

# Brazilian Economic Impact Analysis Regarding the Biodiesel Market Expansion and A New Business Model of Integrated Catalyst Facility within Biodiesel Facilities

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**Abstract:** This paper sought to analyze from an economic point of view the development of a business model for an integrated production of a catalyst in a complex of biodiesel production in Brazil. This integration should allow a leaner and cleaner production regarding the environmental requisites, and that could be possible to evaluate the economic impact of a real case in Brazilian society. For this, it was necessary a study on the possible business models and technologies applicable to this market and economic analysis tools. It was also necessary a study on the Brazilian biodiesel market, business models, production systems and applicability of input-output analysis to perform an economic study on a real case. Once defined the optimal production model to a real case, there was an experimental analysis of the impact on Brazilian job creation and production (GDP). Additional results show the importance of the Brazilian biodiesel market and economic relevance of study in engineering and business. The results of this work are of utmost importance in future economic studies in engineering and business, in the biofuels market or elsewhere.

**Key words:** biodiesel, input-output model, catalyst, economic analysis

## 1. Introduction

Currently, just over 80% of global energy comes from fossil sources and only 8% of the remainder is represented by biofuels (EIA 2013 [1]). However, rising prices of fossil fuels is altering the economic and energy outlook, beginning the gradual withdrawal of the oil era, and for Sachs [2], this final stage is not determined by the depletion of the resource, but justified for reasons economic, political and environmental.

In this context, the Brazilian government created in 2004 the National Program for Production and Use of Biodiesel (NPPB), or in Portuguese, Programa Nacional de Produção e Uso do Biodiesel (PNPB), which consists of an interagency program of the

Federal Government, which aims to implement sustainable way, both technically as economic, production and use of biodiesel, with a focus on social inclusion and regional development by generating employment and income.

## 2. Motivation and Objectives

This article aims to assess the impacts on domestic production and employment generation given the increased demand for biodiesel in Brazil using the economic input-output analysis, formulated by Wassily Leontief in the 1930s and further developed by Miller and Blair (1985) [3], which describes the circular income flow among the productive sectors of the economy and has been widely used in various studies on applied economics [4].

Furthermore, this article intends to measure the impacts of those same differences when comparing a scenario where it is produced nationally the sodium

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methylate catalyst, which is the preferred on used for the production of biodiesel in Brazil, compared to the scenario in which it is fully imported.

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### 3. The Brazilian Biodiesel Market and Trends

The first regulatory framework to introduce a mandatory blending of 2% biodiesel in diesel (B2) was established in 2008, providing a good investment environment in the sector and contributing to the rapid growth of demand for Brazilian biodiesel. In 2010 enters into force B5 blend, or 5% biodiesel in diesel, which marks a new era for this biofuel producers, this mark remains until today. In Fig. 1 you can see the evolution in the volume of biodiesel produced from 2005 to 2012.

For this work, it was considered a scenario of a new regulatory framework for 2014 of 6% (B6). With this, there will be a shock in the final biodiesel product demand, in other words, it will require a production of 3.114 billion liters of biodiesel or R\$6.277 billion, assuming that biodiesel is the main product produced by biodiesel industry.

The sodium methoxide or sodium methylate is one of the major catalysts used in the Brazilian market for accelerating the reaction of alcohols with oils to produce biodiesel, glycerin and other byproducts. For this study it was considered that the entire market uses sodium methylate as the preferred catalyst. Still, it

was considered a scenario with total domestic production of sodium methylate as early as 2014, so it was possible to compare it with the same scenario with this catalyst being imported.

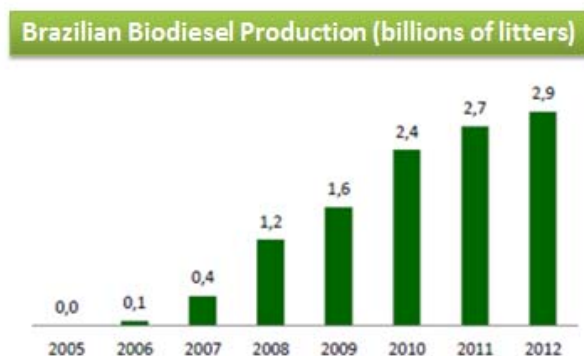
### 4. The Main Impacts due Business Model and Technology Changes

The input-output model, formulated by Leontief, as said, describes the circular flow of the income among productive sectors. The basic design of this model is initially to identify the productive sectors of the economy, the agents that make up the final demand and primary factors of production.

An eighteen aggregated economy sector matrix, named Intersectoral Transactions Matix, was kindly provided by CUNHA was used on this project. The eighteen aggregated sectors are: Biodiesel, Diesel, Oil, Soy Oil, Cane Sugar, Soy, Other Agriculturals, Petroleum, Natural Gas, Food & Beverage, Refinery, Alcohol, Fertilizers, Other chemicals, Transformation, Commerce, Trucking and Other Services. The shock vector used in final demand was R\$6.277 billion in the biodiesel industry.

To measure the effects on final demand and employment generation due to shock in demand for biodiesel, the new matrix of intersectoral transactions was calculated after switching production of sodium methylate national replacing imported, assuming that in 2008 all sodium methylate was imported, there will be an increase in the consumption of the chemical industry for the biodiesel sector, a reduction of imports by the biodiesel industry and an increase in consumption of imported goods by the chemical industry. These changes are called changes in technology by input-output methodology, since the changes directly affect the use of biodiesel production technology industry.

Therefore, given the shock in final demand in biodiesel industry at R\$6.277 billion, it was possible to calculate the total effect on the production of R\$19.763 billion and employment generation of 114,794 jobs. It was also observed that 72% of the total effect on



**Fig. 1 Clear Line Drawings Are Essential Brazilian Biodiesel Production in Billion Liters [5]**

production is reflected by the soybean chain (Soybean, Soybean Oil and Biodiesel itself) and on the employment side, the largest amount of job generation reflection is given in service sectors (Trade, Transport and Other Services) accounting for 74% of job creation. The direct effects on production accounts for 60% of total production, probably by the effects of the soy chain, and on the point of view of employment generation, the indirect effects reach 83%, probably due to the services that are provided to support the soy chain.

When it is produced sodium methylate nationally, it is needed to alter the intersectoral transactions matrix. Therefore, assuming an exchange rate of R\$ 2,00 per U.S. dollar, it is possible to calculate and compare the effects of producing the catalyst nationally with imported catalyst. These results shown in Table 1 demonstrate the positive impact of producing the catalyst nationally.

**Table 1 Results of Difference Between Produce Sodium Methylate Catalyst Nationally and Import It Considering the Impact on Final Demand for Biodiesel**

Total Production Demand due Shock	178.89 R\$ millions
Direct Production	93.78 R\$ millions
Indirect Production	85.11 R\$ millions
Total Jobs Demand due Shock	935.02 R\$ millions
Direct jobs	15.03 jobs
Indirect jobs	919.99 jobs

The effects on production and employment are positive, the first being approximately R\$179 million and the second of 935 jobs, both numbers are in addition on the scenario of imported sodium methylate. Observe a balance between direct and indirect effects in terms of production; however, when it analysed the direct employment, there is a low proportion with regard to indirect employment, likely to be a capital-intensive sector.

## 5. Conclusion

On this article it was evaluated the impacts on eighteen sectors of the Brazilian economy as a result of a new regulatory framework designed for 2014, the B6, using an input-output model with 2008 data and present trends. As a result of this shock of R\$6.277 billion on biodiesel sector, it was possible to predict the total effect on the production of R\$19.763 billion and employment generation of 114,794 jobs in Brazil.

From this model, also two scenarios, one without the consideration of production of sodium methylate nationally, in other words 100% imported, and the second considering this biodiesel catalyst produced nationally. It was concluded that there is a positive balance in the effects of domestic production of sodium methylate of approximately R\$179 Million and additional generation of 935 direct and indirect jobs.

Finally, the author could observe that there is an input-output analysis applicability on an actual case since the expected results are consistent with what was expected in reality and can therefore make use of the methodology to formulate projections of projects still in planning phase that require this kind of analysis for decision making.

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