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PROSPECTS FOR THE USE OF SECOND GENERATION BIOFUELS IN LITHUANIA

Summary. The tightening of environmental requirements for vehicles focuses on measures that can deliver environmental benefits in the short term. One such measure is the use of alternative fuels (fossil fuels) to fossil fuels in the transport sector. This article reviews the trends in the use of this type of fuel and indicates the prospects for their use in the Lithuanian transport sector. It also shows the current trend in the use of biofuels and reveals the prospects for the use of second-generation biofuels.

1. INTRODUCTION

Modern society develops according to the rules of industrialization [1] dictated by the laws of the market [2]. The fuel market is also highly dependent on global economic, political and technological factors [3]. This is also reflected in EU regulations, where the main emphasis is on saving energy resources and using renewable energy sources [4].

The EU White Paper describes a halving of conventional fuel consumption in transport by 2030 and a zero number of conventional cars in cities by 2050 year [5].

Therefore, the focus is on the use of biofuels in the transport sector [6]. Currently, first and second generation biofuels are predominant in the transport sector, therefore it is important to substantiate the viability of their use in the Lithuanian market. The aim of this study is to identify the prospects for the use of second-generation biofuels in Lithuania.

2. OVERVIEW OF THE USE OF SECOND GENERATION BIOFUELS

Ecological problems have been driven by the development of second-generation biofuel production from non-food biomass. Said lignocellulosic raw materials are their by-products, such as sugar cane meal, cereal straw, deforestation waste, municipal waste and vegetative grass, short-growing forests [7].

Energy-producing plants should start to compete with plants grown for food and fiber [8].

The use of second-generation biofuels for commercial use is limited due to technical and economic problems [9]. Production technology in this area has emerged relatively recently, resulting in production capacity of only 0.1% of global biofuel production [10]. Optimizing production and increasing production efficiency requires reliable and stable production technology in order to increase production potential. Oil prices are partly determining the pace of development of second-generation biofuel production. Ecology is a key priority in the transport sector and the transition to sustainable biofuels is inevitable. Technical and economic barriers to second-generation biofuel production are a major problem in preventing the transition to fully commercial consumption [7].

By investing in and improving second-generation biofuel production technology, the process is moving towards increasing commercial use. This would make it possible to phase out first-generation biofuels by replacing them with second-generation biofuels. It is unlikely that the fuel-free industry will undergo drastic changes in the near future, and the trend will continue to be to use first- and second-generation biofuels, increasing the amount of second-generation biofuels in line with established ecological and economic policies [9].

The main tasks of the OECD (Organization for Economic Co-operation and Development) in formulating and promoting national policies are:

• energy supply chain security;
• support for agriculture;
• reducing dependence on fossil fuels
• Reducing greenhouse gas (GHG) emissions.

Second generation biofuel production methods:

Lignocellulosic biofuels are produced using processing technologies:

• biochemical - enzymes and other microorganisms are used to convert the raw materials of cellulose and hemicellulose into sugar, thus obtaining ethanol.

• Thermochemical (BTL method) - this technology produces synthetic diesel, aviation fuel or ethanol, which can be reformed based on Fischer-Tropsch conversion. The process uses pyrolysis / gasification to produce synthesis gas ($CO + H_2$) to produce the aforementioned long-chain biofuels [7].

The technology that uses advance raw material preparation technology is inefficient and expensive. The efficiency of pre-treatment can be maximized by opening the raw cell structure for subsequent hydrolysis, and various pre-treatment options need to be improved [11]. Diluted and concentrated acid processes are close to commercialization, and the AFEX process, which is based on vapor blasting but using ammonia, can provide significant benefits [12].

In order to successfully commercialize second-generation bioethanol and other biofuels, it is necessary to implement technological breakthroughs in biochemical and thermochemical production methods, which would significantly reduce production costs by accelerating investment and deployment. Production technology is constantly evolving, with second-generation biofuels competing with petroleum fuels and first-generation biofuels. It is important to pay close attention to the use of biofuels in aviation, marine and heavy vehicles, which will have limited alternatives after 2020 or later [7].

Second-generation biofuels consist mainly of discarded biomass, ie agricultural and forestry raw materials, sugar cane leaves [13], rice straw [14] and cut grass mass [15]. Agricultural raw materials are lignocellulosic biomass [derived from lignin, cellulose and hemicellulose] as the main raw material [16].

Some biofuels with higher energy content and lower octane number compared to ethanol are butanol. Butanol can be used in pipelines that are low in volatility, low in hygroscopicity, and low in toxicity [17,18].

3. LITHUANIAN CASE STUDY

All data presented in this chapter was analyzed by authors from the official data of Statistic department of Lithuania [19].

The heavy oil products accounted for 73.7% in 2018, although in 2010 this share was lower - 61.3 percent. The share of liquefied and non-liquefied petroleum gas has doubled and the share of light petroleum products decreased by 6.3 percent (Fig. 1).

A fuel and energy consumption in the transport sector increased by 42.4% from 2010 to 2018 years. This was due to an increase in the consumption of heavy oil products (diesel, fuel oil). The consumption increased by 71.2 percent from 2010 to 2018 years (Fig. 2).

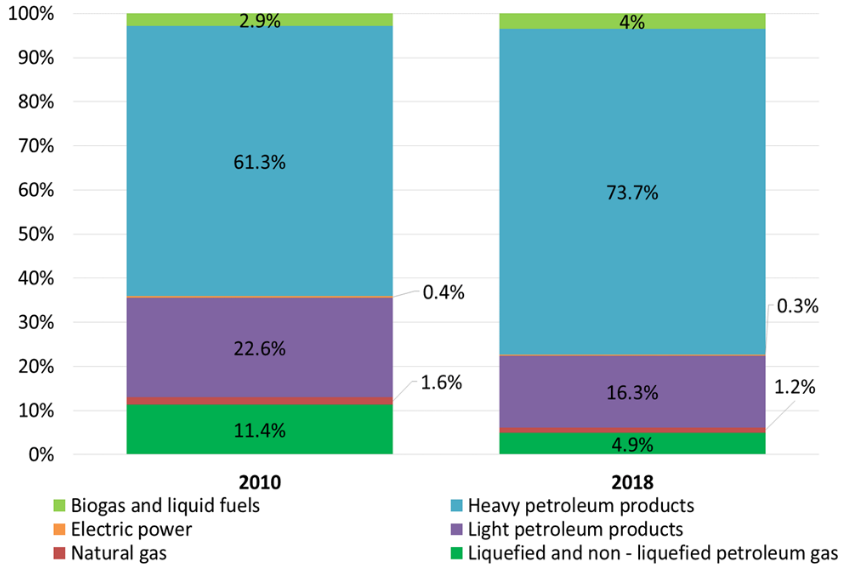

Fig. 1. Structure of final fuel and energy consumption in the transport sector by fuel type

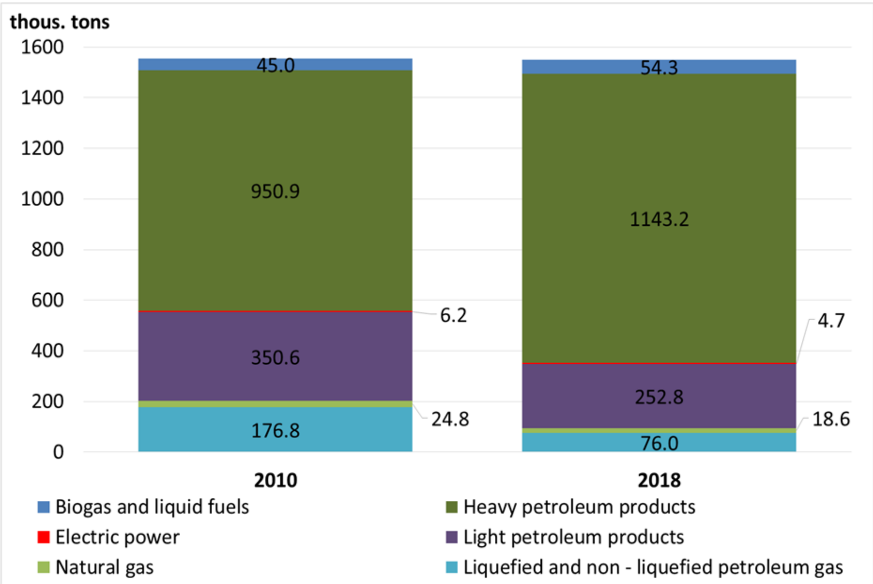

Fig. 2. Structure of final fuel and energy consumption in transport sector by type, thous. TOE (tons of oil equivalent)

Consumption of light oil products (cars and aviation gasoline) from 2010 to 2018 increased by 2.6%, while liquefied and non-liquefied gas decreased by 37.2% (Fig. 2).

The largest consumption of transport fuels is accounted for by the type of fuel - road transport diesel (with biofuels), 74% of 2018 compared to 2010 year. The share of diesel (with biofuels) in road transport increased by 11% (Fig. 3).

The second largest fuel in terms of consumption is petrol with biofuels. T 11% of car petrol with biofuels of calculated on the total amount of fuel was consumed in transport in 2018. The share of petrol with biofuels decreased by 9% since 2010.

The amount of bioethanol in petrol remained almost unchanged during the period under review and amounted to about 5.3% (Fig. 4). The number of biofuels in diesel increased by 0.7% in 2015–2018.

Although these fuels must be blended in higher proportions, the exemptions for blending biodiesel in winter and during transitional periods reduce the overall share.

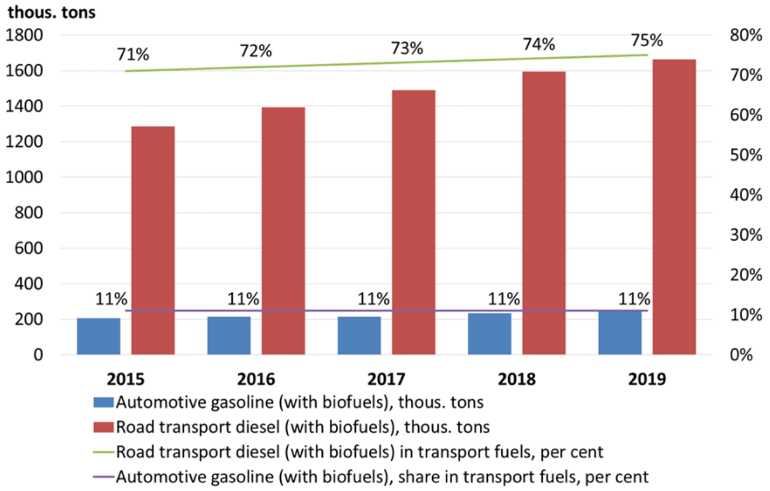

Fig. 3. Consumption of biofuels in transport

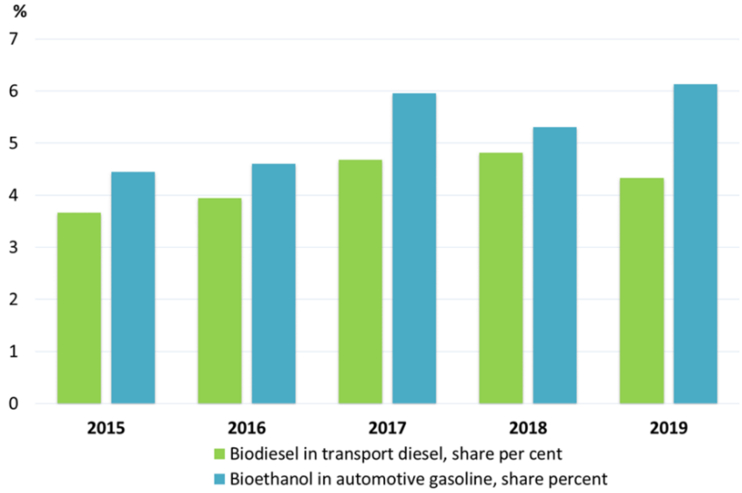

Fig. 4. Share of biofuels in petrol and diesel

The production of second-generation bioethanol was stimulated by Lithuania's commitment to increase the share of renewable resources in the transport sector and the obligation to offer even less polluting fuels. Second-generation bioethanol will use production by-products with starch residues. The second-generation bioethanol produced has been awarded the ISCC (International Sustainability and Carbon Certification) certificate, which confirms that biofuels are produced in accordance with sustainability criteria.

More than half of all palm oil imports into the EU are blended into biodiesel, and the development of the palm oil sector is leading to large-scale deforestation. Thus, the remaining 3% this must be achieved through the use of advanced second-generation biofuels.

The current situation shows that the use of second-generation biofuels in the Lithuanian transport sector has not started, but has a great prospect of making a real big breakthrough in the near future. According to the objectives of the EU Directive [20], the use of second-generation biofuels is an obligation (Table 1) that would bring many benefits to the Lithuanian economy, from the establishment of energy independence to economic benefits by increasing the new fuel production sector.

In Lithuania, only a few fuel suppliers use second-generation biofuels in blends with diesel. HVO (hydrotated vegetable oil) fuels are used for this purpose, which are mixed in a ratio of 15 to 50%, depending on the ambient temperature. But in the general context of fuel consumption, second-generation biofuels make up an insignificant share in Lithuania.

Tab. 1

Targets for the use of first and second generation biofuels by 2030 under Directive 2018/2001

Type of Energy Consumption	Consumption level	The achieved targets to the 2030 period
The first generation biofuels	≤ 7 %	The target includes first-generation biofuels made from food and feed plants with easily recoverable sugars, starch and oil which is accounted to 15 percent primary target.
The Second generation biofuels are produced from feedstocks listed in Part A of Annex IX of Directive 2018/2001	≥ 3.5 %	The target includes Generation II advanced biofuels, which are biofuels made from feedstocks listed in Parts A and B of Annex IX to Directive 2018/2001. This share of biofuels is considered to be twice the energy value of the 15% renewable energy target.
The Second generation biofuels are produced from feedstocks listed in Part B of Annex IX of Directive 2018/2001	≤ 1.7 %	

4. CONCLIUSIONS

1. The development of biofuel production technologies makes it possible to consider them as viable fuels in the transport sector, especially if the source of their production is assessed, i.e. raw materials of non-food origin, the quantities of which are more than sufficient to develop the production of second-generation biofuels in Lithuania.
2. The use of second-generation biofuels in the transport sector is negligible, although both the legal framework and the prevailing global technologies are forcing them to increase.
3. The use of first-generation biofuels in Lithuania is sufficiently well implemented in the transport sector, so further change of biofuel generations from the first to the second will allow easy implementation of the requirements of Directive 2018/2001.

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