

## STUDY ON THE DEVELOPMENT OF THE BIOFUEL MARKET AND THEIR FUTURE IN SUSTAINABLE PRODUCTION

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### Abstract

*Considering the current trends regarding the reduction of greenhouse gas emissions, the protection of the environment and the need to ensure food security, as well as the role that biofuels have in achieving these objectives, in this paper we proposed to analyze the evolution of the biofuels market in the period 2010-2022, but also its prospects for the next period. The research methodology assumed both the bibliographic study of the specialized literature, as well as the collection, processing and interpretation of existing statistical data in the internal (INSSE) and international databases (Eurostat, FAO), which were the basis for formulating the conclusions regarding the future evolution of the biofuels market. At the same time, community documents were presented and analyzed that regulate the use or reduction of the consumption of biofuels, in the perspective of achieving some objectives of a neutral continent. Thus, it can be seen that both at the world level and at the community level, in the period 2010-2022 there were increases in both production and consumption of biofuels, with the exception of the period 2020-2021, when due to the Covid-19 pandemic decreases were recorded. Worldwide production increased by 223% in 2022 compared to 2010, and consumption increased by 119%. At the community level, production increased by 125%, and consumption by 117%. These increases in turn influenced price increases. Regarding the estimates for 2027, at the European level, the directives related to environmental protection and the reduction of greenhouse gas emissions will have the effect of reducing production and consumption. At the level of other developing countries, the production and consumption of biofuels will continue to be supported through financial aid.*

**Key words:** biofuels, production, consumption, sustainability, future

### INTRODUCTION

The crises that the world has gone through in recent years (Covid-19, the war in Ukraine) are a reason to once again discuss the issue of ensuring the necessary energy and fuel at the local and global level, but at the same time respecting the policies and measures to protect the environment, reduce pollution and reduce greenhouse gas emissions and ensure food security [9, 17]. In these conditions, biofuels, together with other alternative sources of energy, represent a solution for a global economy in continuous development. Biofuels are obtained by processing organic raw material or waste, being one of the renewable sources of energy to which humanity currently has access and which can be used in a mixture with ordinary fuels (gasoline, diesel) [13, 16, 22]. They can be solid, coming from agricultural or forestry

plant residues, food plant residues, woody, fibrous, cork residues or other products resulting from agricultural and forestry activities [1, 8, 19]. Liquid and gaseous biofuels are bioethanol, biodiesel, biogas, biomethanol, biohydrogen, synthetic biofuels, etc., they have the advantages of reducing carbon emissions due to the fact that they emit less CO<sub>2</sub> when burned, because they have a low cost due to the sources of origin and are biodegradable, which makes their use much more environmentally friendly [21]. There are other advantages related to the creation of green jobs, increasing profitability, supporting the development of local communities, etc. [15, 18]. Obtaining biofuels, however, requires a large consumption of water, and their caloric capacity is much lower than that of conventional fuels, which represents disadvantages related to their use. However,

their use remains a source of reducing pollution, reducing global warming and stopping the consumption of the Planet's resources. Along with the other sources of alternative energy, which just a few years ago humanity didn't even think they could have access to, biofuels represent a solution, at least in the medium term, but they still generate discussions about their use.

Although in the medium term the consumption of biofuels will increase, this will be due primarily to the economic development of developing countries and less to developed countries, where the use of biofuels is limited on the one hand by the decrease in demand for fossil fuels, and on the other on the other hand, the choice of less polluting alternative energy resources [14].

At the level of the European Union, the use of biofuels was regulated in 2009 by a Directive for Renewable Energy which aimed to reduce carbon dioxide emissions from cars with thermal engines. The directive also regulates the use of agricultural resources to obtain biofuels. Later, new directives (RED3 and FQD4) regulated incorporation rates that influence both production and consumption of biofuels [5].

Through new regulations, the European Union proposes that, starting with the year 2035, the sale of cars with diesel and gasoline engines will be prohibited, which will influence the biofuels market. Although the current EU regulation imposed for 2020 a limit of 95 grams of carbon dioxide/km in terms of emissions at the level of a manufacturer's fleet, through a plan called "Fit for 55" it is foreseen that CO<sub>2</sub> emissions for cars will be reduced compared to 2021 by 15% by 2025, respectively 37.5% by 2030. The plan also estimates that by 2030, 11% of Europe's car fleet will be made up of electric cars, and by 2050, 54 %, which will lead to the decrease of the biofuels market [4]. To achieve the objective of a neutral continent, from the point of view of CO<sub>2</sub> emissions, the E.U. considers that the car fleet should be made up of electric cars and hybrid cars with emissions of a maximum of 50 grams of CO<sub>2</sub>/km, which

by 2050 should have a share of between 88% and 99% of the total.

Meanwhile, new challenges have appeared, such as the war in Ukraine which had a direct impact on the supply chain of agricultural products, due to the fact that it is one of the largest agricultural producers in the world, or the drought which in recent years has affected the large countries producing agricultural products, both from the European Union, but also from other parts of the world, which calls into question the ability of agriculture to ensure the food resources of mankind. In these conditions, the use of agricultural potential to obtain biofuels is considered unfair by environmental organizations, and at the level of the European Union, these organizations plead for the abandonment of mandatory quotas for biofuels (8% in the case of gasoline and 6.5% in the case of diesel) [3]. On the other hand, it is considered that the cutting of forests for the production of biofuels has a much greater negative effect than the production of greenhouse gas emissions.

In other regions of the world, however, at the moment there are still attractive policies related to the use of biofuels, especially renewable diesel, (USA) or financial incentives are granted for their production (India, Indonesia and Brazil), which also encourages consumption.

Therefore, the current growth of the biofuels market is still uncertain.

## MATERIALS AND METHODS

The research methodology primarily involved the analysis of specialized literature on biofuels and the legislative aspects regarding their use and the reduction of production and consumption of biofuels, with the aim of protecting the environment. In the second part of the research, starting from the information taken from the internal and international databases, processed and analyzed with the help of statistical methods, we were able to establish the conclusions regarding the production and consumption of biofuels, both at the global level and at the level community

and national. The growth rates of consumption, production, net trade or prices were analyzed with the help of indices with a fixed base or with a chain base, by using the following indicators:

- The dynamic index with a fixed base was used to determine the value of the increases or decreases recorded in the period 2010-2027:

$$I_{v/1} = \frac{y_t}{y_1} \times 100 \dots \dots \dots (1)$$

- The dynamic index based on the chain was used to determine the value of the increases or decreases recorded from one year to another, in the period 2010-2027:

$$I_{v/t-1} = \frac{y_t}{y_{t-1}} \times 100 \dots \dots \dots (2) [2].$$

## RESULTS AND DISCUSSIONS

Statistical data show that after the COVID-19 pandemic in 2020 caused a decrease in global fuel consumption (estimated at 8.5%) and which was due to both the traffic restrictions imposed and the reduction of commercial logistics, in 2021 it increased by 7 %, still being below the pre-pandemic consumption.

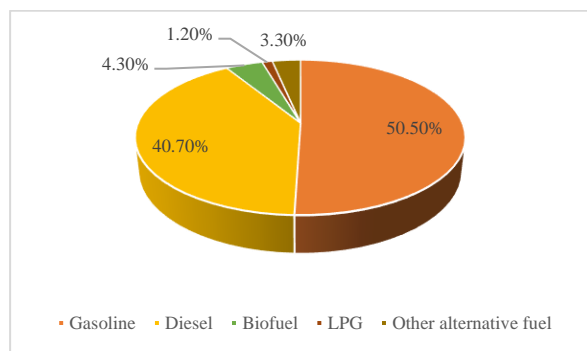


Fig.1. Structure of fuel consumption in 2021  
 Source: own processing based on [11].

The consumption of biofuels also decreased in 2020, the decrease being approximately 8.7%. In 2021, consumption began to increase, so that the consumption of alternative fuels, that is biofuels, electricity, LPG1, NGV2, was 6% higher than the previous year, representing approximately 8.8% of the total amount of fuels used worldwide [20]. If we refer only to biofuels, in 2021 they represented approximately 4.3% of the total fuels consumed worldwide and 49% of the alternative fuels market (Fig.1), this is due to

the increase in demand compared to the hydrotreated vegetable oil (HVO) produced by oil companies. In 2022, the consumption of biofuels increased by 6% compared to the previous year.

The data on the production, consumption and net trade of biofuels (Table 1) reflect the existing situation until 2021, and for the period 2022-2027 the data represent projections, which took into account a moderate forecast. Thus, it can be seen that both worldwide and in Europe, production has continuously increased, with the result that in 2021 the increase compared to 2010 will be 2.23 times higher worldwide and 1.25 times higher in Europe. This increase in production was determined by the increase in demand, which worldwide increased by 119% in 2021 compared to 2010, and at the European level by 16%. What we can note is the fact that in Europe the consumption was permanently higher than the production, which caused the net trade to have negative values in the analyzed period. Supplementing the consumption requirement was achieved on the basis of biofuel imports from large producing countries and areas (China, Brazil, Argentina, USA, etc.). Even at the global level, there were years in which negative net trade values were recorded (2011, 2012, 2015, 2020). As for the projections, they show that starting with 2024, both production and consumption will decrease. If in the case of the production achieved worldwide, the increases from one year to the next were 19% in 2011, 17% in 2018 and 14% in 2016 (the exception being represented by the Covid-19 period which led in 2020 to a decrease of 2% and a return in 2021 of 4%), we note that in the following period a decrease in the production of biofuels determined by the policies of replacing biofuels with other less polluting energy sources is estimated. The same trend can be observed in the case of the production registered and estimated at the European level. Moreover, at the level of consumption in Europe, the forecasts estimate a rate of decrease of 2-3 percent below world

consumption, which is due to the European openness to policies to protect the environment and to replace diesel cars with electric cars. On the other hand, many European countries, although they keep the objectives related to the reduction of greenhouse gases, have taken measures, at least temporarily, to freeze the reduction in the use of biofuels. These measures to reduce the consumption of biofuels belong to developed economies, while developing countries will continue to consume fossil fuels and biofuels, considering their development potential.

In Romania, biodiesel production increased by 39% in 2020 compared to 2019, the amount produced being approximately 292 thousand tons, which represents approximately 1.34% of the amount produced at the level of the European Union (Fig. 2). The major producers are Spain, which produces 19% of the total EU, Germany, which produces 17%, and France, which produces 11%. Because at the level of Romania, consumption is higher than production, the difference being imported from Germany, Austria and Hungary. In 2020,

imports were approximately 56 tons, and in 2019, 27 tons, worth approximately 122 thousand euros [12].

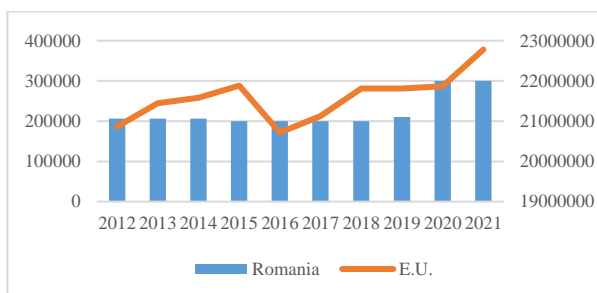


Fig. 2. The evolution of the production capacity of liquid biofuels in Romania and the European Union, in the period 2012-2021

Source: own processing based on [7].

Romania's production capacity was relatively constant during the analyzed period. Compared to the 206,500 tons produced in 2012, the increase was 45% in 2021. At the level of the European Union, production capacity increased by 9% in 2021 compared to 2012. Although the growth rate in 2021 for Romania was high, the share of production capacity was 1.3% compared to that of the European Union.

Table 1. The evolution of production, consumption and net trade, in the period 2010-2027

Year	Production		Consumption		Net trade	
	World	Europe	World	Europe	World	Europe
2010	20,486	11,286	20,674	13,573	-	-
2011	24,435	10,423	24,323	13,888	-388.2	-3,563.3
2012	25,930	10,541	26,225	14,210	-761.2	-3,888.3
2013	28,968	11,112	28,279	13,225	434.4	-1,753.8
2014	32,541	12,918	30,217	13,635	1,081.0	-1,334.3
2015	29,294	12,351	30,095	13,510	-1,127.7	-1,123.1
2016	33,299	12,146	33,100	12,180	-665.0	-252.0
2017	34,726	13,617	34,001	13,456	586.3	-66.8
2018	40,705	14,375	38,149	15,041	1,029.9	-1,926.1
2019	44,910	15,339	43,678	16,803	192.5	-2,502.5
2020	43,808	13,641	45,224	15,712	-2,285.2	-3,556.9
2021	45,712	14,104	44,420	15,648	392.8	-1,555.8
2022	47,429	14,266	46,216	15,859	1,212.9	-1,602.8
2023	50,069	14,152	49,343	15,687	725.5	-1,544.8
2024	52,937	13,965	51,706	15,009	1,230.9	-1,053.2
2025	52,876	13,824	51,372	14,544	1,503.1	-737.1
2026	52,727	13,640	51,094	14,034	1,632.6	-411.8
2027	52,543	13,525	50,980	13,885	-	-378.0

Source: own processing based on [10].

The most important increases in the demand for biofuels in 2022 compared to 2021 were

recorded in the USA where the increase was 3.124 million liters/year, in Indonesia where

the increase was 1.786 million liters per year and in India where the increase was of 1.786 million liters/year. And in Europe the increase

in liters was 1.573 million and in Brazil where it was approximately 794 million liters.

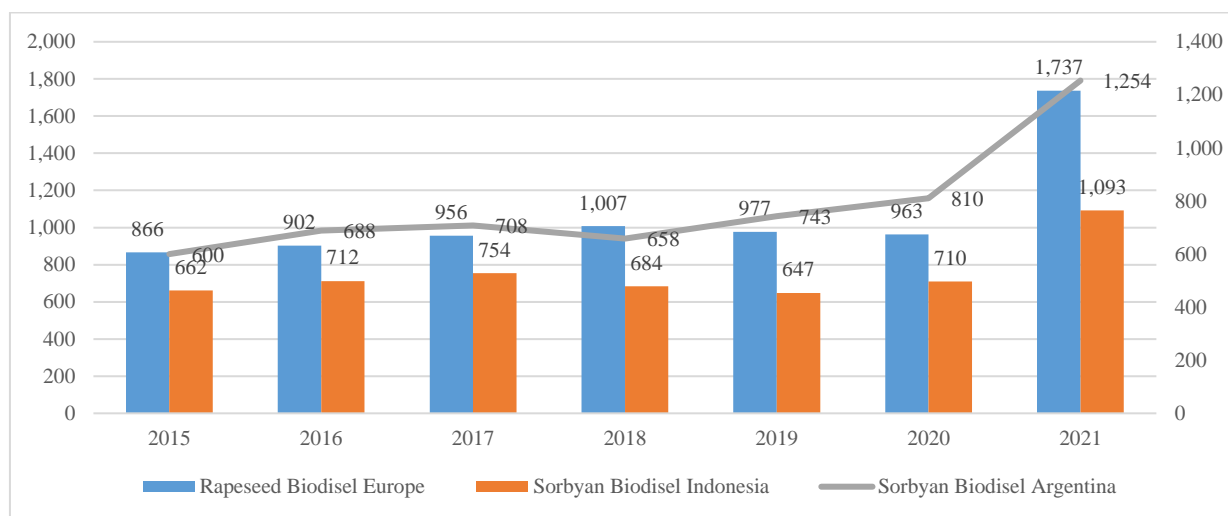


Fig. 3. Price evolution for different categories of biodiesel (US\$/metric ton)  
 Source: own processing based on [10].

As far as prices are concerned, they faced a high volatility that was determined by the crises that the market went through recently (economic crisis, Covid-19 crisis, lack of catalysts, the war in Ukraine). The statistical data show that the biggest price increase, among the 3 variants analyzed, was recorded at Sorbyan Biodiesel Argentina where the increase in 2021 was almost 2.1 times, while at Repesees Biodiesel Europe it was 2 times higher.

Biodiesel Europe, by 53.9% for Sorbyan Biodiesel Indonesia and with 54.8% for Sorbyan Biodiesel Argentina. These price increases came after the 2019-2020 period in which prices decreased due to the decrease in consumption (Fig. 3).

And the price for the different categories of HVO (hydrotreated vegetable oil) increased in 2021 compared to 2020, this being also determined by the high demand for these oils. It is thus established that in the case of HVO fob ARA range, of generation I, II and III, the increases were 47%, 32%, respectively 29%. The production and consumption of HVO also contributed to the increase in global investments in biofuels, which worldwide amounted to almost 8 billion dollars ( Fig. 4). Although America and Brazil had important contributions (approximately 30%), the European Union also has a high share, despite the adoption of regulations regarding the sustainability of raw materials. Given that the estimated consumption for 2025 is approximately 32 million tons, Europe needs approximately 7 million tons.

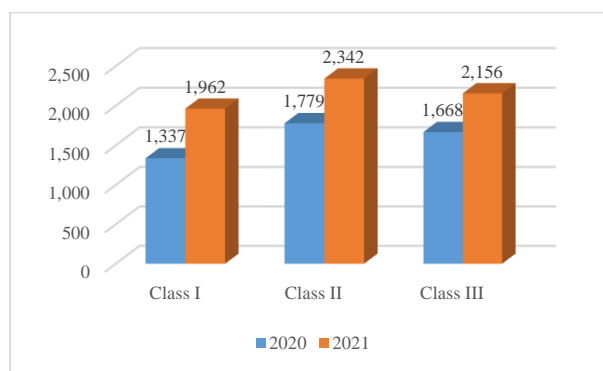


Fig. 4. Evolution of the price of HVO fob ARA in the period 2020-2021 (US\$/metric ton)  
 Source: own processing based on [10].

The price for Sorbyan Biodiesel Indonesia increased 1.65 times in 2021 compared to 2015. The highest rate of price increase was recorded in 2021 compared to 2020, when prices increased by 80.3% for Rapeseed

Although the environmental directives propose reductions in the use of biofuels for road transport, they will continue to be used in other transport sectors, such as aviation or maritime, where alternative fuel sources

cannot yet be used on a large scale. And in the maritime field, there is a European Union proposal called "Fuel EU Maritime" which proposes zero carbon emissions until 2050, which implies the use of fuels with low carbon emissions, which will start to be used from 2025 [6].

## CONCLUSIONS

At the moment we are still in an energy crisis accentuated by the war in Ukraine, which means that at the level of the European Union and at the national level there are contrasting measures regarding the future of energy sources and the way in which the energy requirement you can be assured. Inflation, social crises, political conflicts, make the measures taken at the community level aim to reduce the cost of access to energy, which is why the transition to the use of renewable, more sustainable, but more expensive energy sources ends up being slowed down or postponed. In other countries of the world, large producers of biofuels (USA, China, Brazil, Argentina), the use of biofuels is encouraged through financial compensations (for example, replacing the use of diesel with biodiesel). Therefore, the debates related to the use of biofuels and the place occupied by them in the near future in providing energy sources are still open. Moreover, those who reject the possibility of replacing traditional fuels with biofuels, show that in addition to the ethical problem of using agricultural land for the production of biomass to the detriment of securing food resources, another problem is related to the pollution resulting from the production of biofuels.

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