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## Bioethanol: Renewable energy source

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# BIOETHANOL - RENEWABLE ENERGY SOURCE

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## Abstract

*According to the official document of Romania's energy policy for the period 2020-2030, with a view to 2050, the main objective of the strategy is to increase the energy sector in conditions of sustainability by setting targets for reducing greenhouse gas emissions and promoting renewable energy. In Romania, due to the specifics of each geographical area and environmental restrictions, production systems can be developed by types of renewable sources. The paper presents the importance of using renewable energy for bioethanol production as well as a SWOT analysis to highlight strengths, weaknesses, opportunities and threats regarding bioethanol production in Romania. This type of analysis is useful for decision makers as well as those involved in the value chain for obtaining bioethanol. Considered the most widespread biofuel, bioethanol is a renewable energy source with multiple benefits. The main resources used to obtain bioethanol come from starch raw materials (corn, wheat, potatoes, cassava) to which are added lignocellulosic raw materials in the form of agricultural waste (cereal straw, sugar cane waste, fiber and cotton waste). Renewables currently have a relatively small share in the structure of energy sources in the EU. This requires the promotion of the renewables sector: from legislation to the integration of technologies and the support of innovation in this field.*

**Keywords:** energy policy, renewable energy sources, biofuels, bioethanol

**JEL classification:** Q2, Q20, Q28

## INTRODUCTION

Today, the world's population is consuming more and more fuel than it can produce. This leads to increased use of natural resources and environmental pollution. To meet their growing energy demand, most countries rely on burning fossil fuels, especially coal and natural gas, which lead to greenhouse gas emissions with a major impact on climate change and rising global average temperatures. Due to the diversity of energy resources available and existing technologies in this field, Romania has a high energy potential from renewable sources, sources that can contribute to reducing air pollution and access to clean energy. Also, these renewable energy sources are a source of economic growth and job creation. Bioethanol, the second most renewable energy source after biodiesel used in the transport sector, accounts for 20% of total biofuel consumption [1]. Made from different types of renewable raw materials, bioethanol is one of the viable strategies for replacing fossil fuels and their derivatives and significantly reducing carbon emissions from the air. The aim of this research is to study the key factors that determine the interest in the use of energy from renewable sources, in particular the interest for the production of bioethanol from biomass sources. This paper also provides an insight into the issue of environmental pollution, a better understanding of sustainable energy policies to promote the use of renewable energy sources.

## MATERIALS AND METHODS

The materials and working methods used in this paper refer directly to specialized scientific studies in the field and to the processing of related data as a result of the research conducted. The paper presents directions and policies on the evolution of the renewable energy sector, in particular the use of bioethanol which, together with other biofuels, will play an important role in implementing policies to reduce energy consumption, CO<sub>2</sub> emissions and transform energy needs into renewable sources. Also, a SWOT analysis for bioethanol was conducted, based on the prospects of bioethanol production with an impact on increasing agricultural incomes, creating new jobs and ensuring energy security in Romania. The number of negative or positive aspects resulting from the analysis does not determine the overall evaluation of bioethanol, due to the fact that not all aspects are analyzed

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quantitatively. The results of the analysis are based on tables showing strengths, weaknesses, opportunities and threats.

## RESULTS AND DISCUSSIONS

The Energy Union Strategy launched in February 2015 and approved by the European Council in June 2015 set out priority objectives for the creation of an energy union that ensures security, sustainability, competitive and accessible energy [2]. Through this strategy, the European Union has taken on the role of leading the global transition in combating climate change by providing clean energy. According to the framework strategy launched, in order to achieve the proposed objectives, the Energy Union focuses on 5 interconnected and mutually reinforcing dimensions, which focus on improving sustainability, competitiveness and energy security at Community level:

- Security, solidarity and trust through: diversification of Europe's energy sources, collaboration to ensure a high level of energy security for EU countries, solidarity and cooperation between the main energy producing countries as well as between countries through which energy is transited, ensuring transparency of commercial energy supply contracts and the protection of the confidentiality of sensitive information;
- The fully integrated European energy market by: connecting internal markets through interconnections with a key role for improving security of energy supply, fully implementing and updating existing and related energy legislation, increasing regional cooperation in a common framework enabling the free flow of energy between the countries of the European Union, new benefits for consumers and the protection of vulnerable consumers;
- Improving energy efficiency in order to reduce dependence on energy imports with an impact on reducing gas emissions as well as growth and job creation;
- Decarbonising the EU energy system by using low-carbon energy sources and reducing the use of fossil fuels;
- Research, innovation and competitiveness by promoting advances in innovative technologies that must meet the following conditions: be reliable, secure, sustainable and environmentally friendly.

As a structural element of the European Green Deal, the renewable energy sector is one of the areas of action aimed at stimulating the most efficient use of resources, reducing pollution and restoring biodiversity. Thus, in order to grow a sustainable economy, the European Commission aims for climate neutrality by 2050 and a share of 32% of renewable energy and by 2050 a reduction of greenhouse gas emissions by at least 55% [ 3].

Regarding the share of renewable energy, at national level, the target on the share of energy from renewable sources was recalculated from a share of 27.9% in PNIESC for 2030 to a share of 30.7% [4].

Returning to bioethanol, which is defined as ethanol produced from biomass and/or biodegradable adherents for use as fuel, is a viable alternative to conventional fuel. It can occur from several sources. One source is starchy plants (corn, wheat, barley, oats, rye and starchy potato crops). Another source is made up of plants rich in sucrose (sugars), among which we mention sugar cane, sugar beet and sugar sorghum.

Regarding the annual production of ethanol worldwide, it is observed that the leader in this segment is the United States with a percentage of 53% of world production, followed by Brazil with 30%. At EU level, the cumulative production of the 28 Member States was only 5%, 10.8 times lower than the production recorded by the main bioethanol producer (Table 1).

Also, table 1 shows a decrease in production in 2020 compared to the previous year. These declines can be attributed to adverse weather conditions as well as declining ethanol market demand as a result of global measures to combat the COVID-19 pandemic. Thus, the main producer of bioethanol registered decreases of 11.7% compared to 2019, when the production obtained registered

values of 52.72 mil.kl. And in the case of Brazil, the world's second largest producer of ethanol, there was a decrease in production in 2020, compared to 2019, of 7.7%, with a production of 30.02 mil.kl. Regarding the production of ethanol at the level of the European Union, there is a decrease of 8.9%, registering a production of 4.73 mil.kl.

**Table 1. Annual global ethanol production (mil. Gal./mil. Kl)**

Region	2015	2016	2017	2018	2019	2020	% of world production	% change 2020/2019
United States							<b>53%</b>	<b>-11.7%</b>
Mil.gal *	14,807	15,413	15,936	16,091	15,778	13,926		
Mil.kl	56.05	58.34	60.32	60.91	59.73	52.72		
Brazil							<b>30%</b>	<b>-7.7%</b>
Mil.gal *	7,200	6,750	6,650	7,990	8,590	7,930		
Mil.kl	27.25	25.55	25.17	30.25	32.52	30.02		
EU							<b>5%</b>	<b>-8.9%</b>
Mil.gal *	1,360	1,360	1,420	1,450	1,370	1,250		
Mil.kl	5.15	5.15	5.38	5.49	5.19	4.73		
China							<b>3%</b>	<b>-12.1%</b>
Mil.gal *	770	670	800	770	1,000	880		
Mil.kl	2.91	2.54	3.03	2.91	3.79	3.33		
India							<b>2%</b>	<b>+ 1%</b>
Mil.gal *	190	280	two hundred	430	510	515		
Mil.kl	0.72	1.06	0.76	1.63	1.93	1.95		
Canada							<b>2%</b>	<b>-17.8%</b>
Mil.gal *	450	460	460	460	520	428		
Mil.kl	1.70	1.74	1.74	1.74	1.97	1.62		
Thailand							<b>2%</b>	<b>-7.4</b>
Mil.gal *	310	340	390	390	430	400		
Mil.kl	1.17	1.29	1.48	1.48	1.63	1.51		
Argentina							<b>1%</b>	<b>-17.9%</b>
Mil.gal *	220	240	290	290	280	230		
Mil.kl	0.83	0.91	1.10	1.10	1.06	0.87		
The rest of the world							<b>2%</b>	<b>-4.5%</b>
Mil.gal *	393	487	454	529	522	500		
Mil.kl	1.49	1.84	1.72	2.00	1.98	1.89		
<b>Total</b>								
Mil.gal *	<b>25,700</b>	<b>26,000</b>	<b>26,600</b>	<b>28,400</b>	<b>29,000</b>	<b>26,059</b>		
Mil.kl	<b>97.29</b>	<b>98.42</b>	<b>100.69</b>	<b>107.51</b>	<b>109.78</b>	<b>98.64</b>		<b>-</b>

Source: \*RFA analysis of public and private data sources; <https://ethanolrfa.org/statistics/annual-ethanol-production/>

In Romania, the bioethanol energy market is in full development, the first production capacity being put into operation since 2008 in Brăila. At national level, bioethanol is obtained from plant cultures that contain large amounts of sugars or components that can be converted into sugars (starch or cellulose). The agricultural energy resources underlying the production of bioethanol are: cereals (corn, wheat, barley, rice), sugar beet, sweet potatoes, sweet sorghum, sorghum grains.

Regarding the potential for bioethanol production at national level, it is noted that in 2019 the wheat surplus was 5.31 million tonnes, the production potential of bioethanol being 2.1 million kilotons. Also, in the case of maize, the production surplus was 6.13 million tonnes, so that the production potential of bioethanol would be 2.5 million kilotons. Thus, it is found that the total production of bioethanol from wheat and corn would be 4.6 million kilotons. This fact can rank Romania close to the total productions registered at EU level in 2019 (Table 2).

**Table 2. Bioethanol production potential in Romania**

Year	Wheat		Maize		Total bioethanol production (wheat + corn) (mil. kilotone)
	Surplus (mil. tons)	Bioethanol production potential (mil. kilotone)	Surplus (mil. tons)	Bioethanol production potential (mil. kilotone)	
2017	4.60	1.8	3.31	1.4	3.2
2018	5.19	2.0	4.26	1.7	3.8
2019	5.31	2.1	6.13	2.5	4.6

Source: trademap statistical data processing, accessed April 2021

In order to have an overview of the future prospects for renewable energy that Romania should undertake in this paper, using the SWOT analysis methodology, the strengths, weaknesses, opportunities and threats to bioethanol processing in Romania.

### A. Strengths

- Romania promotes a favorable policy for the production and use of bioethanol.
- The use of bioethanol reduces the dependence on imports of fossil fuels, contributing greatly to energy independence, reduces air pollution and thus global climate change caused by the greenhouse effect, contributes to job creation and encourages the development of the economy in areas rural.
- Bioethanol can be produced from various raw materials (sugar, starch or cellulose), which allows crop diversification.
- Existing technologies can be used to grow sucrose and starch-rich plants.
- A wide variety of raw materials are used to produce bioethanol from cellulose due to the fact that many plants contain significant amounts of cellulose. The raw materials also come from non-food crops that prevent soil erosion and protect the soil water.
- Crops intended for bioethanol capture CO<sub>2</sub> and remove oxygen until harvest.
- Some plant residues resulting from the process of obtaining bioethanol can be reused for heating.
- Bioethanol can be mixed with gasoline in any proportion.
- Bioethanol used as a fuel has a higher octane number than gasoline, with an effect on reducing fuel consumption and increasing electricity.
- Ethanol combustion results in low CO<sub>2</sub> emissions.
- Compared to fossil fuels, bioethanol is biodegradable.
- In small amounts, ethanol is not toxic to humans and the environment.

### B. Weaknesses

- High raw material costs for crops with high sucrose and starch content, especially through the use of large quantities of fertilizers and disease and pest control substances.
- The process of processing ethanol from cellulose-rich crops is more expensive because it requires higher energy consumption.
- The use of bioethanol on a larger scale can create problems related to deforestation and food security of the population. This may be due to the replacement of agricultural crops for human and animal consumption with agricultural crops for biofuels.
- Quite large financial investments are required for the production of bioethanol.
- Bioethanol used as a fuel cannot be used in a large percentage for old cars and should be avoided in aviation, motor boats or seagoing ships.
- At low temperatures, cars that use pure bioethanol E100 start much harder, which is why ethanol mixes with gasoline in various proportions.

### C. Opportunities

- Development of the research and development sector in the field of biofuels.

- The positive effects on the environment of the use of biofuels can lead to the establishment of mechanisms to stimulate the production of raw materials for obtaining bioethanol and tax facilities for both agricultural producers and bioethanol processors.
- Romania may be one of the EU countries exporting bioethanol.
- By supplying the production capacity of bioethanol plants with raw materials from local sources, the opportunity arises to develop additional business in the value chain in rural areas.
- In Romania there is a possibility that agricultural productivity will increase, which may lead to a decrease in production costs for raw materials used in bioethanol processing.

#### **D. Threats**

- The raw materials used to obtain bioethanol from starch and sugar come from food crops, which can lead to food insecurity.
- The share of energy for processing ethanol from cellulose-rich crops is higher than the processing of ethanol from crops rich in sucrose or starch.
- The use of large amounts of fertilizers and pesticides in crops used to obtain bioethanol, which can lead to soil and air contamination.
- Given that the legislation on the use of bioethanol is not very precise, it is possible that its distribution will be limited.
- By using raw materials from cellulose-rich crops, there is a risk that these lands will be deforested, with serious consequences for landslides.
- Through the large-scale use of cereals to obtain bioethanol, there is a possibility that their price will increase at a rapid pace.

### **CONCLUSIONS**

In order to mitigate the threats posed by climate change, which continue to pose a danger to human security, sustainable agricultural solutions that are economically and ecologically viable must be promoted.

Being a 100% biological energy source, bioethanol is considered a renewable energy source that provides a sustainable environment by reducing carbon dioxide emissions with an impact on climate change control.

As a result of this study, we can mention the following conclusions:

- Bioethanol has a number of advantages that place it among the main sustainable and renewable energy resources. The main advantage of bioethanol is that it reduces dependence on fossil fuels, which can be replaced with fuels from renewable plant sources.
- Intensify investments in the development and modernization of bioethanol production capacities for better integration of energy from renewable sources.
- Implementation of mechanisms to stimulate the production of bioethanol through legislative interventions to support both agricultural producers of raw materials needed to obtain bioethanol and bioethanol producers.
- The SWOT analysis presents some considerations for the development of the bioethanol processing sector which may be viable arguments for a future strategy of Romania's industrial policies, including energy policy.

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