RENEWABLE ENERGY AND BIOFUELS: BIODIESEL AND BIOETHANOL AS AN OPPORTUNITY OF INVESTMENT

ENERGIA RENOVÁVEL E OS BIOCOMBUSTÍVEIS: BIODISEL E BIOETANOL COMO UMA OPORTUNIDADE DE INVESTIMENTO

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Submissão: 27 Jul. 2012 A**provação**: 30 Set. 2012. **Última revisão:** 14 Nov. 2012. **Publicação**: 30 Nov. 2012. **Sistema de avaliação**: *Double blind review*. Centro Universitário UNA, Belo Horizonte - MG, Brasil. Editor geral Prof. Dr. Mário Teixeira Reis Neto, Co editora Profª. Dra. Wanyr Romero Ferreira

Abstract

The fuel shortage is now the subject of debate in all countries of the world, so far as the years pass, the less the existence of so-called energy from fossil fuels, or non-renewable energy. For this reason, it has been great investment in alternative energies, which are renewable and environmentally sustainable. Therefore, this article aims to show the contribution of biotechnology to this discussion through biofuels. The study shows the importance of biofuels in the current scenario with a focus on bioethanol and biodiesel. Also presented is a new frontier for the development of Biodiesel, Biodiesel produced by microalgae. The article was designed as an exploratory and qualitative research. The data collection was through the Documentary Research and Library Research, collecting, correlating and analyzing the information of greatest interest about this topic. The results show that Brazil has been considered a world leader in renewable energy production, which opens doors to endless opportunities and that the biodiesel produced by microalgae can be a way to address one of the paradigms that exist today for Biofuels: a power generation without compromising food production in the world.

Keywords*: Biofuels, Bioethanol, Biodiesel, Fuel, Energy*

Resumo

A escassez de combustível é hoje tema de debate em todos os países do mundo. À medida em que os anos passam, menor é a existência de energias provenientes dos chamados “combustível de fóssil” ou energias não renováveis. Pelo motivo do grande investimento em formas alternativas de energia que são renováveis e ambientalmente sustentáveis, este artigo tem como objetivo mostrar a contribuição da biotecnologia para essa discussão através dos biocombustíveis. O estudo apresenta a importância desses biocombustíveis no cenário atual com foco no Bioetanol e no Biodiesel. Além disso, é apresentada uma nova fronteira para o desenvolvimento do Biodiesel, o Biodiesel produzido por meio de Microalgas. O artigo foi concebido como uma pesquisa exploratória e qualitativa. A coleta de dados foi por meio da pesquisa documental e da pesquisa bibliográfica, coletando, selecionando e analisando as informações de maior interesse a respeito dessa temática. Os resultados apresentam que o Brasil tem sido considerado uma referência mundial na produção de energias renováveis, o que abre portas para infinitas oportunidades e que o Biodiesel produzido por meio de microalgas pode ser uma saída para enfrentar um dos maiores paradigmas existentes hoje para os Biocombustíveis: a geração de energia sem comprometer a produção de comida no mundo.

Palavras-Chave: *Biocombustíveis; Bioethanol; Biodiesel; Combustível; Energia.*

1. Introduction

In recent years, the world has experienced a big challenge when it comes to fuel. The fuels produced through fossil, called non-renewable resources are increasingly scarce and therefore more expensive. In this group are listed Plastics, Gasoline, Natural Gas, Coal, and others.

This shortage of non-renewable resources has driven a relentless search for energy sources that can replace them and are renewable. Among the renewables, can cite the Solar Energy, Wind Force and Ethanol.

However, the generation of energy by these sources was not enough, by several structural factors of the countries and mainly because the producers of Sugar Cane, the main ingredient of Ethanol, in certain situations shift the production of ethanol to produce sugar.

Since then, biotechnology emerges as a solution to these obstacles, through the development of Ethanol and Biodiesel. In Brazil this development program starts from the year 1975. After the first Oil Crisis, Brazil`s government decided to develop a fuel in order to substitute the gasoline produced from Oil. The Ethanol produced from sugar cane was the answer and the Brazil started to produce cars running by this green fuel. Another great advantage to produce Ethanol in Brazil is the development of rural areas creating local jobs and avoiding the migration of workers to the main cities.

On the other hand, both Bioethanol and Biodiesel use mostly inputs which also serve to feed the population, and in view of the world population growth, this presents itself as a potential problem. Biotechnology then must face a main new challenge: a renewable energy source that does not compromise food production in the world.

For this reason, this article deals with a very important issue for the development of the country, which is the opportunities for renewable energy, particularly grounded in bioethanol and biodiesel, which today can be produced using inputs that do not compromise food production .

The research question that guides this study is "How biofuels can help in the production of renewable energy without compromising food production in the world?"

To answer this question, it was necessary to fulfill the following general objective: Analyze how biofuels can increase renewable energy production without compromising food production in the world.

The methodology used to accomplish this purpose was the realization of an exploratory and qualitative research, with a data collection conducted using documentary research and bibliographic research, seeking to understand the ways of producing biofuels, presenting at the end a new frontier, that is the biodiesel produced using microalgae.

The survey results showed that Brazil has a large space to expand and invest in new forms of fuel and it is already considered one of the leading biofuel producers in the world. The new frontier, Biodiesel production using microalgae, becomes an excellent opportunity for the country in view of the extent of their river basins and the extensive coastline that guides good part of their regions.

2. Forms of energy and biofuels

The Theoretical starts with the presentation of the Nonrenewable Energy, follow by the Renewable energies. At the end, are showed the biofuels, with focus on the Bioethanol and the Biodiesel.

2.1 Nonrenewabe energy

According to Mastrangelo (2011), nonrenewable energy has its origin from the ground and cannot be replaced in a relatively short period of time. The fossil fuels are the principal category of nonrenewable energy. Examples of fossil fuels include; plastics, coal, derivates of oil, diesel and natural gas. These resources come from the decomposition of animals and plants that have died millions of years ago and nowadays explored by humans.

For Dorado et. at. (2003), exist many forms of nonrenewable energy. Oil and coal are currently the most used forms of them. Coal is a combustible material explored from the deep earth. It is obtained from mining and is the most difficult resource to get. Oil is another combustible energy that is obtained from drilling, although unlike coal, once the hole is drilled the oil can be pumped out of the hole. These make the exploration of Oil easier while reduces the cost to get it instead to explore coal.

The search for non-renewable energy has caused many political and economics issues. Internationally the world's main reserves of oil are located in the Middle East. Thus the demand for oil requires political intervention from world politicians because this region is, by history and political, unstable. The recent example relies on the war in Iraq, located in the Middle East. In the past, many conflicts result in the burnout of the oil refinery when one group has not wanted another to get the oil they have. Other oil reserves are located around the world and the associative exploits each country. Another area that demand attention and care is Alaska in the Northern United States. Alaska is mostly forest reserve and a home of several animals. Some congressmen want to explore the deep oil that is underneath Alaska but environmentalists against it say that is not worth destroying all of the natural land to get the Oil. Because of legislators and rules of the United States' government we rely mostly on oil coming from the Middle East (MASTRANGELO, 2011).

Above the war, there are many other international problems with use non-renewable energy. The world relies mainly on nonrenewable energy sources such as oil, according to Dorado et. at. (2003). As previously stated most of the oil in the world is located in the Middle East. Most of the instability in this region is because of one country wanting to fight another over oil, because they are afraid that we are going to run out of oil. Other problems arise from using oil, such as; large cities such as Toronto, Canada and New York City, New York sometimes have a brown haze over the city. This is due to the large number of cars in these cities that causes more pollution then the average city.

For this reason, the whole world is concern about this situation, and research for new ways to solve this problem. The main solution in this case, is finding a cheap, usable, renewable form of energy. Currently there are researchers, scientists and government agencies trying to find a solution to this evolving problem.

2.2 Renewable energies

According to Lund (2006), renewable energy source consists in energy that can be continually replenished by itself. Using the criteria it's include energy from water, wind, the sun, geothermal sources, and biomass sources such as energy crops.

Both renewable and non-renewable energy sources are used to generate demand for daily-use such electricity, power vehicles, and provide heating, light and cooling.

Renewable resources have a great cost-effectiveness variety depending the location where it can be explored around the world. Although water, wind, and other renewable may appear free, depending directly of the cost in collecting, harnessing, and transporting the energy so that it can transform into usable energy. For example, to utilize energy from water, a appropriate dam should be built along with electric generators and transmission lines (LUND, 2006).

Lund (2006) observes that renewable resources themselves have the nature of non-polluting. The main focus should be attempted through the structures built to harness them can have positive or negative environmental impacts. For example, dams may affect fish migration and procreation but may also create wildlife habitat. Each case deserves its special attention.

To Turner (1999), the main examples are:

a) Hydropower: is the application of water potential power transformed to generate electricity. Water is the most common renewable source of energy applied in the United States nowadays

b) Wind: For several years, humans have used wind driven to pump water or grind grain, usually with windmills. Today large, modern wind turbines are used to generate electricity, for individual use or small power plants for contribution to a utility power grid.

c) Solar: Solar technologies utilizes the sun's energy to provide heat, light, hot water, and in small percentage, electricity for homes, and industry. Despite sunlight's significant potential for supplying energy, solar power provides less than 1% of U.S. energy needs. It is a still expensive technology in development.

d) Geothermal power: Uses the natural sources of heat in deep the Earth to produce heat or electricity. Currently, most geothermal power is produced using steam from underground. Geothermal power generation produces less emissions and the forecast of this power source is continuously available for the future.

e) Biomass power: is obtained from the energy in plants and plant-derived materials. Examples are food crops, grassy and woody plants, and residues from agriculture or forestry. This technology has great use in municipal and industrial wastes for decomposition of organic wastes.

Xianoming, et. al (2005) believes that the future of this renewable biofuels, with a focus on Bioethanol and also Biodiesel representing an important step to avoid power shortages in a sustainable way.

2.2.1 Biofuels

Demirbas (2009) explains that Biofuel is a type of fuel, which consists from biomass. The term covers solid biomass, liquid fuels and various biogases. Biofuels are more and more gaining public and scientific attention, justified by factors such as continuous increase of oil price, the strategic importance in the field of energy security, the debates over the greenhouse gas emissions from fossil fuels, and incentives by government through subsidie.

Biofuels provided 1.8% of the world's transport fuel in 2008. Investment into biofuels production capacity exceeded $4 billion worldwide in 2007 and is growing. According to the International Energy Agency, biofuels have the potential to meet more than a quarter of world demand for transportation fuels by 2050 justifying its great importance in the near future.

For Demirbas (2008), the most important biofuels are centered on the Bioethanol and the Biodiesel.

Bioethanol is an alcohol made by fermenting the sugar components of plant materials. Several crops can be used to produce ethanol. For example, Brazil focused its production from sugar cane while US uses corn to get the same result. With advanced technology and the incentive made by biotechnology, cellulosic biomass, such as trees and grasses, are also used as feedstocks for ethanol production. The production depends of several factors such location, temperature, soil and so on. Ethanol can be used as a fuel for vehicles in its pure form, as applied in Brazil and also usually used as a gasoline additive to increase octane and improve vehicle emissions. Bioethanol is widely used in the Brazil with its dual-fuel cars and in US.

Biodiesel is produced from vegetable oils, animal fats or recycled greases (PARENTE et al. 2003; KNOTHE, 2006; GOMES et al. 2008). Kaufman and Ziejewski (1984) have presented the advantages of using biodiesel as the main raw material sunflower. In Brazil Biodiesel is made from Mamona and Cottonseeds. Biodiesel can be used as a fuel for vehicles in its pure form, but it is usually used as a diesel additive to reduce levels of emissions of particulates, carbon monoxide, and hydrocarbons from diesel-powered vehicles. Biodiesel is produced from oils or fats using transesterification and is the most common biofuel nowadays in use in Europe (PETERSON, et. al. 1996). One of the characteristics of Biodiesel is a significant percentage of the mass of oxygen in their composition, around 11%, which represents low power energy, but contributes to the increased cetane number and reduces the concentrations of gaseous pollutants emitted (MUÑOZ et al. 2004).

Hilbert, et. al. (2002) also shows that biodiesel is an important solution to the transport that is done by agricultural vehicles, as handlers. The use of this type of biofuel in such equipment may substantially reduce the emission of gases that pollute the environment. This point of view is also advocated by Ali and Hanna (1996).

There are various social, economic, environmental and technical issues with biofuel production and use, which have been discussed in the popular media and scientific journals. These include: the effect of moderating oil prices, the "food vs. fuel" debate, poverty reduction potential, carbon emissions levels, sustainable biofuel production, deforestation and soil erosion, loss of biodiversity, impact on water resources, as well as energy balance and efficiency. The International Resource Panel, which provides independent scientific assessments and expert advice on a variety of resource-related themes, assessed the various issues realting to biofuels use in its first report *Assessing Biofuels: Towards sustainable production and use of resources* (UNEP, 2009). In it, it outlined the wider and interrelated factors that need to be considered when deciding on the relative merits of pursuing one biofuel over another. It concluded that not all biofuels perform equally in terms of their impact on climate, energy security and ecosystems, and suggested that environmental and social impacts need to be assessed throughout the entire life-cycle. Finally, for Murugesan, et. al (2009), biodiesel represents a major step forward for the development of sustainable energy.

3. Methodology

The Methodological aspects from this article present the typology of the survey followed by the technique used for data collection and analysis and processing of data collected. Finally, the limitations are presented for the study.

In this article, to achieve the ultimate goal, the work was conceived as an exploratory and qualitative research. According to Gil (1995), the exploratory research are developed in order to provide overview of type approximation. This study is characterized as exploratory because it critically examine the production of bioethanol and biodiesel. The qualitative approach was due to the understanding and interpretation of data collected through documental research and bibliographic research regarding this topic.

Data collection was structured by documental research or primary source, that in the definition of Marconi and Lakatos (1990) is characterized in a source of data collection limited to documents. The documental data collection occurred through reports from Brazilian federal government, using data from the Brazilian Agriculture Enterprise (Embrapa), the Brazilian Institute of Geography and Statistics (IBGE) and the National Oil Company (Petrobras). The purpose of the search this data was to present a current and future scenario of biofuels in the country.

In order to support the documental data collection a bibliographic data collection was performed. This data collection was conducted in the following databases of journals: SciELO - Scientific Electronic Library Online, Google Scholar, EBSCO - Electronic Journal Services; Jstor and B-on - *Biblioteca do Conhecimento Online*. The keywords used to search these databases were: Fuel, Biofuel, Renewable Energy, Energy Not Renewable, Ethanol, Bioethanol, Diesel, Biodiesel, Micro-algae; Shortages of fuel and alternative energy.

The documents were selected within the area of interest, that is biofuels as energy opportunity. After the selection, the main assertions were allocated in Microsoft Excel 2010 spreadsheets. Once cataloging, the data were analyzed in a combined way, to built a theoretical construct. They were combined and separated, and then inserted into separate sets of subjects.

The limitations are related to the size of the study, because to be a theme widely spread around the world, there are thousands of materials available and the research does not address all these aspects. Another limitation is the availability of data, which are still confidential to governments and enterprises by representing a highly profitable business, thus, was not possible deeper in some initiatives of biofuel production. It can also be considered another limitation the study objectives: by the reason of the study be linked to the field of management research, it does not present technical aspects of production of biofuels, something that would be expected in an article related eminently to the biotechnology area and not the management area. In this case, the objective of the study is to describe the biofuels as an investment opportunity for the country. However, it is recommended to develop a study of this subject.

Finally, the availability and reliability of the data was also a limitation, because those who make public is the government itself, and this may open room for discussion of the truth of the data and political and partisan influences on the publication of the data.

4. Results

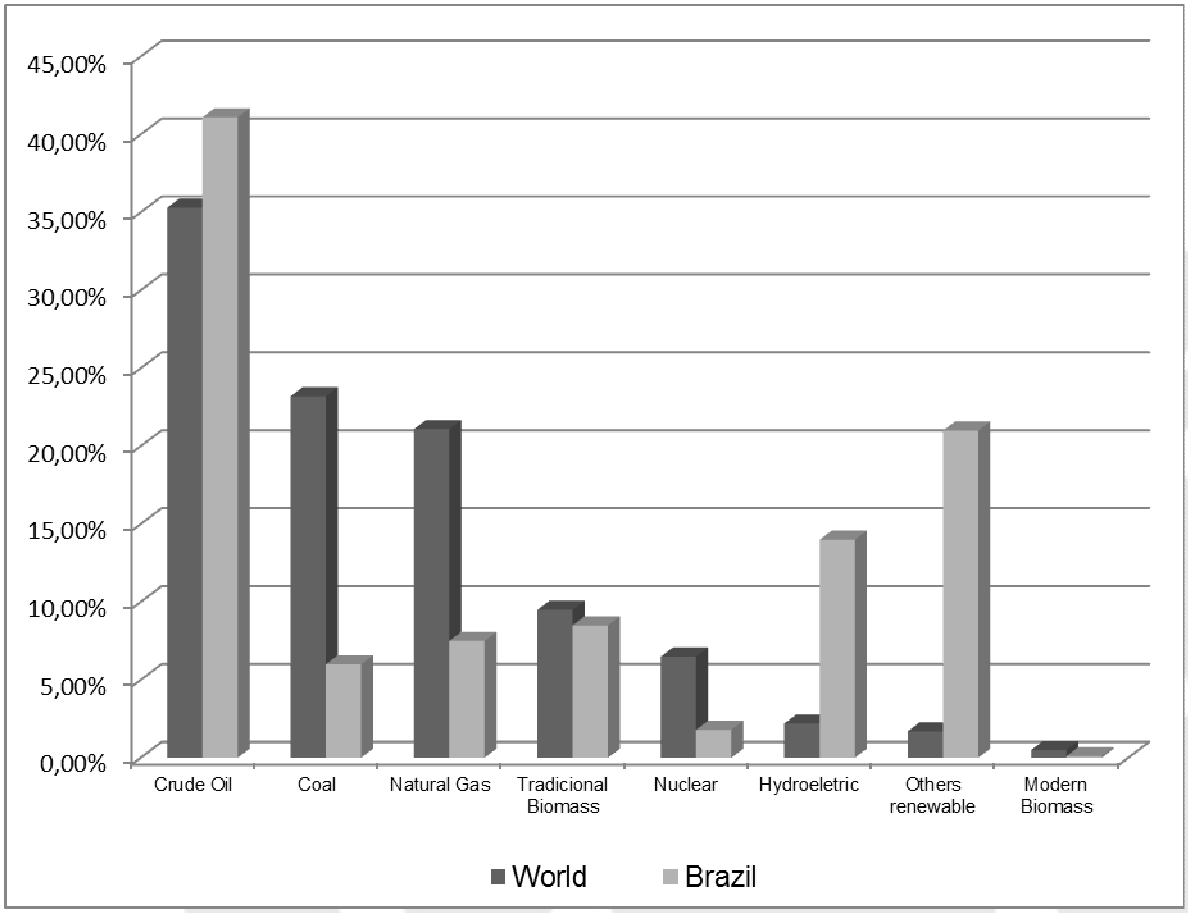
This section presents data related to the Challenges for Non-Renewable Energies, followed by the Concerns and Investments in Renewable Energies. Later are presented the Role of Ethanol to Power Generation, and the Importance of Diesel and Biodiesel as sustainable energy. Finally it is shown the New Frontier, through the Biodiesel produced by Micro-Algae.

4.1 Challenges for non-renewable energies

Over the years, it becomes increasingly scarce energies called non-renewable resources, to solve this need, the country has searched for new sources of energy that can replace non-renewable energy in the future. It is understood by non-renewable energy the energy that is produced from Fossil Fuels Items because no exist Mechanisms to Replenish Them.

As an example of the main non-renewable energy can be mentioned: Plastic, Gasoline, Coal, Natural Gas, among others.

According to Graphic 1, it can be noted that the energy matrix in Brazil as then in the World is still concentrated on non-renewable energy, which increases the need to search for new energy sources:

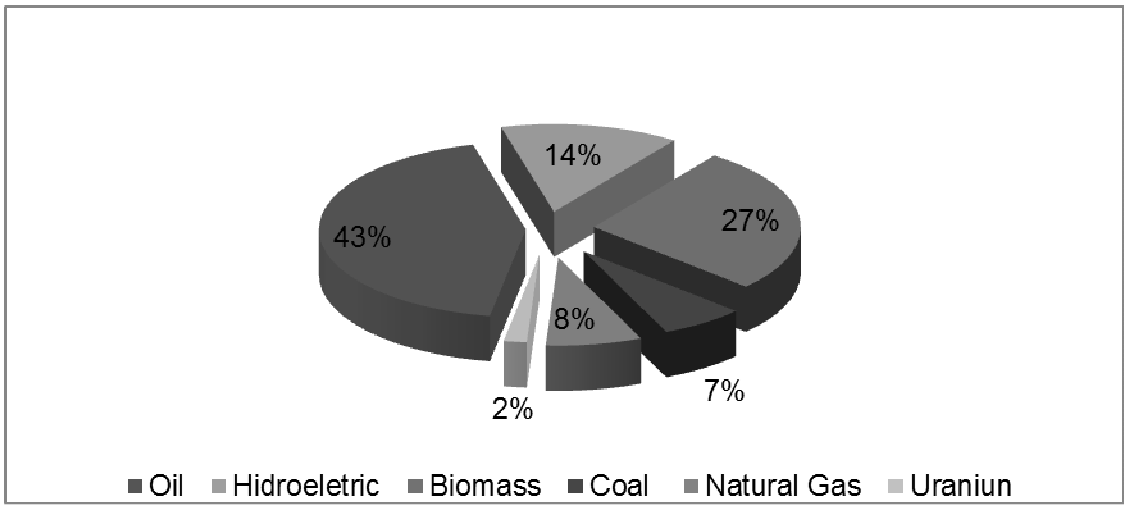


Graphic 1: Energy Matrix Composition.

Source: Petrobrás (2010).

The analysis of Graphic 1 allows one to realize that gasoline is still prominent among the energies. One can also note the importance of coal for power generation and worldwide growth of Brazil as regards renewable energy, which means new opportunities.

When analyzing only the non-renewable energy, limiting themselves to Brazil, one realizes the importance still occupied by the gasoline before all other energy sources, as can be seen in Graphic 2:



Graphic 2: Brazilian's Energy Matrix

Source: Petrobrás (2010).

Finally, the Figure 2 try to understand the future opportunities for energy generation, which makes a comparison between the Brazilian Energy Matrix in 2008 and expected to be achieved in 2017:

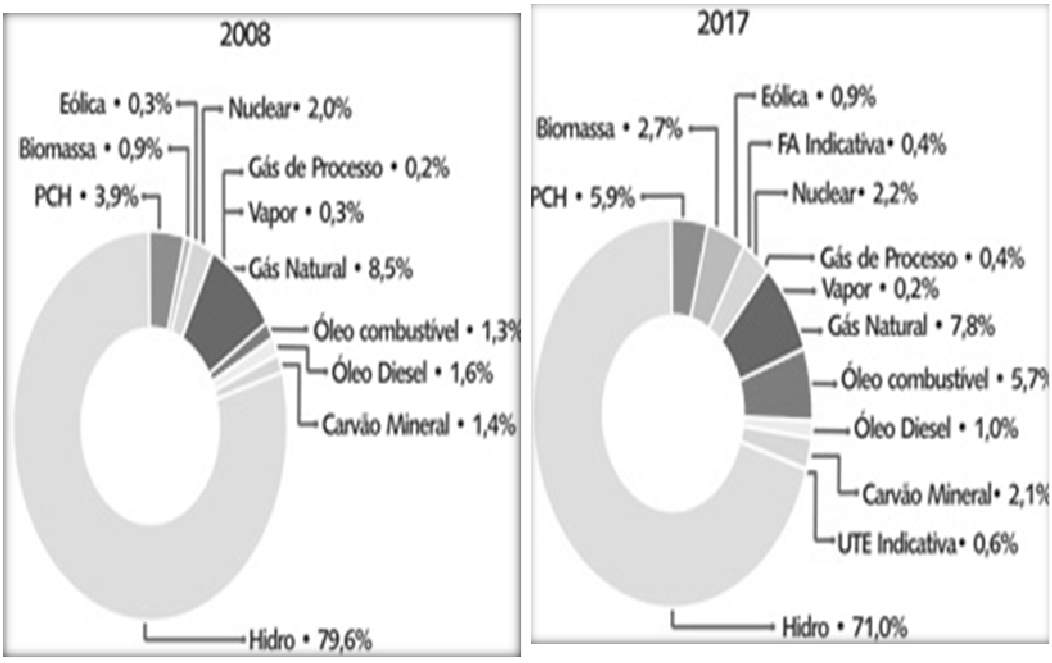


Figure 2: Brazilian's Energy Matrix – Comparison Between 2008 and 2017.

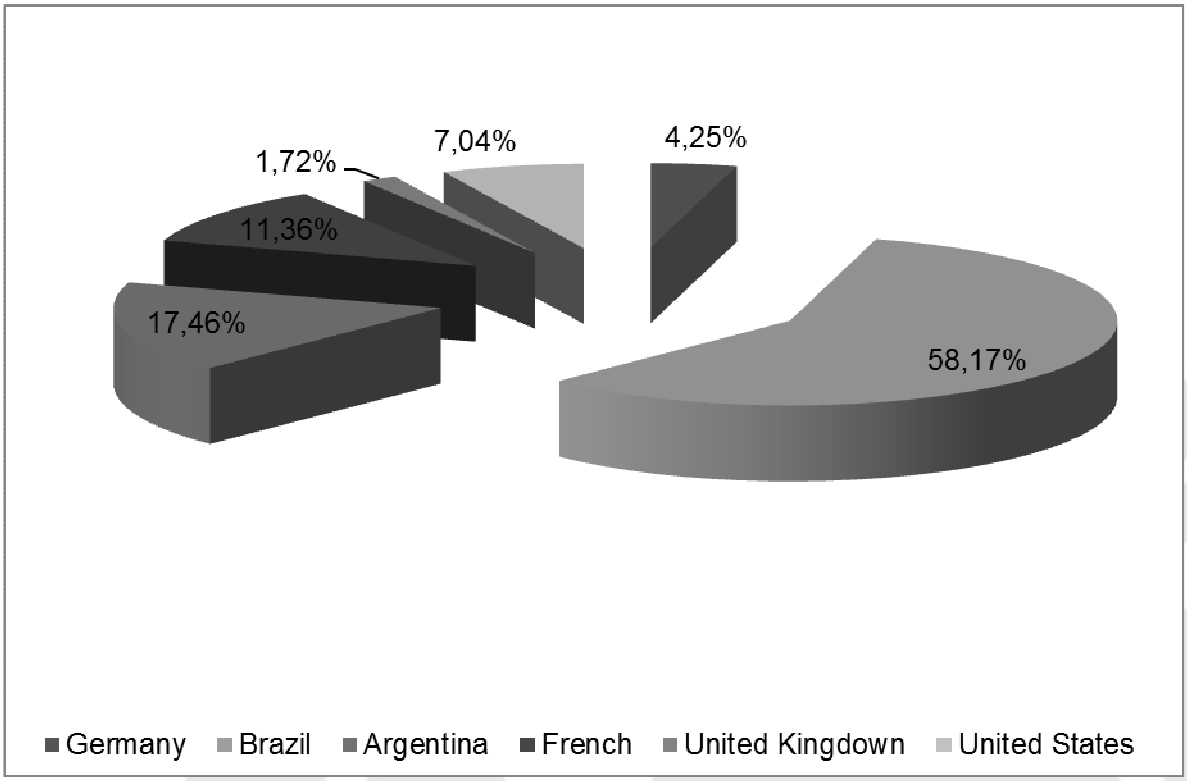
Source: Carvalho Junior (2011).

Figure 2 shows that there are many opportunities for investment in renewable energy, something that was looked and have been treated with great attention, as will be seen in the next section.

4.2 Concerns and investments in renewable energies

As previously shown, several concerns have been faced with the need to invest in renewable energy. It is understood by renewable resource any natural resource that is depleted at a rate slower than the rate at which it regenerates. The resource must have a way of regenerating itself in order to qualify the renewable.

Brazil stands today as one of the largest producers of renewable energy in the world, as seen in Graphic 3:



Graphic 3: Renewable Resource's Energy Percentage.

Source: Petrobrás (2009)

Among renewable energy include: Oxygen, freshwater, biomass, solar energy, wind force, biodiesel, and more energy used in Brazil today, Ethanol.

4.3 The role of ethanol to power generation

Ethanol has emerged in Brazil in order to assist in developing the country and to solve a serious problem: a shortage of non-renewable resources.

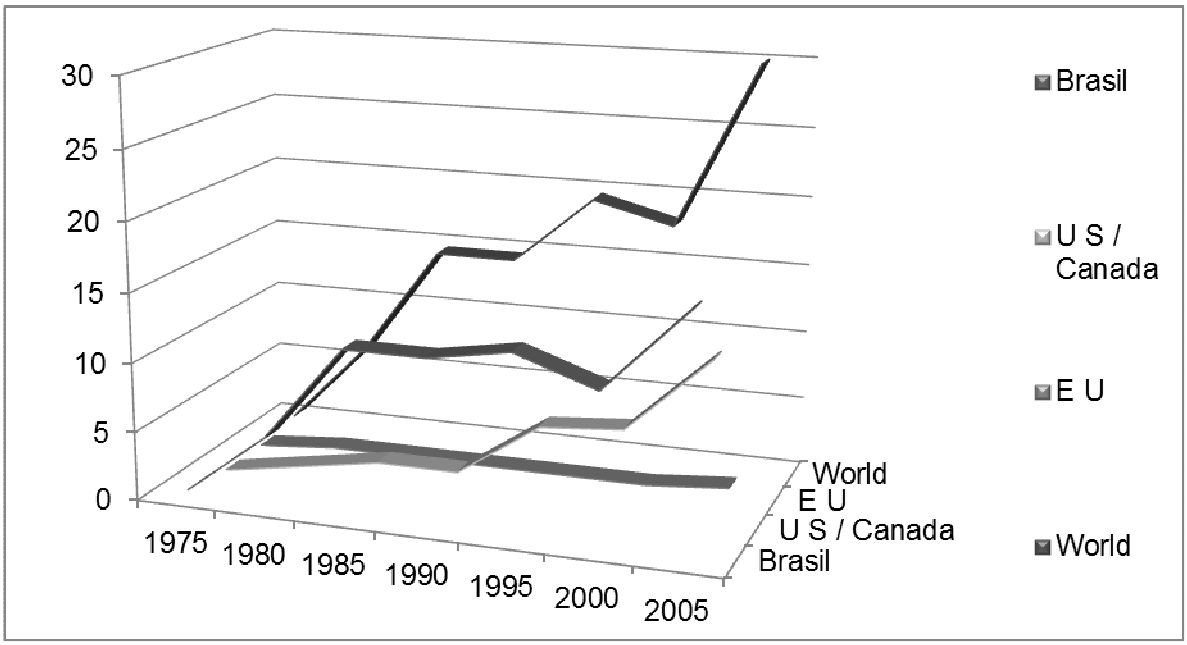
Since then, there's the creation of the Brazilian Ethanol Program, which was released in 1975, aiming to use a new source of energy as fuel, especially for land vehicles.

After its creation, the Ethanol market grew considerably, with one of the leading markets for energy production in the country. Brazil has advanced a lot in this sense, becoming one of the biggest producers of Ethanol in the world.

Additionally, the development of Ethanol also had a strong social character, helping to develop agribusiness in the country, generating many jobs in the fields, which were regions that were deprived for many years.

The main production was done by the Sugar cane. Because Brazil has vast plantations of sugar cane, this input was always easily found in the country. In the U.S. ethanol has been produced by the corn.

This investment in ethanol production has caused a downsizing in the need for oil imports, which was good for the country, considering that the price of oil continues to rise each year. This made the cars run on Ethanol became a trend among the population, increasing the number of sales considerably. The Graphic 4 shows the growth of ethanol production in Brazil and the world:



Graphic 4: World's Ethanol Production.

Source: Petrobrás (2009).

After reviewing the Graphic 4 it is noted that Brazil stands out as the largest producer of Ethanol (by Sugar cane) in the world, which means that the sector has many opportunities for growth. The United States and Canada come close behind, with the production of ethanol using corn. But there is a big problem in the production of Ethanol, that use as the raw material Sugar cane, because sugar cane can be used to produce both sugar and ethanol, and for this reason there is a conflict of interest in choosing which products that will be produce. This production was usually chosen as the demand of international market, leaving the country itself with deficiency in one of the both products in most of the opportunities, therefore, to improve this development, and provided an important aid of Biotechnology, starts production Bioethanol.

4.3.1 Bioethanol

The Bioethanol is regarded as the second-generation ethanol. He comes from the perceived opportunity to advance Brazil's Ethanol production and the worldwide interest in this fuel.

Instead to be produced by the juice of the Sugar cane, as regular ethanol, the Bioethanol is produced using the biomass of Sugar cane , which are the remains left over after extracting the juice.

This production process is represented by Figure 3:

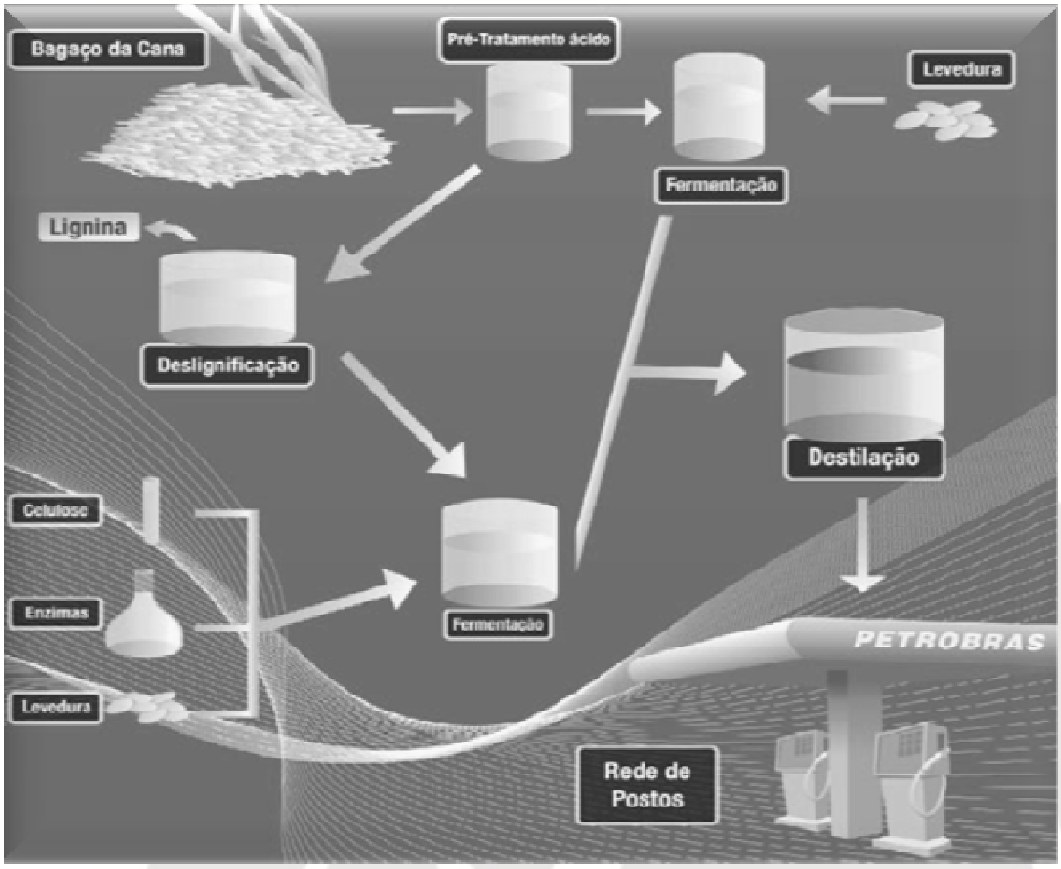


Figure 3: Bioethanol Production.

Source: Carvalho Junior (2011).

The main advantages around the production of bioethanol are:

- The Brazil is a recognized worldwide leader in alternative fuels, especially renewable ones;
- Potential reduction of carbon particles in the atmosphere;
- Product acceptance in the international market;
- The country itself, followed by the United States, as a leader in the consume of this product.

By support these advantages are several initiatives that serve to support the increased production of Bioethanol. Bioethanol is produced when one can use the biomass of Sugar cane to produce more fuel, thus eliminating a huge waste.

The Bioethanol has the same characteristics of regular ethanol, which makes it a potential replacement.

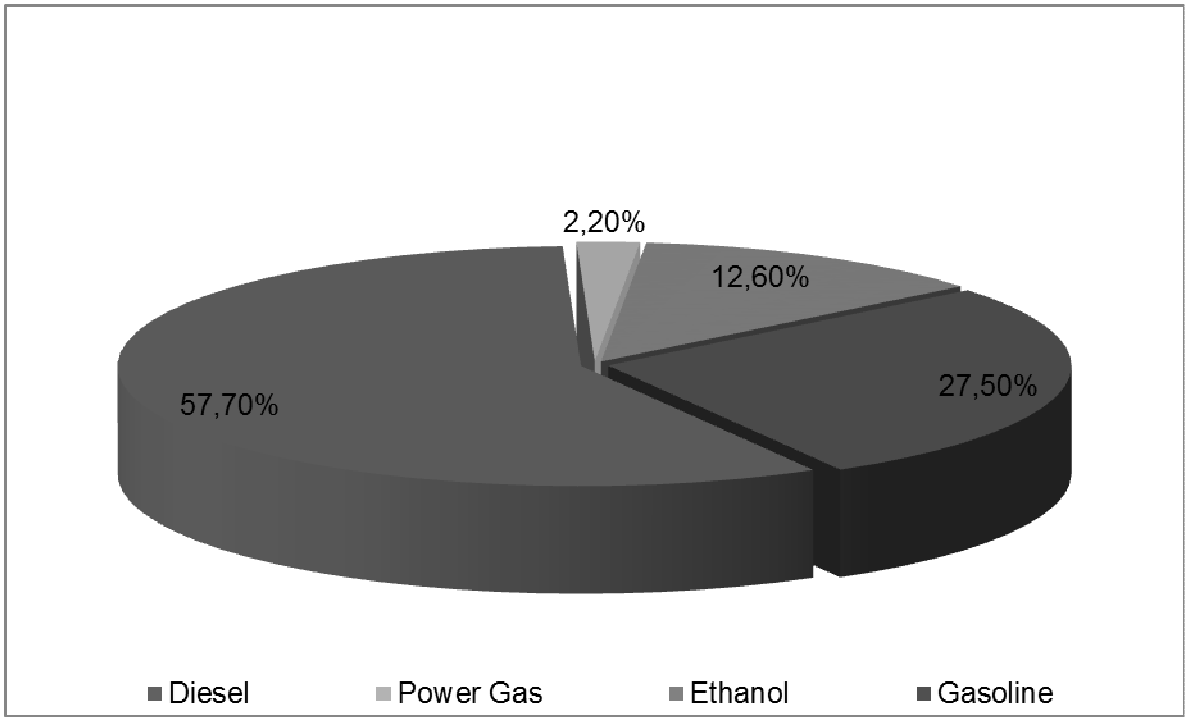
With the advance in this production, one can reduce the dependency on non-renewable fuels, especially fossil fuels, in view of the severe shortage of such products, and the value they currently have in the international market. Furthermore, it is of interest to major consumers, Brazil and the United States, an increase this production.

It can be also add aspects of biotechnology for the planting of Sugar cane, generating species capable of producing even more energy than the already known.

Finally, it is worth mentioning that concern for replacing non-renewable fuels does not revolve just around the gasoline, it is also necessary to consider the importance of diesel, particularly for transportation, and for this reason to study alternative forms of Biodiesel production.

4.4 The importance of diesel and biodiesel as sustainable energy

As important as gasoline, is diesel fuel, that besides being non-renewable, occupies an important place in the national energy matrix, particularly for transport. The Graphic 5 presents a matrix of transport fuel:



Graphic 5: Actual Brazil Fuel Matrix in Transportation.

Source: Petrobrás (2009).

Diesel is a non-renewable energy and also causes air pollution, which makes it necessary to find new sources of energy. Based on these needs, and with the help of biotechnology, has been developed to Biodiesel.

The Pro-Oil, which is the Brazilian Biodiesel Program, was launched in 1975 aiming to create a renewable energy source to replace regular diesel.

This program consists of extraction of vegetable oil from specialized plants in Brazil, and made after this extraction and processing, this product is added to regular diesel. Figure 4 shows the geographical production of biodiesel in Brazil:

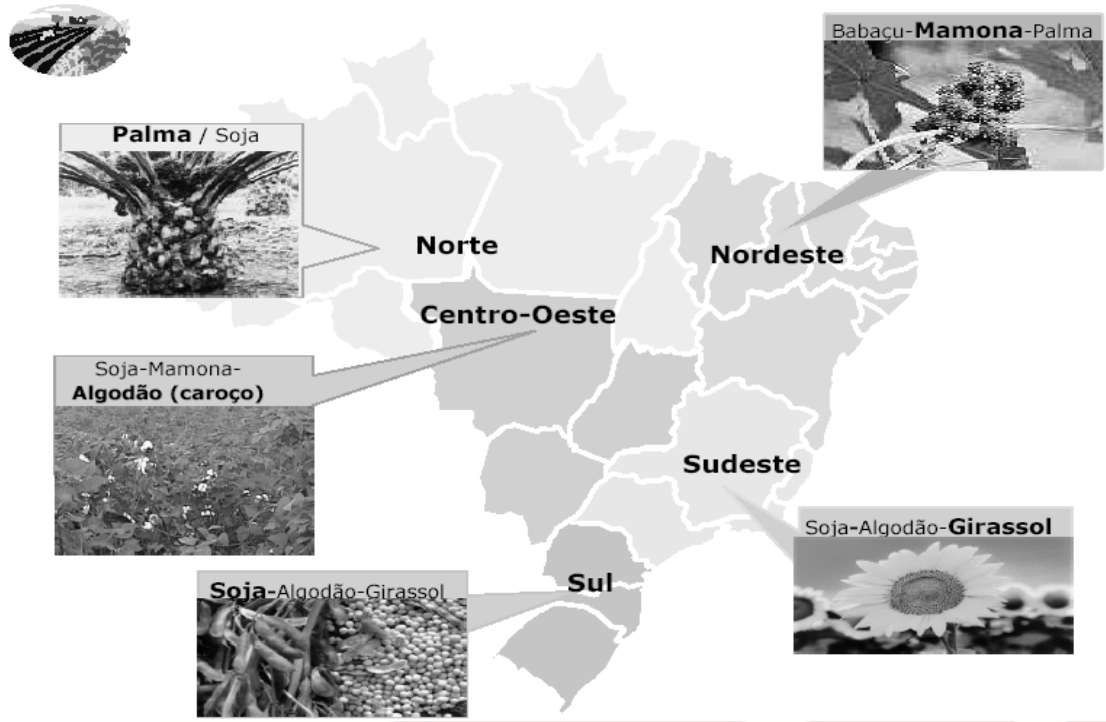


Figure 4: Geographic Production of Biodiesel in Brazil.

Source: Embrapa (2009).

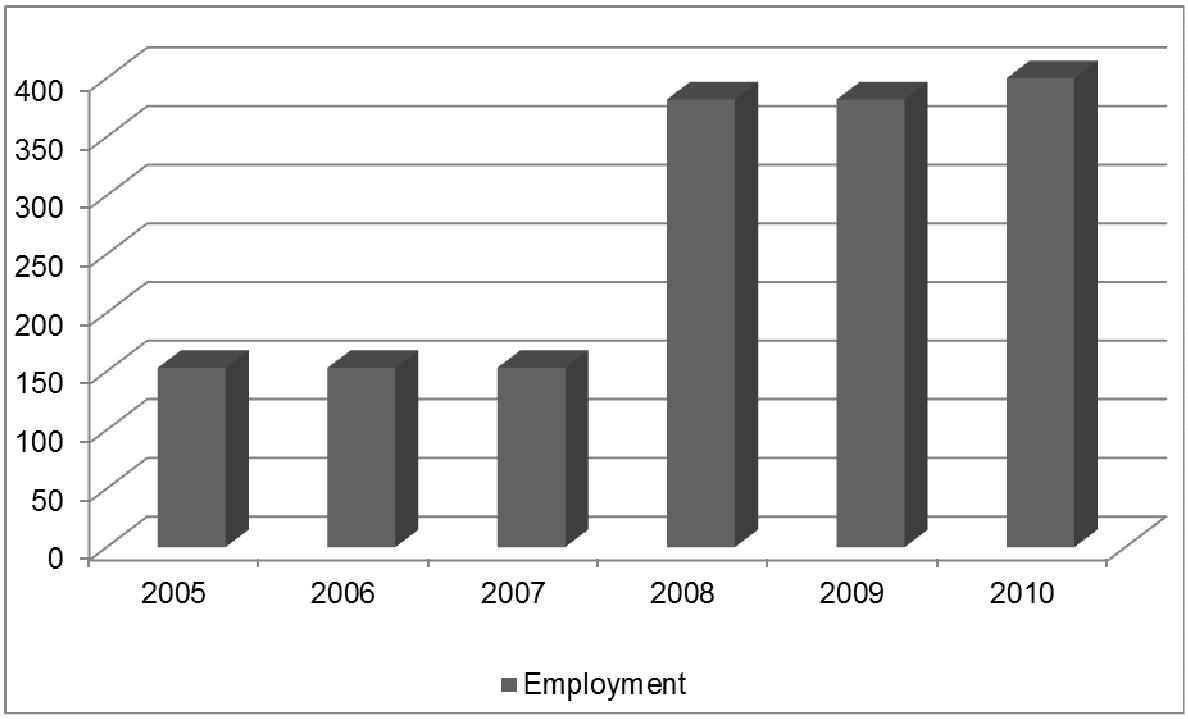
Among the species that are used, the oil concentration is higher in Babaçu almond, followed by the coconut fruit. Chart 1 shows the oil concentration in species that are used for extraction:

Specie	Oil Origen	Oil Concetration	Production's Months	Performace ton/ha
Coco	Fruit	57%	12	4
Babaçu	Almond	66%	12	0,2
Mamona	Grain	47%	3	0,6
Amendoin	Grain	42%	3	0,7
Canola	Grain	41%	3	0,6
Sun Flower	Grain	41%	3	1,2
Dendê / Palma	Almond	22%	12	4
Soya Bean	Grain	18%	3	0,3
Cotton	Grain	15%	3	0,2

Chart 1: Oils Species Cultivation in Brazil.

Source: Embrapa (2009).

The need to invest in the field work to produce Biodiesel also helps in another social aspect of the country, which is the valorization of rural workers. Over the past five years, with the need for increased production was also increased by the great labor of farm workers, generating more jobs in the field, as shown in Graphic 6:



Graphic 6: Development of employment in Brazil.

Source: IBGE (2009).

Such investment has been so significant that Brazil has been mixing about 2% of biodiesel in regular diesel, but the expectation is that this percentage will increase to 5% in 2014.

Anyway, Biodiesel is facing some challenges, considering that for production, it is necessary to give up food production, because the raw materials are the same. From this challenge, the need now is to get something capable of producing biodiesel and does not compromise food production.

4.5 New frontier, through the biodiesel produced by micro-algae

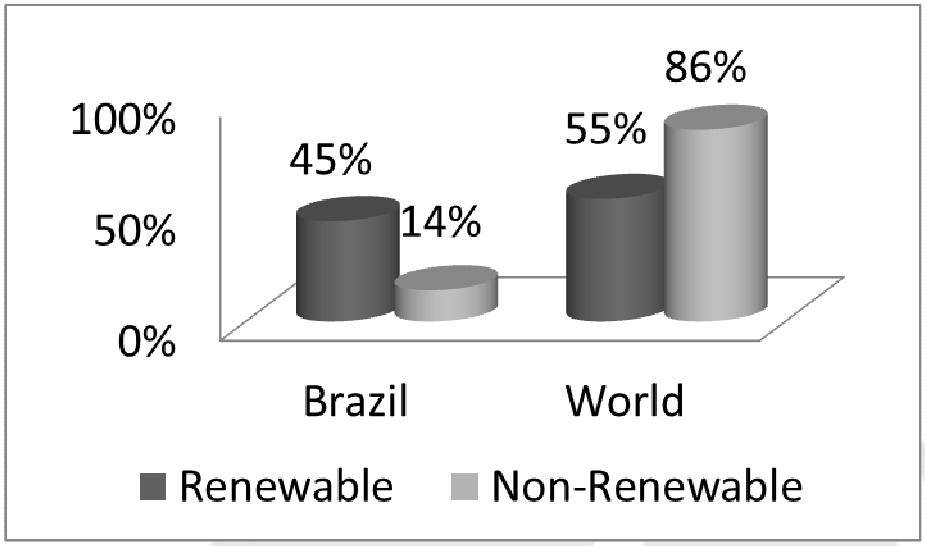
Aiming to increase the production of Biodiesel, in view of the needs identified, but without compromising food production, there is the Biodiesel produced by micro-algae.

In addition to producing biodiesel, this process saves water in addition to capturing CO2 from the atmosphere, which makes it absolutely sustainable. In order to produce biodiesel through micro-algae is necessary a large production area, as shown in Figure 5:

Figure 5: Production of Biodiesel from Micro-Algae.

Source: Cyanotech (2011).

One can consider various incentives to invest in this mode of production, starting with the need for continued use of diesel, which grows every year. Studies show that biodiesel can replace 100% of the diesel, with power generated from a fully sustainable manner. In addition, Brazil is already considered a leader when it comes to renewable energy production, as can be seen in Graphic 7:



Graphic 7: Production of Renewable Energy in Brazil.

Source: Carvalho Junior (2011).

The Graphic 7 shows that 45% of the energy produced in Brazil is renewable, which represents a huge opportunity for investment in the production of biodiesel through micro algae. Additionally, is a latent need to reduce dependence on fossil fuels. This need to find new sources of energy can help to support the Brazilian domestic market.

The production of biodiesel using algae Micro consists of extracting lipids from microalgae in order to generate biodiesel. It is a process that can be considered complex but of great economic viability, taking into consideration the importance of diesel for transport in the country. The final process is to filter the oil from micro algae and turn it into biodiesel. Figure 6 shows the cultivation of microalgae in closed photobioreactors:

Figure 6: Cultivation of Microalgae in Closed Photobioreactors.

Source: Carvalho Junior (2011).

However, there are great challenges for this process for the production of Biodiesel. The biggest is how to produce in large scale with positive economic returns. Additionally, it needs a large initial investment in equipment and areas for cultivation.

On the other hand, are great advantages. The biggest one is that the biodiesel produced by microalgae will not compromise food production, which is facing a major paradigms in these new forms of fuel. This is a new strategic source of renewable energy and is healthier for the environment.

5. Conclusions

The purpose of this article was to present, in general, new environmentally sustainable energy options created using biotechnology. This issue is relevant because in recent decades, the world is experiencing the beginning of an energy crisis, because the energy more used, especially for transportation, are from non-renewable resources. For this reason, it has been great the search for new sources of energy that can replace the energy currently used.

Big and audacious projects, as the Ethanol, emerged bringing positive effects in this direction. However, such fuel is facing a number of challenges for the reason that it is used the same raw material to produce both sugar and ethanol. The result is the international market deciding on what will be produced in the country, according to global demands (fuel X sugar).

Since then, appear the Biotechnology with a series of alternatives to solve these problems through biofuels. For ethanol, there is the Bioethanol considered the second-generation ethanol, which aims to produce fuel through the remains left over from sugar cane after extraction. For diesel fuel, emerges the biodiesel, which uses a series of plants to extract oil and produce biodiesel.

However, Brazil is facing a great challenge. Being considered a "farm to the world, " the country is a major producer of food for all nations, and the processes of biofuels, especially biodiesel, use of raw materials from food production to fuel production, causing a major paradigm.

Brazil proved that is possible to face the trade-of to produce energy vs. produce food with its biotechnology knowledge and utilizing the potential area of cultivation. Also promoting the social development so necessary the create the basis of sustainable economic development.

Emerges then the production of biodiesel through microalgae as a possibility to produce biodiesel without compromising food production. This is the main issue when renewable resource is pointed as the substitute of fossil fuels. Even more, with the development of biotechnology, is proving the possibility to produce energy from different sources. The biodiesel from micro-algae is the best example. The food cultivation is not compromised the biodiesel can 100% replace the common diesel.

This study has as main contribution to demonstrate the great potential existing in Brazil for investments in biofuels, especially as biodiesel as raw materials produced using micro-algae, given the length of coastline in the country. Although the study lacks a scientific deepening, especially as regards the way to produce biodiesel using microalgae, the study shows to the field of research in management a new investment opportunity that accompanies a worldwide trend.

Finally, for a country that aspires to become the 5th world power in the next decade[i], Brazil must increase investment in this type of renewable energy, particularly those that do not compromise food production, because the country have a importance in this area. This will be a first step for Brazil to take off towards the so dreamed of development.

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[i] Source: “O Brasil decola.”. Report in the magazine The Economist, on November 12, 2009.