



## BIODIESEL AND THE ENERGY TRANSITION IN THE STATE OF GOIÁS, BRAZIL

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### ABSTRACT

With the increase in demand for fossil fuels, biodiesel has assumed an important role in the global energy matrix. Brazil has also followed this scenario. One of the states that stands out is Goiás, one of the largest biodiesel producers in the country. Therefore, the objective of this study was to identify the current overview regarding raw materials, installed capacity, production and prospects for biodiesel in the state of Goiás, Brazil. This analysis was carried out using a bibliometric analysis methodology, combined with research in yearbooks and reports about biodiesel. The results showed that Brazil is the fourth largest producer of biodiesel in the world. Goiás is the third largest Brazilian producer, with approximately 1.2 million m<sup>3</sup> of biodiesel in 2023. Highlight for the mesoregions of South Goiás and North Goiás, which together produce 70% of Goiás' biodiesel.

**Keywords:** Biodiesel; Circular economy; Decarbonization; Renewable energy.

### INTRODUCTION

The last few decades have seen a significant increase in the consumption of fossil fuels, despite the reduction in resources, rising prices and pollution associated with this type of fuel. These factors have made biodiesel an excellent fuel to incorporate into the global energy matrix [1].

According to data from the Organization for Economic Co-operation and Development/Food and Agriculture Organization – OECD/FAO, the demand for biodiesel and other biofuels will grow. The global expectation is that biodiesel will play a leading



role in the total fuel consumed by transportation [2]. The International Energy Agency predicts that global demand for biofuels will reach 4.6 million m<sup>3</sup> by 2045 [3].

Following the global scenario, over the next 10 years, Brazil is expected to witness a significant increase in the consumption of fossil fuels such as gasoline and diesel, which will consequently lead to an increase in the use of biofuels. Biodiesel, for example, should be included in fossil fuels through mandatory quotas, established by public policies focused on the energy transition, on meeting decarbonization goals and a circular economy [2].

Goiás is one of the Brazilian states with a leading biodiesel production base in the country. The state has significant economic potential in the biodiesel sector, a fact that is corroborated by the growth of the Brazilian renewable fuel market and policies that encourage the production of biofuels in the country [4]. According to this, the objective of this study was to identify the current overview regarding raw materials, installed capacity, production and prospects for biodiesel in the state of Goiás, Brazil.

## **MATERIALS AND METHODS**

### **The state of Goiás**

Goiás, located in the Center-West of Brazil, in 2022, had a population of 7.06 million inhabitants distributed over 340,111 km<sup>2</sup> [5] [6]. The state is divided into five mesoregions: North of Goiás, Northwest of Goiás, East of Goiás, Center of Goiás and South of Goiás [5]. Mesoregions are subdivisions that bring together municipalities in each geographic area that have similar social and economic characteristics, but that are not an administrative or political entity [7].

### **Steps developed**

Information on biodiesel in the world and in Brazil was obtained from a bibliographic survey with secondary data in scientific articles. For this, the bibliometrix R-Tool was used, a bibliometric analysis methodology that allows the identification of trends in each research area [8]. In this study, the Scopus and Web of Science databases were used [9], considering publications from the last five years. Additionally, yearbooks and reports were sought, given that much updated and consolidated information about biodiesel is in databases external to the aforementioned databases.



## RESULTS AND DISCUSSION

### The global biodiesel overview

Currently, the world's largest producers of biodiesel are the European Union (EU), the United States and Indonesia, with, respectively, 31.3%, 19.2% and 18.9% of the total produced in the world of this renewable fuel. Brazil appears as the world's fourth largest producer of biodiesel, with 11.7%. Together, the EU and these three countries produce 81% of the world's biodiesel [2].

### Biodiesel in Goiás

The main source for producing biodiesel in Goiás, as in Brazil, is soybean oil, with 67% of all raw material used in production. Followed by 17.5% from other fatty materials, 7.1% from beef fat and 6.7% from other sources that include chicken and pork fats, corn and cottonseed oils and used frying oil [10].

Regarding biodiesel production, Goiás has been increasing its production every year. In 2014, the state produced 0.64 million m<sup>3</sup> of B100 biodiesel (100% biodiesel). In 2023, the state's production of B100 biodiesel was 1.18 million m<sup>3</sup> (the third largest producer in Brazil), an increase of 83.8% in the period [10]. However, this percentage is lower than the national growth in the period, which was almost 120%. While in 2014 Goiás produced 18.8% of Brazilian biodiesel, in 2023 this percentage fell to 15.7% (**Table 1**).

**Table 1.** Biodiesel production (B100) in Goiás between 2014 and 2023.

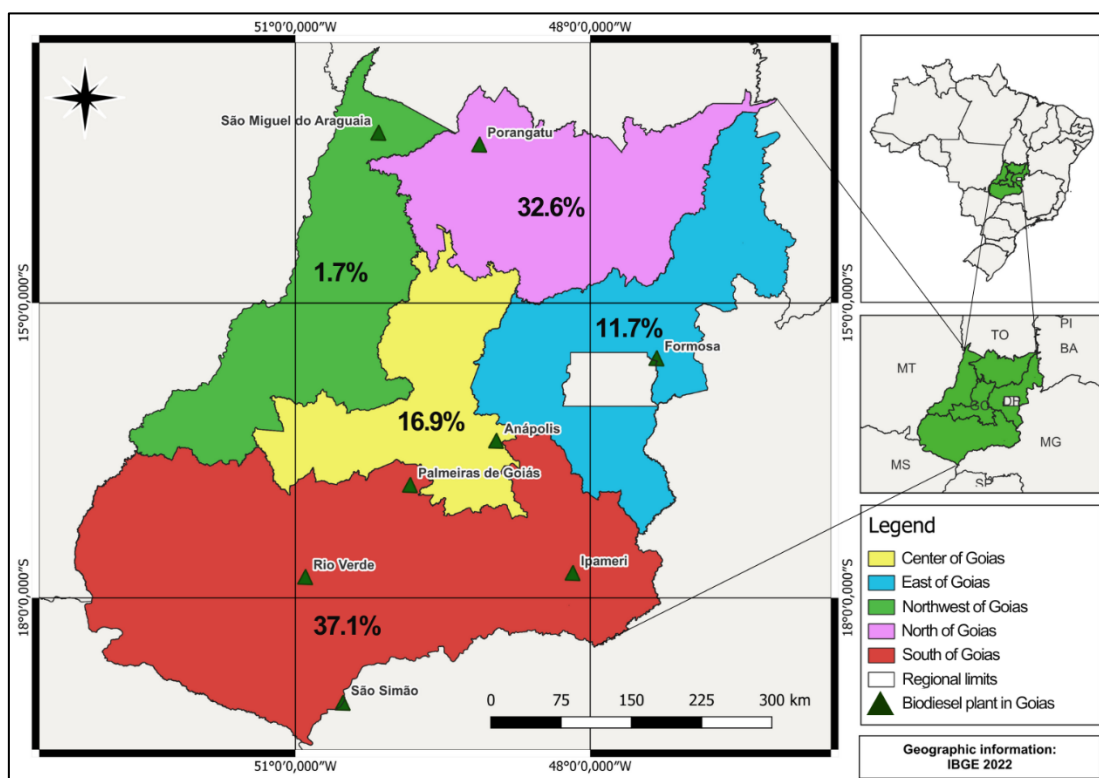
Annual production of Biodiesel (B100) – (in millions of m <sup>3</sup> ) – Goiás									
2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
0.644	0.695	0.650	0.717	0.758	0.865	0.878	0.964	1.104	1.184

**Source:** Own elaboration based on [10].

In terms of total nominal capacity of biodiesel installed in Goiás, according to the map presented in **Fig. 1** it is possible to verify that the mesoregions of South Goiás and North Goiás are those with the largest installed capacity for biodiesel production in the state. Together, these two mesoregions have a production capacity of approximately 70%. On the other hand, the Northwest Goiás region, which has a biodiesel production unit, has the smallest biodiesel production capacity in Goiás, with only 1.7% of the state's total capacity. It is also worth noting that, in 2023, Goiás produced 58.3% of the 2.018 million m<sup>3</sup>. year<sup>-1</sup> of installed capacity in the state.



Currently, Goiás has ongoing requests to expand two of its production units, a factor that should add 164,250 m<sup>3</sup> annually to the state's biodiesel production capacity [10]. The estimated average capital expenditure (CAPEX) for expanding a production unit is R\$ 490.00 m<sup>-3</sup>.year<sup>-1</sup> [11], which represents an annual investment of R\$ 80.5 million for the Goiás biodiesel sector.



**Figure 1.** Installed biodiesel production capacity, by mesoregion of Goiás.

## CONCLUSION

Nowadays, Goiás is the third largest producer of biodiesel in Brazil. Nonetheless, there is room for growth in Goiás' production of this biofuel, given that the state uses just over 58% of its installed capacity to produce biodiesel and that there are plans to expand existing plants.

Another issue that the state needs to evaluate is the disparity in biodiesel production in the mesoregions of Goiás. While the South and North of Goiás are making significant progress in this market, the Northwest of Goiás produces only 1.7% of the state's biodiesel. With the prospect of an increase in the fraction of biodiesel to be incorporated into diesel in Brazil, to 20% by 2030, the biodiesel market is likely to grow.



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