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# Potential contribution of bioethanol fuel to the transport sector of Vojvodina

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ABSTRACT

The Autonomous Province of Vojvodina is an Autonomous Province in Serbia and it is an energy-deficient country. The indigenous reserves of oil and gas are limited and the country is heavily dependent on the import of oil. The oil import bill is a serious strain on the country's economy and has been deteriorating the balance of payments situation. The country has become increasingly more dependent on fossil fuels and its energy security hangs on the fragile supply of imported oil that is subject to disruptions and price volatility. The transport sector has a 26% share in the total commercial energy consumption in Vojvodina. About 0.62 million tons of gasoline were consumed by this sector in 2008. Gasoline consumption in the transport sector is also a major source of environmental degradation especially in urban areas. Consequently, Vojvodina needs to develop indigenous, environment-friendly energy resources, such as bioethanol, to meet its transport sector's energy needs. Vojvodina produces about 3 million tons of sugar beet every year. There is a vast potential for bioethanol production from molasses of sugar beet in the country. Bioethanol can be used in transport sector after blending with gasoline, in order to minimize gasoline consumption and associated economical and environmental impacts. This paper presents the assessment of the potential contribution of bioethanol in the transport sector of Vojvodina. It is concluded that 20% of annual gasoline consumption in transport sector could be met from ethanol by the year 2026.



**Contents**



## 1. Introduction

The Autonomous Province of Vojvodina is an Autonomous Province in Serbia, containing about 27% of its total population according to the 2002 census. It is located in the northern part of the country, in the Pannonia plain. Vojvodina is an energy-deficient province. The indigenous reserves of oil and gas are limited and the country is heavily dependent on the import of oil. The oil import bill is a serious strain on the country's economy and has been deteriorating the balance of payment situation. The country has become increasingly more dependent on fossil fuels and its energy security hangs on the fragile supply of imported oil that is subject to disruptions and price volatility [1–3].

Transport system is an important element of the enabling environment for economic growth. Regions with adequate means of transportation have grown economically and those lacking in this vital field have historically lagged behind. In Vojvodina, the transport system consists of roads and railways transport services. Among these, road transportation is not only the most popular and

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widely used; it is also the only mode, which is available to most of the population. Road transport is a backbone of Vojvodina's transport system. The road traffic – both passenger and freight – has grown much faster than the country's economy [4,5].

The consumption of fossil fuels in the transport sector is a major source of environmental pollution in the country. Air pollution from the use of gasoline and diesel oil in the transportation vehicles is increasing with the increasing number of vehicles. Most motorcycles and rickshaws, due to their two-stroke engines, are the most inefficient in burning gasoline fuel and contribute most to emissions. This is adversely affecting the quality of air, especially in the metropolitan areas.

Air pollution, as global problem of the whole mankind, provoked programmed and systematical investigations of air in the area of Vojvodina, which was oriented to the following of trends of contents of specific polluters, estimation of effects of the polluted air on health aspects of population, nature and material resources, introduction of the preventive measures, informing of publicity and increasing of the level of consciousness of population [6]. In the region of Vojvodina, systematic measurements of emitting of general and of specific polluters, quality of air in many settlements is followed. The average yearly concentration of CO in air of the capital city of Vojvodina, in the centre of Novi Sad, is 0.19 $mg/m^3$, and its highest concentration reaches even 3 $mg/m^3$. Maximal lead content is 0.45 $\mu g/m^3$, while yearly average was 0.3 $\mu g/m^3$. Annual average concentration of $SO_2$ is 8 $\mu g/m^3$, and that of $NO_2$ 10 $\mu g/m^3$. These data once more confirm fact that the transportation represents the extremely potent air polluter and source of emissions of harmful gasses [7,8].

In May 2000 the European Commission presented a proposal for a directive on the promotion of electricity from renewable energy sources in the internal electricity market, setting out targets for member states on generation of electricity from renewable energy sources as a proportion of gross electricity consumption by 2010. In order to promote the use of renewable energy, the Commission adopted the "Green Paper" [9].

In the area of the common agricultural policy and the rural development policy, Agenda 2000 [10,11] invites member states to encourage renewable energy sources. Biomass, in particular, must be developed by all available agricultural, fiscal and industrial means. The key recommendation of the European Conference on Renewable Energy was that the European Union should set a new medium-term target: renewable sources should satisfy at least 20% of energy consumption by 2020. For example, despite the broad potential for biomass in Spain the resources are underused and biomass energy therefore offers a magnificent development opportunity which should be encouraged in coming years. In this way it is hoped that electricity self-sufficiency can be achieved by 2010, 51% of which will come from wind power, with a saving of 4000 ktons in primary energy, and avoiding emissions of about 12 million tons of $CO_2$ per year [12].

Consequently, Vojvodina needs to develop indigenous, renewable and environment-friendly fuels to meet its transport sector are growing energy needs. Ethanol (bioethanol) is one such fuel. There is a vast potential for bioethanol production from molasses of sugar beet in the country [13]. Industrial bioethanol is produced through fermentation of molasses and subsequent distillation. It is then converted into fuel bioethanol through molecular sieve technology. Fuel bioethanol can be used in transport sector as pure bioethanol or after blending with gasoline (gasol). Bioethanol has a calorific value of 29.6 MJ/kg. The comparison of energy content of different fuels is shown in Table 1.

**Table 1**
Comparison of energy content of different fuels.

| Fuel | Energy content (MJ/kg) |
|---|---|
| Gasoline | 46.4 |
| Diesel | 45.6 |
| Bioethanol | 29.6 |
| Methanol | 19.7 |

This paper presents an overview of fuel consumption patterns and the potential contribution of fuel bioethanol in meeting the energy needs of the transport sector of Vojvodina.

## 2. Energy consumption patterns in the transport sector of Vojvodina

Transport sector is one of the major consumers of commercial energy in Vojvodina. The share of transport fuel in total final commercial energy consumption has 26.2% in 2007.

Crude oil production in Vojvodina in the year of 2008 amounted to 0.636 million of tons, what was insignifficantly less than in the year of 2007 (0.647 million tons). Total importation of oil and oil derivatives for the needs of Vojvodina in 2008 was 0.881 million tons, what is for 2.3% less if compred with the year 2007 (0.915 million tons). Total assured quantity of domestic and imported crude oil and of imported oil derivatives for Vojvodina's needs in the year of 2008 amounts to 1.562 million tons, what is for 2.4% less than in the year 2007 (1.617 million tons). Processing of the crude oil and finishing of semi-finished products for the year of 2008 amounts 3.452 million tons, what is for about 1.7% than in the year 2007 (3.546 million tons). Of the total quantity of oil derivatives, which are obtained in oil refineries in Vojvodina, in Vojvodina are consumed some 43%. Projected consumption of oil derivatives in the year 2008 amounts to 1.511 million tons, what is for 3.1% more than in the year 2007 (1.528 million tons). Consumption of the oil derivatives as the transportation fuels in the year 2008 amounts to 0.620 million tons, what is for about 2.4% higher than in the year 2007.

It is realistic to expect that the production of oil would be kept on the current level for the prolonged period of time. The largest part of the domestic oil stems from geological reserves of oil and gas in Vojvodina, which contribute with some 90% of the total countrysupstrat reserves. The needs of the crude oil are considerably higher than the domestic reserves, and it can be expected in the future period that the differences between the produced and the necessary quantities of the oil in the country will be even more and more greater. This problem is resolved with imports of oil and, to some degree, with the exploitation of oil wells situated abroad. Differently from the exploitation of the domestic emplacements, whose level stagnates, foreign oil exploitation grows from 1 year to another, so that the domestic production is even more and more supplemented [14].

Projection of the needs of motor gasoline in Vojvodina till the year 2026 is outlined in Table 2. The needs for motor gasoline have special importance, as its substitution with bioethanol can be predicted. Projection of gasoline need in subsequent years indicate the evident increase, so that the discovering of alternative energy resources obtains high signifficance.

## 3. Potentials of fuel bioethanol production in Vojvodina

Economy of Vojvodina is largely based on developed food industry and fertile agricultural soil that makes up to 84% of its territory. About 70% of agricultural products is corn, 20% industrial herbs, and 10% other agricultural cultures. Other branches of industry are also developed, such as metal industry, chemical industry, electrical industry, oil industry, construction industry, etc. Sugar beet is one of the major crops of the country.

Besides to raw materials shown in Table 3 that can be classified as already conventional raw materials for the bioethanol production, significant are also the non-conventional raw materials that