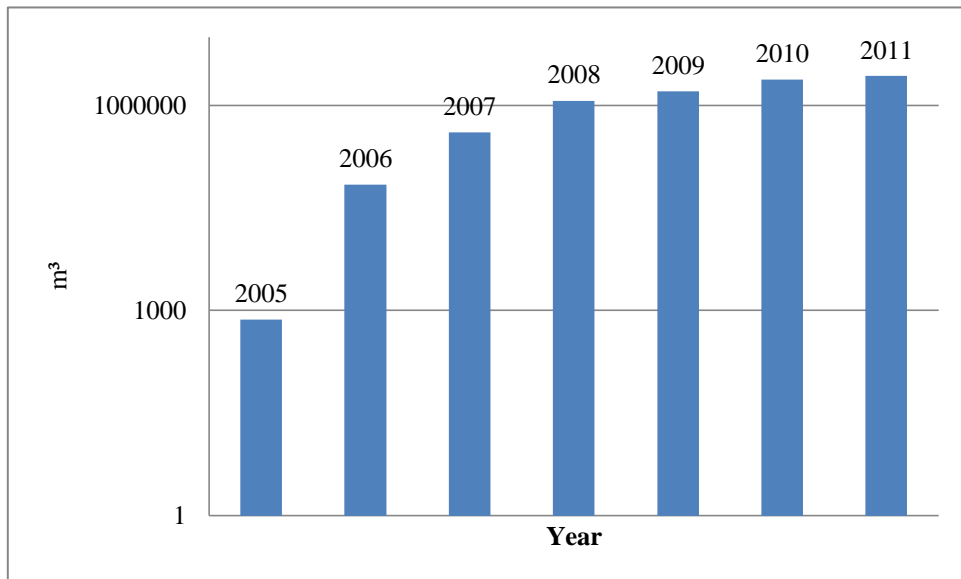


Figure-3. Production of biodiesel

Source: Prepared by the author with data from ANP

For these constant increases were industries that invest with cutting-edge technology. In agriculture, agricultural technicians hired by Mills developed new ways of increasing production cultivation and decreasing the cost of existing cultures and developed research in cultures virtually nil in our country trying to diversify as much as possible, the raw materials for the production of biodiesel.

In the industrial park, the technology from Germany and the United States did raise its production industries with a lower cost. Professionals were trained, while maintaining the competitiveness of businesses on the demanding market of biodiesel.

Before the solid existing industrial park in the country, the prospects of increasing the percentage of mixture, the future projections are quite confident, but the increased production will come across new percentages of biodiesel mixture in diesel oil. There is no possibility any if the Government does not intervene in the market.

To the Coordinator of the Inter-ministerial Biodiesel Group of staff, [Rodrigues \(2011\)](#) "today the country has an installed capacity of production that represents twice the consumption that represents with 5% of mixture", i.e. the country could take a giant leap by passing from the current 5% to 10% the mixture without that companies needed to invest, because they already have this ability to produce.

4.3. Future Demand Based on Prospects for National and International Economic Growth

The country is growing reasonably in recent years. For the next, the growth should be greater due to sporting events like the World Cup of football in 2014 and the Olympics in 2016. Will be years in which the construction is on the rise and the transport sector should be next for the high number of tourists who will disembark to attend these events. According to the ANP, the diesel oil consumption in 2011 rose by 2.46% compared to 2010. This represents about 3 million liters more than the previous year, this sector of biodiesel impacted, on increased sales of biodiesel to the distributors.

The balance on the market of a commodity is determined by the "amount that consumers want to buy, be exactly equal to the amount that producers want to sell" ([Vasconcellos, 2000](#)), i.e. If there is oversupply, sellers leave their products in stock and will decrease their production lines: in the case of excess demand, consumers will be willing to pay more for a shortage of products on the market. The biodiesel industry, in this line of thinking, does not show excesses on either side, i.e. market balance.

In Figure 4 you can see the evolution of annual production and production capacity

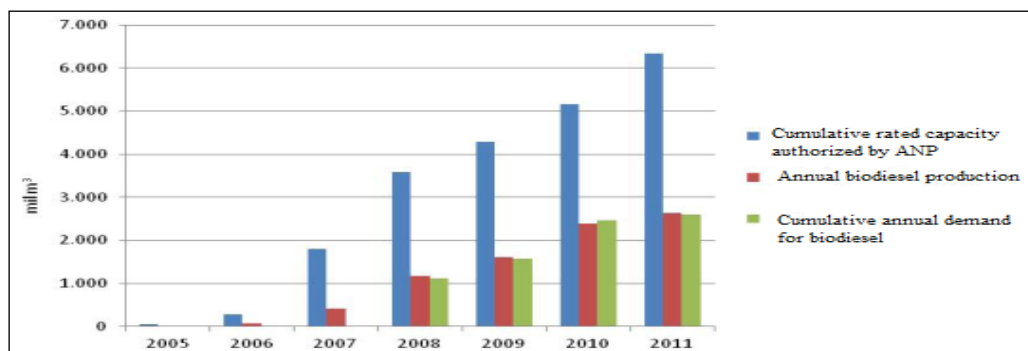


Figure-4. Annual Evolution of production and production capacity

Source: ANP - Agência Nacional do Petróleo (2012)

Since the year 2008, demand is being monitored closely by production, means nothing to expand production if there is sufficient demand to withdraw the product from power plants. Today we have accumulated capacity authorized by ANP of production of about 6.3 billion liters/year, however this huge volume will only be produced if there is demand.

4.4. Desenvolvimento e Evolução das Usinas de Biodiesel do Setor nas Diferentes Regiões do País

The evolution of the biodiesel industry is now visibly growing in all regions of the country. At the beginning of the national program of use and consumption of biodiesel was released by the federal Government in the year 2005, the Director of the Department of renewable fuels at the Ministry of mines and energy, [Dornelles \(2012\)](#) comments that one of the points to carry out the program of biodiesel in the country was to "bring a program that could serve all regions of Brazil, a way to bring wealth, income, employment, capital, knowledge, education and productive activity". The earliest regions that stood out were the southern and Midwest for having an abundance of raw materials and cutting-edge technology.

Thus, they dominated the first two years of the programme. Over the first few years the mistrust began to decrease between entrepreneurs and producers of oilseeds and soon the sector grew rapidly in the other regions. Table 4 shows the distribution of operating power plants in the country.

Table-4. Distribution of plants in Brazil and an installed capacity of production

Region	Number of power plants	Installed capacity in m ³ / day	Percentage/ installed capacity by region	Percentage of plant by region
South	10	5.056,30	25,89 %	15,62 %
Southeast	12	2.367,33	12,12 %	18,75 %
Midwest	31	9.432,19	48,28 %	48,44 %
North	5	620,00	3,18 %	7,81 %
Northeast	6	2.058,13	10,53 %	9,38 %
Total	64	19.533,95	100 %	100 %

Source: Prepared by the author with data from ANP

It can be observed that the Midwest region has the largest amount of installed plants reached a total of 31 usinas. This is the great offer of soybeans, raw material of greater representation for biodiesel production and the excellent climate prevailing in the region. According to data from CONAB Midwest region in 2011/12 crop harvested around .70 34,949 million tons of soybeans, figures which show that 48.44% of total installed power plants in the country are in the Midwest region.

The northern region has only 5 power plants required for biodiesel production, Had to yield an area of 2011/12 698.50 thousand hectares and a crop that came to .70 2,148 million tons, according to CONAB. There's also the Amazon forest a large area of the region is unable to plant and the climate is not as favorable for the cultivation of soybeans. Projects for new crops are already being carried out in the region since 2006.

A região Norte possui apenas 5 usinas instadas para a produção de biodiesel, Possuía para a safra 2011/12 uma área de 698,50 mil hectares e uma colheita que chegou a 2.148,70 milhões de

toneladas, segundo a CONAB. Por também haver a floresta Amazônica uma grande área da região fica impossibilitada para o plantio e o clima não é tão favorável para o cultivo da soja. Projetos para novas culturas já estão sendo realizados na região desde 2006.

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Currently has an installed capacity of production of 19,533 .95 million liters/day. The Midwest region has 48.28% of total installed capacity.

We must highlight the southern region that has only 10 biodiesel plants, but has an installed capacity of production that comes to 5,056 .30 million liters/day, in addition to owning the largest biodiesel plant in the country with a production capacity of 1,050 million/ day.

Businesspeople in the industry do not ooze efforts and investments in new biodiesel-producing units. In table 5, presents the new plants authorised for construction and enlargement in different regions of the country.

Table-5. New biodiesel plants under construction and its capabilities

Region	Number of power plants	Installed capacity in m ³ / day	Percentage of installed capacity by region	Percentage of plant by region
South	7	3.007,00	62,96 %	50,00%
Southeast	1	247,00	5,18 %	7,14 %
Midwest	5	1.471,79	30,81 %	35,72 %
North	1	50	1,04 %	7,14 %
Northeast	0	0	0	0
TOTAL	14	4.775,79	100 %	100 %

Source: Prepared by the author with data from ANP

It is observed in table 1, which are being built in the southern region 7 plants with a production capacity of 3,007 m³/ day. This number is for two reasons: the first one for the installation of the first plant in the State of Santa Catarina with a production capacity of 510 m³/day and the second by the construction of one more unit of vegetable oils plant plateau (Oleoplan) in the State of Paraná who at the moment of its full operation will reach 1,050 m³ / day production. The Northeast region has so far no prospect of new plant and even expansion of existing ones.

Thus, it can be said that the biodiesel chain brings, in addition to the generation of jobs, social inclusion and benefits the environment. Research conducted by FGV in 2010 shows that by the year 2020 investments should reach 7.36 billion real. This gives an idea of how the regions will be able to strengthen and develop in the coming years.

5. FINAL CONSIDERATIONS

This study aimed to analyze the biodiesel market in the country and assess the prospects of the sector for the future. Sought to demonstrate the importance of biodiesel in the generation of jobs and income for thousands of families who are part of this cycle, moreover, biodiesel acuity has in relation to the environment and the health of the population.

Through research, we can identify the main raw materials used for the manufacture of biodiesel and some new crops being planted in the regions where the climate is not favorable for planting soybeans. The biodiesel sector entrepreneurship is investing in the construction and expansion of the producing units.

Was analyzed the current production capacity of 64 biodiesel plants scattered in Brazil, and concluded that for the industry to grow in all its ramifications is necessary immediately, increasing the percentage of biodiesel in the diesel oil. Today the percentage of 5% is already obsolete, causing the plants are braking a little their investments. It was noticed that, it is possible to increase this percentage to 10% without any impact on biodiesel chain.

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