ADVANTAGES AND DISADVANTAGES OF BIOFUELS: OBSERVATIONS IN LATVIA

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Abstract. Biofuels have recently emerged as a major issue in energy policy, rural development and natural resource management. The main effort is to improve energy security and reduce greenhouse gas (GHG) emissions. The aim of the study, outlined in the paper, is to investigate the present situation and trends of biofuel development in Latvia, taking into account the sustainability aspects. In order to achieve this aim, several tasks were set: to investigate the biofuel production, balance and consumption trends in Latvia, comparing with other European Union (EU) countries, particularly the Baltic States; to review the latest findings regarding advantages and disadvantages of the first generation of biofuels; to evaluate future perspectives of biofuel development. The materials used for the studies are: scholar papers, regulative documents, reports and data of the EU and Latvian institutions. The suitable qualitative and quantitative research methods have been used for various solutions in the process of study. The results of the study show that: the share of consumption of biofuels in Latvia is higher than EU28 average, and the balance of biofuels is positive; and from the sustainability perspective, biofuels offer both, advantages and disadvantages; taking into account the European Commission regulations that crop-based biofuels are not eligible for any subsidies after 2020, Latvian government and officials should revise the present biofuel policy and support measures. Therefore, some proposals for further development of biofuels in Latvia are offered.

Keywords: biofuels, development, production, consumption, Latvia.

Introduction

In 2009, the EU adopted the Renewable Energy Directive, the so-called RED [1]. The Directive mandates that all Member States shall have 10 % (on energy basis) biofuels in the transport sector by 2020. Biofuel must meet a number of sustainability criteria as described in the Directive, which must also meet, in order to be eligible for financial support, such as tax exemptions. The Fuel Quality Directive [2] sets requirements on fuel specifications, but also obliges fuel suppliers to reduce greenhouse gas (GHG) emissions. By 2020 every unit of energy sold must reduce life cycle greenhouse gas emissions by at least 6 %, compared to the EU average fossil fuel in 2010. The Directive provides the fuel suppliers with a number of options to obtain this 6 % reduction, e.g., via reductions in oil refineries or use of biofuels and alternative fuels. Biofuels must meet the same sustainability criteria as in the RED. The first targets set in 2003 aimed at achieving 5.75 % of biofuels for transport fuels by 2010. But the RED and Fuel Directive revised the targets to 20 % of transport energy from renewable energy by 2020, with only 10 % required to be supplied by biofuels or other “green” transport energies [3]. New EU initiatives require that biofuels must emit a minimum of 35 % less GHG than the fossil fuels they replace and this requirement will increase to 50 % in 2017. Driven by policies aimed at enhancing energy security through the diversification of energy sources, reducing greenhouse gas emissions and accelerating agricultural development, the production and use of biofuels have increased rapidly in recent years. There are, however, conflicting views on the potential benefits of large scale bioenergy production, and recent debates have also drawn attention to a range of environmental and socio-economic issues that may arise in this respect [4].

Therefore, the aim of the study is to investigate the present situation and trends regarding biofuel development in Latvia, taking into account the sustainability aspects. According to the aim, several tasks were set: 1) to analyse production and implementation of biofuels in Latvia, comparing to other EU countries, particularly the Baltic States; 2) to explore different aspects and impacts of biofuel development; 3) to evaluate the future perspectives of biofuel development.

The principal materials used for the studies are as follows: different sources of literature, e.g., scholars’ articles, research papers and the reports of institutions, including the European Commission (EC) and governmental; published and unpublished data from the Central Statistical Bureau of Latvia (CSB), data from Eurostat databases. The suitable qualitative and quantitative research methods have been used for various solutions in the process of study: systematic review; analysis and synthesis; data grouping; comparative analysis; critical appraisal, correlation-regression etc.

Results and discussion

Development of biofuel production and implementation in Latvia

In October 2009, the mandatory 4.5-5 % biofuel blending requirement was introduced in Latvia. Only after the introduction of this measure the share of biofuels in transport has increased notably.

In 2011, the average European share of biofuels was 3.8 % of overall transport fuel consumption, but with a large disparity between the countries, for example, between the countries of the Baltic region [5]. Sweden was clearly in the lead with the share 8.8 % while Estonia ranked last with 0.2 %, but Latvia with 4.8 % had a higher share than EU28 average and exceeded the shares of the other Baltic States. Moreover, comparing the trends of biofuels share in the total fuel consumption in the Baltic States and EU28 average from 2004 to 2011, we can see (Fig. 1) that statistically significant increase of the share can be observed for EU28 average ($r = 0.94$, $\alpha < 0.001$), Lithuania ($r = 0.84$, $\alpha < 0.01$) and Latvia ($r = 0.72$, $\alpha < 0.05$), but decreasing trend, which is not statistically significant, is observed for Estonia.

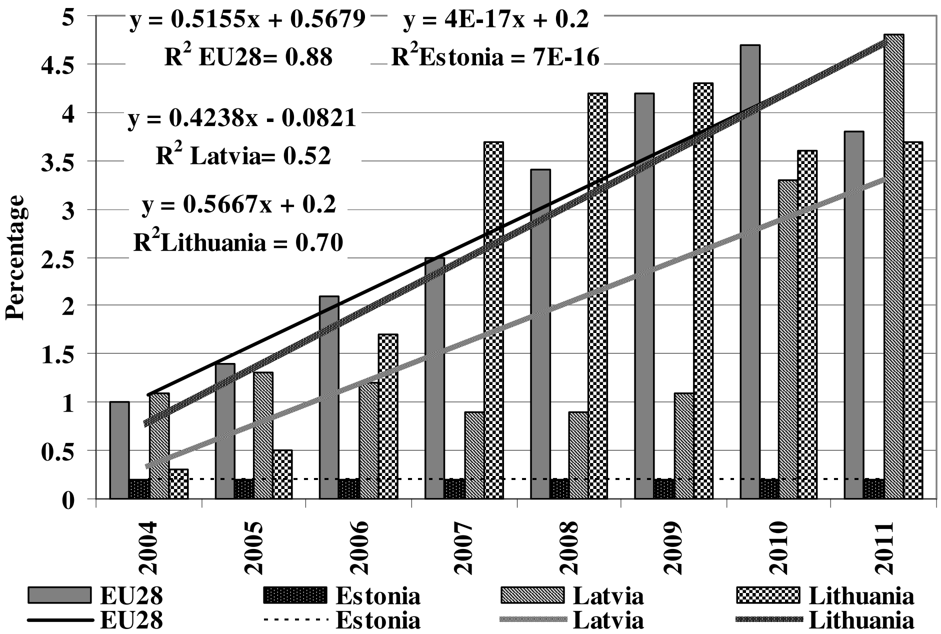

Fig. 1. **Trends of share of biofuels in the total fuel consumption in the Baltic States and EU28 average, 2004-2011 [5]**

The analysis of the biofuel production figures (Table 1) shows that the subsidies actually facilitated biofuel production in Latvia and it mainly took place within the framework of the support quota. The biodiesel production has increased 43 times or by 4310 % from 2005 until 2012. The volume of produced biofuels in 2010 was close to the quota amount set in order to reach the biofuel target in transport consumption, although the actual consumption of biofuels in transport was below the target.

Table 1

Biofuel production and support indicators in Latvia in 2005-2012 [6]

Indicator	2005	2006	2007	2008	2009	2010	2011	2012
Produced amount, thsd. t	2.1	11.7	20.7	39.7	58.5	58.3	55.9	92.1
- bioethanol	–	5.0	11.6	11.6	13.5	14.8	2.0	1.6
- biodiesel	2.1	6.7	9.1	28.1	45.0	43.4	53.9	90.5
Support quota, thsd. t	20.0	29.0	39.0	50.0	62.0	63.2	n/a	n/a
Supported amount, thsd. t	2.3	14.3	25.4	38.9	45.4	49.3	n/a	n/a

After the cessation of the support measure, production of bioethanol has considerably decreased in Latvia, though the produced volumes of biodiesel have grown.

The results of comparing production of different types of biofuels in 2011 in the Baltic States and in the EU27 average show (Table 2) that there is no biofuel production in Estonia; in Lithuania the tendencies of production are similar to EU27, but in Latvia the production of biogasoline is around 6-6.5 times less than in EU27 and Lithuania. However, Lithuania does not produce bioethanol.

Table 2

Production of different kinds of biofuel (% of ktoe) in EU27 (average) and Baltic States, 2011 [7]

Type of biofuel	EU27	Estonia	Latvia	Lithuania
Biogasoline	15.3 %	0.0 %	2.3 %	14.4 %
Biodiesel	70.8 %	0.0 %	94.1 %	85.6 %
Other liquid biofuels	13.9 %	0.0 %	3.6 %	0.0 %
Total	100.0 %	0.0 %	100.0 %	100.0 %

In Latvia, the export of biodiesel has increased from 2008 to 2012 four times (in tons) [8], but the final consumption of biodiesel has decreased in 2012, comparing with 2010 by 22.5 % (Fig. 2). These trends demonstrate that not all produced biodiesel is used in Latvia, a part of it is exported, which makes the state support inefficient, thus compromising the aim of support – to encourage the consumption of biofuels. Even though the production of bioethanol in Latvia has decreased from 2008 to 2011 [8], the volume (tons) of bioethanol in the final consumption has increased due to growing import.

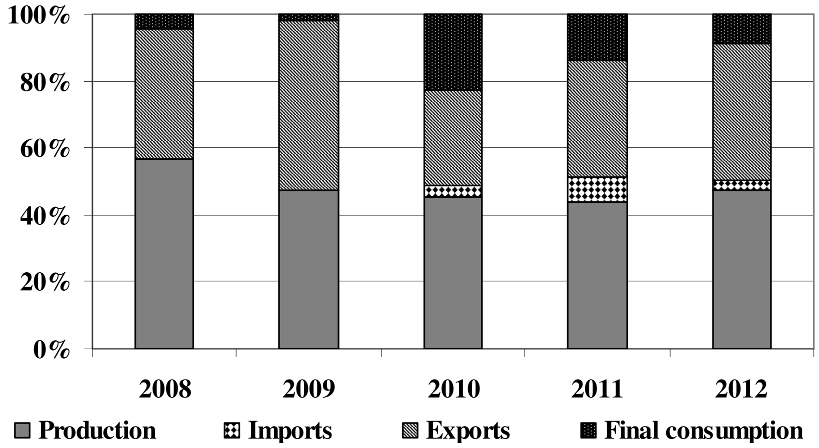

Fig. 2. **Balance (%) of biodiesel in Latvia, 2008-2012 [8]**

In general, the national direct support for the production and use of biofuels, as well as other measures (e.g., minimum biofuels admixture, excise tax rebates) have been effective enough to create and develop the biofuel industry, but it did not ensure achieving the bioufel consumption target by 2010. Despite the fact that during the period 2010 – 2005 the Latvian biofuel producers received direct aid payments of EUR 95.6 million, the share of biofuels in transport to final energy consumption surged in recent years, with only the minimum 5 % admixture of biofuels in fossil fuels, i.e., from 0.48 % in 2009 to 4 % in 2011 [6].

Advantages and disadvantages of first generation biofuels

Bioenergy, particularly biofuels, sustainability is a key aspect of the future energy development. The use of rapeseed biodiesel represents a good opportunity for the achievement of the European goals in terms of GHG emission reductions, considering a saving of emissions, measured in carbon dioxide (CO_2) equivalents, of 56 % respect to conventional diesel [9]. However, this result does not take into account the negative environmental impacts caused by land use changes (direct and indirect), which would lead to GHG emissions, in turn resulting in a decrease in the percentage of the estimated saving [9]. The land use changes and intensification of cultivation following the increased demand for biofuels may cause new GHG emissions and affect the biodiversity, the soil quality, and the natural resources [9-10]. Moreover, Howard et al. [11] affirm that the first generation biofuels are inefficient both in terms of economy and the environment.

Subsidising biofuels and bioenergy with the aim of reducing GHG emissions is a less effective and costlier way of achieving this goal than many other more cost-effective solutions, such as improving the energy efficiency and conservation or encouraging more effective renewable energy options where feasible. The structure of the existing support (sum of biofuel subsidies and farm payments) will not only continue to be significant, but is likely to rise over time [12]. Moreover, taxpayer costs of biofuel and renewable energy policies in general are very high, especially relative to their benefit, which can easily be negative [13].

The feedstocks, which are cultivated as intensive monocultures (as is the case for many important food crops), where the conversion of extensive agricultural systems and natural habitats such as grasslands into intensive monocultures is one of the major threats to biodiversity; non-native feedstocks are also potentially invasive and may have negative impacts on ecosystems; ecosystem services such as soil regeneration, carbon sequestration, natural chemical cycles, pollination and protection against flood may be affected [14].

Some advantages and disadvantages of biodiesel production and usage indicated by different scholars' studies are summarized in Table 3. The results show that biodiesel, with both its advantages and disadvantages, has some good and some bad features, e.g., it is less suitable in low temperatures and attracts moisture.

Table 3

Some advantages and disadvantages of biodiesel production and usage [14-17]

Aspects	Advantages	Disadvantages
Cost	It is made from renewable resources	Currently more expensive than fossil diesel fuel
Energy availability	Fossil diesel fuel is a limited resource, but biofuels can be manufactured from a wide range of materials	Mainly produced from edible oil, which could cause shortages of food supply and increased prices
GHG emission	Significantly less harmful carbon (CO_2*, CO, THC) emission	Reduction of fuel economy
Energy security	Viability of the first generation biofuel production	Conflicts with food supply
Usage	Relatively less flammable compared to fossil diesel	Less suitable for use in low temperatures
	Significantly better lubricating properties	It can only be used in diesel-powered engines
	Significantly less harmful carbon emission compared to standard diesel	More likely than fossil diesel to attract moisture
Air pollution	Significant reduction of PM emissions	Caused increases in NOx
* - different views exist of reduction or increasing of CO_2 emission		

However, Haines-Young and Potschin [14] argue that, in general, the first generation biodiesel, produced from oil crop, waste cooking oil and animal fats is not able to replace fossil fuel.

Further perspectives of biofuels

Under the new EU level proposals [18] there were two restrictions introduced: 1) the share of the first generation – food or agricultural based biofuels will be limited to 5 %, and 2) conditions for support. In the period after 2020 biofuels should only receive financial aid if they lead to substantial GHG savings and are not produced from crops used for food and feed. This problem can be solved by concentrating on the development of the next generations – second and third generation of biofuels (e.g., lignocellulosic ethanol, Bio-SNG, synthetic biofuels) that will use a wider range of feedstock including lignocellulosic material, waste and residues and will not compete with food production [10] or stimulate production of algae origin biodiesel [3].

However, Harvey and Piligrim [3] stressed that unlike Brazil and the USA, Europe has not seen such major strategic innovation programme for the development of the second generation biodiesel, such as biomass to liquid (BtL), which is necessary to meet the more stringent GHG reduction requirements from 2017.

The so-called second generation biofuels, which are produced from wastes and residues, offer a number of advantages, such as the cost [20]. Waste origin biofuels could be produced using different feedstocks, e.g., municipal solid waste sewage sludge; food wastes [21]. The suggested technologies are the following: sewage sludge is converted to biogas via anaerobic digestion; food industry waste may be converted to ethanol via fermentation; lignocellulosic may be converted to biocrude via pyrolysis/thermochemical routes [21]. Moreover, biofuels produced from organic waste materials are generally considered to be sustainable, even if they use first generation conversion technologies, as they do not impact significantly on the land-use, indirect effects, food prices, etc. [21].

The third generation biofuels produced from microalgae and cyanobacteria offer potential advantages over plant based biofuels, such as high biomass productivity and the ability to grow in cultivation ponds [22]. Latvian researchers have also carried out studies in this field [23]. However, some scholars argue that along with potential environmental and social benefits, production of algal biofuels could result in significant resource inputs and negative environmental and other detrimental effects, as it is true for all forms of energy production [24]. Despite that, it is recognised that algae are almost ideal as organisms for developing the highly productive and robust crop strains that are essential for economically viable biofuel production [22]; in general, biofuels derived from biomass is not the best way to store energy of the sunlight, since for biodiesel from rapeseed it is less than 0.1 %, for bioethanol less than 0.2 %, and for biogas around 0.3 % [24].

In the light of the above-mentioned, the Latvian politicians, government and officials must review and reassess the acting programmes and plans regarding development and support of renewables, particularly biofuels, encouraging the usage of alternative or “green” transport energy. For example, Estonia has opted to stimulate the usage of electricity in the road transport [25].

Conclusions

1. The development of biofuel production and implementation in Latvia is more or less successful, because the growth of biodiesel production has increased 43 times from 2005 to 2012 and the share of biofuels in the total fuel consumption show statistically significant growing trend. At the same time the target share of consumption in 2010 is not reached, because a large amount of the produced biodiesel is exported. In general, the state aid policy has been partially inefficient, because it is focused on production stimulation and does not encourage the consumption of biofuels.
2. From the sustainability perspective, the first generation biofuels offer both, advantages and disadvantages related to environmental and socio-economic impacts. The most important of these impacts or risks are: GHG emissions, air pollution, biodiversity, subsidies, cost of production and implementation etc. Besides, some of the usage properties of biodiesel are inferior to diesel, e.g., less suitable in low temperatures and attracts moisture.
3. Latvian policy and plans on alternative transport energy in the light of the latest proposals and initiatives of the EU must be revised and reassessed and more attention must be devoted to development of the second generation biofuel (e.g., waste feedstock) and the third generation biofuel (e.g., algae as biomass producer), and seeking other sources of alternative or “green” energy, e.g., electricity.

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