Chapter 10

Biodiesel in Brazil Should Take Off with the Newly Introduced Domestic Biofuels Policy: RenovaBio

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Additional information is available at the end of the chapter

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Abstract

Our planet's climate has experienced changes mainly ascribed to the emission of carbon dioxide (CO_2), which accumulates in the atmosphere and causes an increase in the Earth's average temperature. In 2015, heads of state and scientists from several countries met in Paris to discuss measures aimed at curbing greenhouse gas emissions in order to limit that temperature rise to 2°C by the end of this century. As CO_2 needs to be banned from our environment for the sake of our own planet, it is reasonable for biofuels to present themselves as clean alternatives for the gradual replacement of fossil fuels. Biodiesel stands as an option. After 2005, some public policies were created in Brazil as an attempt to establish biodiesel as a replacement for mineral diesel, mainly in the transport sector. Although moderately successful, none of them compare in scope and reach to RenovaBio, a domestic biofuels policy that will make the production and use of biodiesel take off, once and for all. Therefore, herein, we present a brief overview on the status of the biodiesel production and use before the enactment of this new biofuels policy and the forecast of what it is expected to happen after its implementation.

Keywords: RenovaBio, biodiesel policy, fossil fuel, GHG, carbon dioxide, CO_2 emission

1. Introduction

The climate of our planet undergoes changes that mainly derive from the emission of greenhouse gases (GHGs), among which is carbon dioxide (CO_2), considered by many as the most significant man-made GHG. When expelled by the exhaust of internal combustion-powered vehicles, CO_2 accumulates in the atmosphere and causes an increase in the Earth's average temperature. As CO_2 has a very long atmospheric lifetime [1], usually longer than the other

three main heat-trapping gases (methane, nitrous oxide, and CFCs—except for CFC-13 and CFC-115), it is seen as the chief culprit of global warming, which has worried the scientific community around the world in recent years.

Bearing in mind that it is essential to limit CO_2 emissions in the air, dozens of heads of state and hundreds of scientists from all over the globe gathered at the end of 2015, in Paris, for the 21st Conference of Parts—also known as COP21 or Paris Agreement—with the main goal of engaging nations in an international agreement on climate change in which everyone pledged to collaborate so that the increase in the average temperature of our planet should not exceed the limit of 2°C by the end of this century.

At the COP21, Brazil voluntarily committed to: (1) cut down on GHG emission up to 37% by 2025 and 43% by 2030—considering 2005 as the base year for both scenarios [2]—which would represent approximately 1.2 million tons of carbon dioxide equivalent (CO_2eq) by the year 2020 [3]; (2) increase the use of biofuels from sustainable bioenergy up to 18% of the total domestic energy mix by the year 2030 [4]; and (3) increase the share of renewables to an estimated 45% by the same year [5].

So, considering the scenario wherein CO_2 needs to be banned from our environment for the sake of our own planet, it is reasonable for biofuels to present themselves as clean and renewable alternatives [6] for the gradual replacement of fossil fuels such as gasoline and mineral diesel, for example. Therefore, because biodiesel is biodegradable, less toxic, and almost 100% renewable [7, 8], it stands as an option.

After 2005, some public policies were created in Brazil as an attempt to definitely establish biodiesel as replacement for fossil diesel, mainly in the transport sector. Although successful to some extent, none of them compare in scope and reach to the recently created National Biofuels Policy (RenovaBio), whereto there is a hope it will make the production and use of biodiesel increase at a much faster rate.

Therefore, this work is primarily aimed at informing the reader about the past biodiesel policies that were implemented to boost its production and use, providing special emphasis to the most recent one: RenovaBio.

2. Early stages of biodiesel in Brazil and first public policies

The first time Brazil began to flirt with biodiesel was during the 1920s, when the *Instituto Nacional de Tecnologia*, a government technological institution, began to undertake studies on that biofuel [9].

Although the first real tests with biodiesel in Brazil began to appear 20 years later, in the early 1940s, during World War II [10], it was only during the 1970s, after continued increases in oil prices, that conventional biodiesel technology, using a catalyst and an alcohol, became well known in Brazil [11].

With the oil shock of 1973, the world awakened to the importance of finding different sources of energy that were not dirty like those produced by the fossil fuels. That year became a

landmark in our planet's energy history, whose focus would be on overcoming the energy crisis via two main groups of action: conservation of energy—or energy saving—and the use of alternative sources of energy [12].

Following that type of awareness, Expedito Parente, the leading Brazilian biodiesel scientist at that time, created the first patents of that biofuel in the country, which would represent the outcome of his studies in the late 1970s and early 1980s. As a result, he became the mainstay and principal proponent of the early developments of biodiesel in Brazil.

The first policies created to promote the production and consumption of biodiesel in Brazil (**Table 1**) are discussed ahead.

2.1. Social Fuel Stamp (SCS)

The Brazilian government launched the Social Fuel Stamp program—or *Selo Combustível Social (SCS)*, in Portuguese—in December 2004, through Decree No. 5297 [13], to promote social inclusion of family farmers from the two poorest regions of Brazil: North and Northeast [14]. The intention was also to regionalize the production—highly dependent on soybean and beef tallow—of other abundant raw materials, such as palm, cotton seed, and maybe jatropha [15].

Plentiful in both regions, castor would be a nice contender if it were not for the fact that this oilseed presents a very high viscosity content of 14.1 mm^2/s, which is way above the maximum determined by the Brazilian Petroleum Agency (ANP) of 6.0 mm^2/s [16]. That technical constraint alone deems castor an unsuitable alternative feedstock for the production of biodiesel [10, 17–20].

The SCS is also a mechanism that serves to reduce government taxes and allow the Brazilian Development Bank (BNDES) to grant lower funding fees for biodiesel producers who acquire raw materials from—and provide technical assistance to—family farmers [15].

Through ANP, the Federal government promotes auctions for the purchase of biodiesel. During the first stage of the auction, 80% of the total volume is offered to biodiesel producers who already have the SCS. This phase, restricted to holders of the stamp, grants them the purchase and delivery of the product for specified periods. The remaining 20% of biodiesel is offered to any producer, with or without the stamp [21, 22].

Year	Mechanism	Program name and acronym (in Portuguese)
2004	Decree No. 5297	Social Fuel Stamp (SCS)
2005	Law No. 11097	National Program of Production and Use of Biodiesel (PNPB)
2009	Law No. 12187	National Policy on Climate Change (PNMC)
2014	Law No. 13033	Mandatory blend on diesel: increase to 6% and 7%
2016	Law No. 13263	Mandatory blend on diesel: increase to 8%, 9% and 10%
2017	Law No. 13576	National Biofuels Policy (RenovaBio)

Table 1. Policies that helped biodiesel in Brazil.

Although the SCS program was conceived to bring about major social and economic changes in the North and Northeast regions, as initially intended by the government, except for some modest progress, many authors see it as a failure. The reasons vary from high logistic and harvesting costs to low economies of scale, low utilization of agricultural machinery, artificial irrigation and fertilizer, and lack of access to financing due to red tape [18]. Therefore, this program is currently under revision in order to correct the aforesaid problems, already realized by the government.

2.2. National Program of Production and Use of Biodiesel (PNPB)

On January 13, 2005, the Brazilian government formally introduced The National Program of Production and Use of Biodiesel (PNPB, Brazilian acronym for *Programa Nacional de Produção e Uso de Biodiesel*) into the energy matrix through the implementation of Federal Law No. 11097 [23].

One of the main objectives of PNPB, besides the promotion of social inclusion of family farmers, primarily from the North and Northeast regions of Brazil, was also to reduce the import of mineral diesel [9, 24], thus positively affecting the Brazilian trade balance.

In addition, the program also meant to establish a minimum blending percentage of biodiesel into petroleum diesel. At first, the suggested blending percentage (2%) was optional to run from 2005 to 2007, then mandatory from January 2008 onward (**Table 2**).

Table 2 shows that the production percentage rates from 2005 to 2010 were (on average) very high when compared to the ones from 2011 to 2017. Although 2014 was a year in which the blend changed twice, the percentage increase was relatively low: only 17%. And since then, the percentage has declined, even negative in 2016—a year in which there was a decrease in the biodiesel production for the first time since the establishment of the PNPB program, in 2005.

Right from the beginning of the PNPB program, soybean has become the main and overwhelmingly dominant raw material for biodiesel production, accounting for an average of 75% and beef tallow, in second, with an average of 15%. Other raw materials, such as cotton seed, used cooking oil, and other fats would represent, altogether, the remaining 10% [25]. This high dominance of both feedstocks has driven the Brazilian government to create mechanisms to incentivize the use of alternative raw materials [15, 26].

2.3. National Policy on Climate Change (PNMC)

Law No. 12187 was sanctioned on December 29, 2009, and amended by the Presidential Decree No. 7390 on December 9, 2010 [27]. Together, they establish principles, goals, instruments, and guidelines of the National Policy on Climate Change (PNMC) and elucidate terms such as adaptation, mitigation, emissions and sources of emissions, greenhouse gases, and their eminent impacts [27].

Both law and decree also provide that any measures taken to reduce any type of emissions must have a national range, besides being focused on the prevention or minimization of damages caused directly by anthropogenic activities. On the other hand, these measures should also consider the different socioeconomic contexts of their application, as well as allocate to the population and economic sectors the burdens and charges resulting from such impacts.

Year	B100 (m^3)	%	Blend
2005	736	—	B2
2006	69,002	9275	B2
2007	404,329	486	B2
2008	1,167,128	189	B2/B3
2009	1,608,448	38	B3/B4
2010	2,386,399	48	B5
2011	2,672,760	12	B5
2012	2,717,483	2	B5
2013	2,917,488	7	B5
2014	3,422,210	17	B5/B6/B7
2015	3,937,269	15	B7
2016	3,801,339	−3	B7
2017	4,291,294	13	B8
2018	5,590,000*	30	B10

*Expected demand [21].

Table 2. Annual biodiesel production and respective rounded percentages [25].

Furthermore, both policies also shed light on how to diminish natural and anthropogenic impacts, and how to promote the understanding about the consequences of existing and forthcoming climate change events [27].

One of PNMC's guidelines is Brazil's Nationally Determined Contributions (NDC) committed at the Paris Agreement.

2.4. Blending mandates on diesel: 6 and 7%

On September 24, 2014, the Federal government enacted Law No. 13033 [28], turning mandatory the blending of biodiesel into petroleum diesel in the following percentages: 6% (B6) beginning on July 1, 2014, and 7% (B7) starting on November 1 of the same year.

This policy also allows the voluntary addition of biodiesel to diesel in amounts greater than the mandatory percentage in public transport, rail, inland navigation, equipment, or vehicles for mineral extraction and electric power generation, tractors, and other automotive vehicles intended to pull or tow agricultural machinery or to carry out agricultural work [28].

2.5. Blending mandates on diesel: 8 and 10%

Law No. 13263, implemented on March 23, 2016, alters Law No. 13033 to establish new mandatory blending percentages of biodiesel into mineral diesel, as follows: 8, 9, and 10 (B8, B9, B10) to commence on March 1 of 2017, 2018, and 2019, respectively [29]. But the latter policy upholds the prerogative of voluntary addition of the former.

This law also authorizes the increment of up to 15% (B15) of biodiesel to fossil diesel sold to end users, in any part of the country, after completion (up to 36 months of its enactment) of specific tests and experiments on engines that validate the use of the mixture [29]. The specific tests (50 or so) shall be conducted by more than 20 different companies, spread out through more than 15 locations nationwide [21].

With the anticipation of the B10 blend to March 2018, there should be a progressive increase in the biodiesel-to-diesel mix aiming to achieve the B15 in 2025 in order to meet the country's NDC, committed at the Paris Agreement [21].

3. The most recent public policy on biofuels: RenovaBio

3.1. What is RenovaBio?

The National Policy on Biofuels or *Política Nacional de Biocombustíveis* (RenovaBio) is an integral part of the national energy policy to consolidate the production and use of biofuels in Brazil. This program, converted into Law No. 13576 by the Federal government on December 26, 2017 [30], aims to radically expand the production and use of biodiesel, biomethane, and ethanol, among other biofuels, and increase energy security throughout the country and, therefore, create more jobs and income, promote a greater social insertion of family farmers, and help Brazil meet its GHG emission reduction targets, committed at the COP21 [30].

Besides helping the biodiesel market, RenovaBio will also boost the ethanol industry and Brazil's foreign trade balance by diminishing the country's reliance on imported corn ethanol from the United States.

With a nationwide scope, this program also outlines rules for marketing biofuels in the country under the flag of environmental sustainability, and fosters credibility and predictability of national fuel supply. By doing so, RenovaBio will not just help the environment, but it will lay the market conditions for domestic and foreign private investments [31, 32].

This fresh and innovative regulatory framework is supported by two main pillars: the encouragement of energy efficiency throughout the production and use of biofuels and the recognition of biofuels capacity to remove carbon from the environment [33], or mitigate its impacts.

When formulating the basic tenets of RenovaBio, policy-makers and researchers took into account successful international models of initiatives that were enacted for the areas of biofuels and renewable energy, such as the Low Carbon Fuel Standard (LCFS), the Renewable Fuel Standard (RFS), and the Renewable Energy Directive (RED) [34, 35].

Both LCFS and RFS laws, implemented in the United States in 2005 and 2007, respectively, are primarily aimed at reducing carbon intensity in the transport sector [36, 37], while the RED directive, sanctioned in the Europe Union, in 2009, demand that each EU country expressively increase their share of renewable energy to the energy mix in a way that the overall EU share be 20% by the year 2020 [38].

3.2. RenovaBio and Brazil's commitments to mitigate carbon dioxide emissions

Biofuels have aroused the interest of the Brazilian government in the light of its mitigating potential against the harm caused by petroleum-derived fuels, mainly in the transport sector [22]. Therefore, by enacting RenovaBio, the Brazilian government has overtly shown to the international scientific community its desire to comply with the Paris Agreement, in which the country presented its voluntary goals for 2030 under the NDC.

To achieve these goals, Brazil will adopt actions to reduce GHG projected emissions and increase the share of renewable energy and biofuels into the country's energy matrix [39], as aforementioned.

Furthermore, there is a possibility of voluntary use of biodiesel in mineral diesel to be greater than the mandatory blend in specific cases, such as: 20% in captive fleets or road users serviced by supply point; 30% in rail transport; 30% in agricultural and industrial use; 100% in experimental use, specific or in other applications [21].

Decree No. 9308, sanctioned on March 15, 2018, addresses the annual compulsory targets to reduce domestic emissions of GHGs and assigns to the National Energy Policy Council (CNPE) the definition of these goals, which are based on recommendations of the Interministerial Committee on Climate Change (CIM) [40].

The breaking down of the national mandatory targets—provided by CNPE—into an individual goal that must be assigned to each biofuel distributor is responsibility of ANP. The distributors that do not comply with their individual goals will be subject to a fine proportional to the noncompliance goal, which may not exceed 5% of their annual revenue, registered in the previous two years [40].

This decree has also established a RenovaBio Committee to provide technical support to CNPE in the process of defining—until June 2018—the annual national reduction targets and it is consisted of agents from seven Ministries, among them Mines and Energy, Environment, and Agriculture. Representatives of other federal, state, and municipal agencies, as well as public and private sector entities from the biofuels market, in addition to technicians and specialists from the sector, whose assistance will be considered provision of unpaid public services, may also be part of this committee as guests [40].

One of the new facets of RenovaBio, missing in previous biofuels policies, is the creation of two important market mechanisms: *Certificado de Produção Eficiente de Biocombustíveis* (CPEB), or Certificate of Efficient Production of Biofuels, and *Créditos de Descarbonização* (CBios), or Decarbonization Credits.

3.2.1. Certificate of Efficient Production of Biofuels (CPEB)

Chapter 2 of the RenovaBio policy defines the CPEB as a document issued exclusively by inspection companies as a result of the biofuel certification process. These companies must be highly qualified as such (ISO-standard) and be approved by the government in order to inspect the biofuel companies—either producers or importers [30].

After the inspection and certification are over, ANP will audit the whole process in order to approve or disapprove the issuance of the certificate. In case of approval, the list of certified producers and/or importers is published in the official government gazette so they can take advantage of their certification status when marketing their biofuels.

In case of disapproval, ANP then assesses the whole process to see if there was incompleteness or any sort of fraud. If the latter is the case, then ANP establishes an administrative process to revoke the accreditation of the inspection company. If the former is the problem, then ANP sends the whole paperwork to the inspection company redo the process again [41], as shown in **Figure 1**.

Article 28 of the RenovaBio law states that a bonus of up to 20% will be applied on the value of the energy and environmental efficiency grade of the producer or importer of biofuel whose CPEB proves a negative emission of GHGs in its life cycle in relation to its substitute of fossil origin.

It is up to the RenovaBio Committee, among other responsibilities, to monitor the market, supply, and development of the production of biofuels, particularly the installed capacity of companies that hold the certificate that deems their production efficient and environmentally friendly. Government Order No. 103 of March 22, 2018, has set the green light for this Committee to start its activities immediately [42].

3.2.2. Decarbonization Credits (CBios)

Chapter 2 of the RenovaBio law states that Decarbonization Credits are instruments registered in the form of scripture for the purpose of attesting the individual target of fuel distributors whose proof of achievement shall be based on the amount of credits held by the fuel distributor on the date defined by the policy [30].

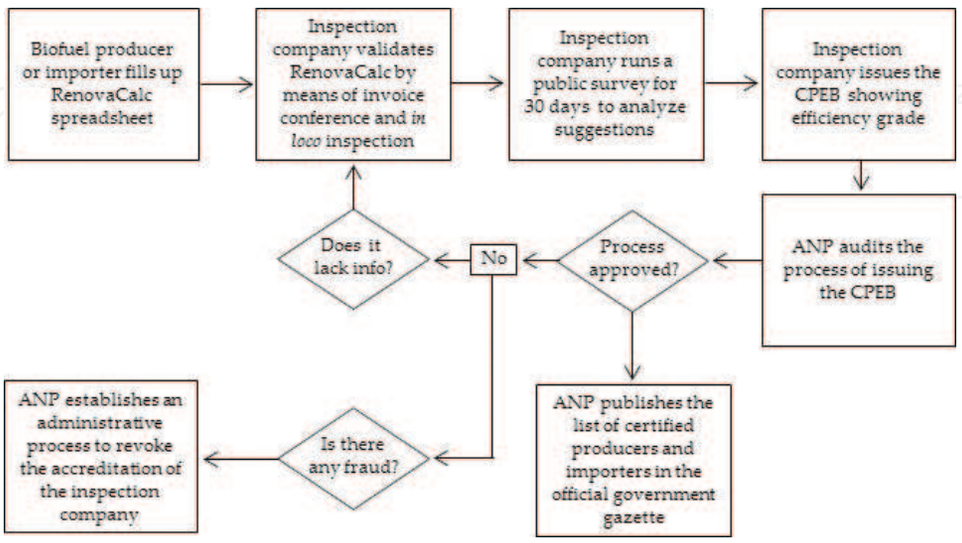

Figure 1. CPEB issuance process flowchart. Source: Adapted from [41].

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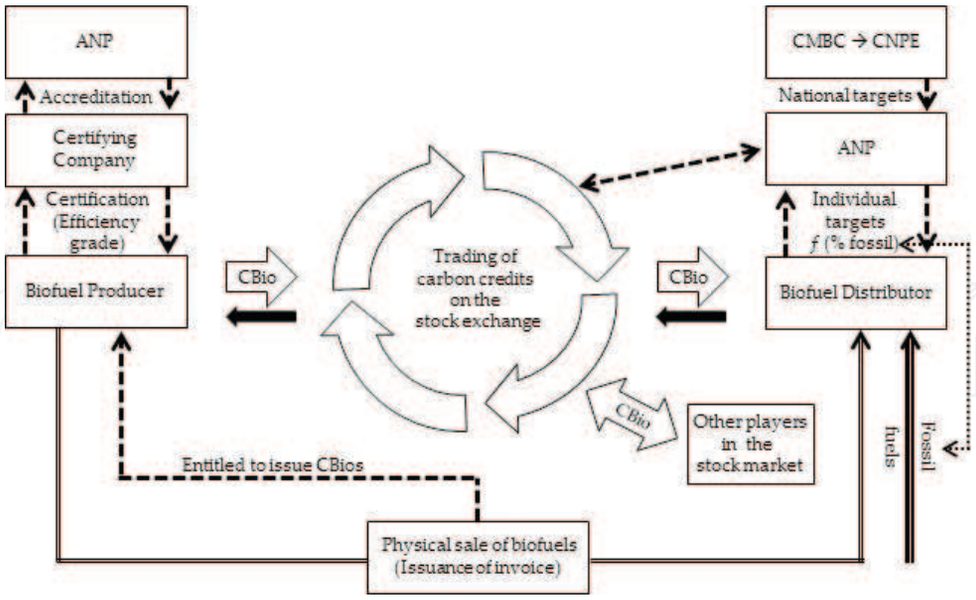

Figure 2. CBios flowchart. Source: Adapted from [41].

The values of the annual mandatory targets were established in units of CBios, with each CBio corresponding to 1 ton CO_2eq, whose calculations consider the difference between the GHG emissions in the life cycle of a biofuel and the emissions in the life cycle of its fossil substitute [40].

These calculations will consider energy efficiency in MJ/ton or cbm and environmental impact in gCO_2e/ton or cbm [33] and will be carried out by RenovaCalc, which is a tool that accounts for the carbon intensity of a biofuel in gCO_2eq/MJ [43].

Besides carrying out analyses and studies for the definition of compulsory goals, plus the evaluation and suggestion of preventive measures to adapt them, other responsibilities of the RenovaBio Committee are the monitoring of supply, demand, and price of CBios issued and traded in the stock exchange from the commercialization of biofuels. **Figure 2** shows the links of CBios with the biofuel producers and distributors and how they interplay with the government agencies and certifying companies.

4. Current and future production, consumption, and capacity

4.1. Production, consumption, and installed capacity before RenovaBio

Historically, Brazil has adopted soybean and beef tallow as the main feedstocks for the fulfillment of biodiesel demand in the country. As previously mentioned, soybean alone accounts for three-fourths of the domestic production, mostly done in the Mid-West and in the South, regions that house the vast majority of Brazil's biodiesel plants, whose owners are also major soy producers and agribusiness companies, well established in both areas for a long time and, therefore, are better prepared to take advantage of the big soy market that was developed throughout the country [3].

Since the inception of the PNPB program, in 2005, biodiesel production has leap-frogged from 736 thousand to 4.3 billion liters in just 12 years (**Figure 3**). Such a growth turned Brazil into the second biodiesel producer in the world, trailing only the United States, as the number one producer with approximately 5.5 billion liters, in 2016 [44].

In footstep with the production growth, the installed capacity also jumped from zero to approximately 8 billion liters in about the same period (**Figure 3**). If on one hand, this growth leads to an idle capacity rate that is close to 50%; on the other hand, it makes biodiesel producers optimists to comfortably meet the production forecasts for at least 5 years after the enactment of the new biofuel policy.

4.2. Production, consumption, and installed capacity after RenovaBio (forecast)

The expected biodiesel production growth to 18 billion liters in 2030 suggests a major boost of the installed capacity to around 22 billion liters. In order to meet that forecast, it will be

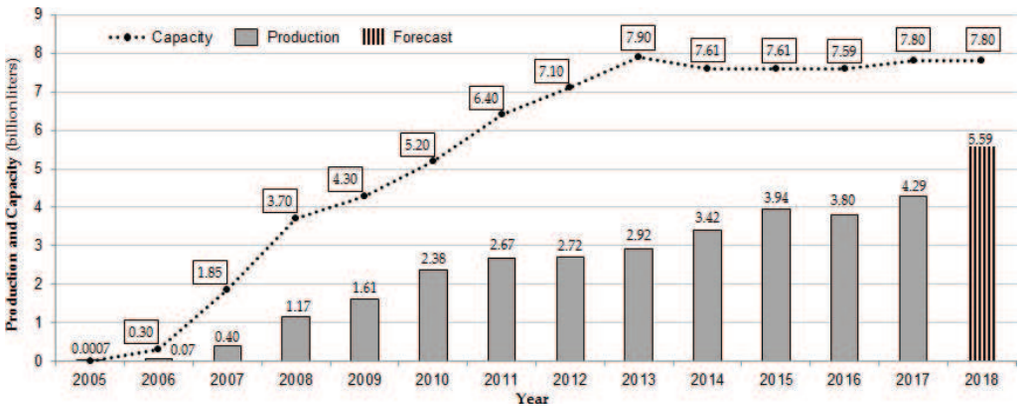

Figure 3. Biodiesel annual production (B100) and accumulated installed capacity. Source: Adapted from [25].

Status	Accomplished	Forecasted			Unit (million)
Year	**2016**	**2020**	**2025**	**2030**	
Soybean					
Processed	40.7	55.1	77.3	107.2	t/year
Installed capacity	65.0	68.8	96.6	134.0	t/year
Number of plants	117	120	139	165	—
Biodiesel					
Production	3.8	6.4	11.4	18.0	m^3/year
Installed capacity	7.3	8.0	14.3	22.5	m^3/year
Number of plants	50	51	76	109	—

Source: Adapted from [45].

Table 3. Future scenario for soybean processing units and biodiesel refining.

necessary not just to expand the capacity of current plants but also a twofold increase in the number of biodiesel plants in operation now (**Table 3**).

That kind of growth will require an investment volume of R$ 21.7 billion [45], equivalent to approximately US$ 7 billion, from the government and the private sector, which will represent a major boost on the local economy where the current biodiesel plants are already installed, as well as where the new ones should be built.

Such expansion in the production and use of biodiesel should represent some positive externalities like the creation of new jobs along the entire biodiesel chain, and the reduction of CO_2 emissions in the atmosphere as a replacement for part of the petroleum diesel Brazil still needs to import, which should represent an economy of US$ 1 billion per year for an equivalent amount of nearly 1.2 billion liters of diesel not imported [3].

5. What still needs to be done in spite of RenovaBio

The complexity of this policy requires the government to pay special attention to questions on how the process steps will be supervised and how to allocate the individual targets of the biofuel distributors which, in turn, can acquire the decarbonization certificates whose prices still need to be defined, as well as the costs for the certification of production [46].

The technology mostly used to produce biodiesel in Brazil is the transesterification, which is inefficient. Besides, the process uses methanol, which is from a fossil source, instead of ethanol, which is cleaner, renewable, and produced locally from sugarcane. And the country still imports a good chunk of the alcohol that is used to produce biodiesel, therefore affecting the trade balance negatively.

Furthermore, there needs to be greater incentives for the diversification of the mix of raw materials used in the production of biodiesel, since soybeans and beef tallow together represent about 90% of the total and they present environmental problems due to the use of pesticides and herbicides [47], as well as GHG from land use and land use change [48].

Perhaps alternative sources, such as palm—whose yield per hectare is approximately six times greater than that of soybeans [22]—may be an option. However, this feedstock still needs investments in R&D so that its production increases in such a way that the amount of available oil would be enough not only to meet its main market—culinary—but also the production of biodiesel.

Although at this moment in time palm does not have enough scale to meet the market demand for biodiesel, Embrapa's research with this oilseed has had positive results in adapting it to other environments that are different from the traditional ones in the legal Amazon, where most of palm is harvested [21].

Thus, it is hoped that palm oil will have a much larger penetration in the mix of raw materials for the production of biodiesel and, therefore, provide a greater competitiveness of the sector and increase the income of family farmers, especially those from the north and

northeast. But that will depend as well on the success of policies such as *Propalma—Programa de Produção Sustentável da Palma de Óleo no Brasil*, or the Brazilian Program of Sustainable Palm Oil Production [21].

On the overseas front, the European Union has recently strengthened its position to disfavoring traditional biofuels, such as ethanol from sugarcane and corn, and biodiesel from oilseeds. The maximum demand for these biofuels in energy demand is forecasted to decrease from 7% in 2020 to 3.8% in 2030. This proposal has received harsh criticisms from various sectors of the industry [21], as well as from the scientific community.

At a moment in which the demand for food and bioenergy will continue to grow for the next years as a result of populational growth, increased world income, and the evolution of energy policies toward cleaner and more sustainable sources [21], the European Union position, along with the United States decision to withdraw from the Paris Agreement, raises concerns regarding the immediate growth of biofuels worldwide. On the other hand, Brazil has now a great opportunity to set the stage to confirm its world leadership in the field of biofuels [33].

6. Conclusion

Over the last years, we have noticed that a clear global movement is underway to reduce the use of fossil fuels in order to decrease the GHG emission in the atmosphere and, therefore, limit the rise of the temperature of our planet to 2°C, preferably to 1.5. One of the ways to achieve this reduction is by replacing fossil fuels used in motor vehicles with renewable ones such as biodiesel.

The enactment of the latest and most innovative domestic biofuels policy to date, RenovaBio, establishes a legal framework for its production and use in the country by promoting energy efficiency and competitiveness of the sector through meritocracy.

By allowing greater market predictability for the entire biofuels chain, RenovaBio poises to take this industry in Brazil to new heights by creating more jobs and boosting the economy with major investments from the government and private sectors.

However, there are some problems that may undermine the whole program if not addressed accordingly. For example, at the time of the creation of the Social Fuel Stamp, the focus was put on the social side of the program, neglecting the technical aspects that deemed that initiative a failure, as in the case of castor and palm feedstocks.

Another major problem lies in the technology used to produce biodiesel in Brazil: the transesterification, which is inefficient. Also, the process uses methanol—which besides from being a fossil source, the country still imports a good chunk of it—instead of ethanol, which is cleaner, renewable, and produced from the local sugarcane.

Furthermore, the main raw materials used to produce biodiesel in Brazil (soy and beef tallow) present some environmental problems that are already known by the government and industry experts, largely due to the use of pesticides and herbicides, in addition to GHG from land use and land use change.

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