BIOENERGY IN LATVIA: SECTOR VALUE AND IMPACTS

Ligita Melece, Agnese Krieviņa
Institute of Agricultural Resources and Economics, Latvia
ligita.melece@arei.lv, agnese.krievina@arei.lv

Abstract. In order to meet the mandatory targets towards renewable energy sources (RES), Latvia, like many EU countries, facilitates energy production from renewable sources. Apart from the contribution to RES targets, the development of bioenergy in Latvia has presented business opportunities from one side and public burden from another side. The paper examines the value of bioenergy production sector in Latvia and some of its main impacts – the public service obligation (PSO) arising from the public support to the bioelectricity sector, as well as savings stemming from the use of fuelwood. Suitable qualitative and quantitative research methods have been applied to the studies. The authors have attempted to evaluate the approximate value of the bioenergy production sector in Latvia in 2014 based on the main production flows in biofuel, bioelectricity and bioheat sectors. According to the evaluation, the total bioenergy production sector value in Latvia was almost 690 million EUR in 2014. The majority of this value is generated by the heat sector (heat produced from fuelwood; consumption of fuelwood by industry, construction, and households; export of fuelwood), followed by the biofuel sector (produced biofuels; export of rape seeds) and the bioelectricity sector (mandatory purchase of electricity from biogas and biomass). Latvian bioenergy sector is export-oriented to a large extent; there is especially high value of the export of fuelwood, mostly wood pellets. The obtained results reveal that PSO boosts the price of electricity in the manufacturing sector of Latvia by about 8 %, while making only 0.2 % in the analyzed costs structure. At the same time, electricity prices of large industrial consumers in Latvia are higher than the EU average by about 6-9 %, which affects the cost competitiveness of Latvian manufacturing enterprises. The theoretic value saved due to the use of fuelwood (mainly firewood) instead of natural gas, arising from the lower price of fuelwoods versus natural gas, was evaluated at somewhat 407 million EUR in Latvia in 2014.

Keywords: bioenergy, sector value, impacts, Latvia.

Introduction

Considering the seriousness of the threat posed by climate change, the transition to low carbon economy has become an important priority for the European Union (EU) Member States. Along with the environmental concerns, also energy market is facing such challenges as scarcity of fossil fuels besides population increase and energy security [1-3]. It is considered that the development of renewable energy is an option for many countries seeking to simultaneously reduce the dependence on imported fossil fuel and restrict greenhouse gas (GHG) emissions [4]. To fulfill their international obligations and common objectives, the EU Member States have agreed to raise the share of energy consumption from renewable energy sources (RES) to 20 %, and to reduce CO_2 emissions by 20 % by 2020 [5]. Moreover, the Climate and energy policy framework for 2030 agreed at the end of 2014 envisions to increase the share of RES to 27 % and to reduce GHG emissions by at least 40 % compared to the level of 1990 by 2030 [6]. However, it is recognized that increased biomass production within the EU is likely insufficient to meet projected demands [7].

The European Commission (EC) has stressed that despite the many benefits associated with biomass use, there are a number of sustainability risks that need to be properly managed [6; 8]. These risks include: unsustainable feedstock production; emissions from land use, land use change and forestry (LULUCF); lifecycle GHG emission performance; indirect impacts (e.g., cost for consumers); inefficient bioenergy generation; and air emissions [8]. Bioenergy (bioelectricity, bioheat and biofuels) is the leading RES in the EU-28 [1; 8; 9]. In order to meet the mandatory targets towards RES, Latvia, like many EU countries, facilitates energy production from renewable sources. Traditionally Latvia has had a high share of renewable energy in its total energy balance, which has been ensured by solid biomass and hydro power. Starting from 2010, there has also been a rapid growth in the electricity generated from biogas of agricultural and forestry origin feedstock and electricity from biomass (also from wind power), as well as the production of biofuels has been increasing since 2005. Apart from the contribution to RES targets, the development of bioenergy in Latvia has presented business opportunities from one side and public burden from another side.

Many previous studies and scientific papers on bioenergy published by the Latvian researchers, *inter alia*, the authors of this paper, chiefly deal with production issues (including technology, volumes, potential etc.), subsidies and risk evaluation, socio-economic and environmental impact etc. [10-15]. Despite various detailed studies having been conducted; the value of the bioenergy sector in general and its impact have not been evaluated previously in Latvia.

The aim of the studies is to evaluate the value of the bioenergy sector in Latvia and its impact. Due to the limited size of the article, only the main impacts – the public service obligation (PSO) arising from the public support to the bioelectricity sector, as well as savings stemming from the use of fuelwood – have been estimated in the paper.

Materials and methods

The principal materials used for the studies are as follows: different publications and papers, e.g., research papers and the reports of institutions; the data from the Central Statistical Bureau of Latvia (CSB) database [16-18] and the Eurostat database [19; 20]. The appropriate qualitative and quantitative research methods have been used for various solutions in the process of study: monographic; analysis and synthesis, data grouping, logical and abstractive constructional etc.

Based on the data availability [16-18], the following calculations were made to evaluate the bioenergy production sector value in Latvia:

1) biofuel sector value = $Q_{biofuel}$ x $P_{biofuel}$ + $Exp_{rapeseeds}$, where
   $Q_{biofuel}$ – produced quantity of biodiesel (no production recorded for bioethanol in 2014);
   $P_{biofuel}$ – average export unit value of biodiesel (FAMAE 96.5-100 %);
   $Exp_{rapeseeds}$ – export value of rapeseeds;
2) bioelectricity sector value = $Q_{bioelectricity}$ x $P_{bioelectricity}$, which
   is represented by the total value of the mandatory purchase of electricity from biogas and biomass plants, i.e. paid amounts to producers (before the deduction of subsidized energy tax);
3) bioheat sector value = $Q_{heat:fuelwood}$ x P_{heat} + $\sum(C_{households:fuelwood}$ x $P_{fuelwood})$ + $\sum(C_{industry/construction:fuelwood}$ x $P_{fuelwood})$ + $Exp_{fuelwood}$, where
   $Q_{heat:fuelwood}$ – produced quantity of heat (from fuelwood) in heat and CHP plants;
   P_{heat} – average price of heat for final consumption;
   $C_{fuelwood}$ – consumption volume of fuelwood (per fuelwood category) of households;
   $P_{fuelwood}$ – average price of fuelwood (per fuelwood category) for final consumption;
   $C_{fuelwood}$ – consumption volume of fuelwood (per fuelwood category) in industry and construction;
   $Exp_{fuelwood}$ – export value of fuelwood.

The foreign trade data on bioenergy, used in the calculations and analysis, have been retrieved for bioenergy products covering the following Combined Nomenclature (CN) codes: undenaturated ethanol for fuel – 220720; denaturated ethanol for fuel – 220710; FAMAE 96.5-100 % – 38260010; B30 and below – 271020; rape seeds – 1205; firewood – 440110; wood chips – 440121, 440122; wood pellets – 440131; wood briquettes – 44013920; sawdust – 44013930; other fuelwood – rest of 4401 [21; 22].

To evaluate the impact of bioelectricity support on manufacture in Latvia, the authors used the value of PSO of RES by attributing it to the electricity produced by biogas and biomass plants (according to the structure of the purchase costs of RES electricity) [1; 23]. The obtained PSO of bioelectricity was analyzed in the context of the total electricity consumption and electricity prices paid by the manufacturing sector [17; 19] and other main costs in manufacture [20].

The authors evaluated the total gain from the gross consumption of fuelwood stemming from the lower price of fuelwood versus natural gas [18]. The savings were obtained replacing the fuelwood prices (expressed per JG) per fuelwood gross consumption category (expressed in JG) by the natural gas price and calculating the difference between the existing gross consumption value of fuelwood and the calculated value in the prices of natural gas.

Results and discussion

The authors have tried to evaluate the approximate bioenergy production sector value in Latvia in 2014, based on the main production flows in biofuel, bioelectricity and bioheat sectors (detailed calculation procedure described under methodology). According to the evaluation (Figure 1), the total bioenergy sector production value in Latvia was about 689 million EUR in 2014.

Bioenergy sector
(688.5 mill EUR)

Biofuel sector
(117.0 mill EUR)

- production value of bioethanol and biodiesel (61.2 mill EUR)
- export value of rape seeds (55.8 mill EUR)

Bioelectricity sector
(95.3 mill EUR)

- value of mandatory purchase of electricity from biogas and biomass plants (95.3 mill EUR)

Bioheat sector
(476.2 mill EUR)

- production value of heat from fuelwood in heat and CHP plants (96.8 mill EUR)
- value of fuelwood consumed in industry and construction (44.2 mill EUR)
- value of fuelwood consumed by households (87.2 mill EUR)
- export value of fuelwood (247.9 mill EUR)

Fig. 1. **Evaluation of bioenergy production sector value in Latvia in 2014**

The majority of this value (476 million EUR) is generated by the heat sector, consisting of production of heat from fuelwood in heat and combined heat and power (CHP) plants; value of fuelwood consumed in industry and construction, and by households; as well as fuelwood exports to other countries. The value of biofuel sector is considered to be formed of the production of biofuels and export of rape seeds as the raw material for biodiesel production, and totaling about 117 million EUR. Slightly less value is created in the bioelectricity sector, which is represented by the mandatory purchase of electricity from biogas and biomass plants, majority (72 %) of which is compensated through public support mechanism.

Latvian bioenergy sector is export-oriented to a large extent (Table 1), specifically, there is very high value obtained in the sector from the export of fuelwood, mostly wood pellets [18].

Table 1

Foreign trade of bioenergy products in Latvia in 2014

Product	Export, mill EUR	Import, mill EUR
Ethanol for fuel	**3.9**	**15.2**
undenaturated	3.8	13.2
denaturated	0.1	2.1
Biodiesel	**66.3**	**27.0**
FAMAE 96.5-100 %	53.1	6.9
B30 and below	13.2	20.1
Rape seeds	**55.8**	**34.9**
Fuelwood	**247.9**	**13.4**
firewood	17.4	0.1
wood chips	51.6	2.1
wood pellets	169.7	9.5
wood briquettes	5.6	0.1
sawdust	1.2	1.4
others	2.5	0.2
Total	**373.9**	**90.6**

Fuelwood exports accounted for 26 % of the total production volume of fuelwood in 2014, with export of wood pellets reaching even 93 % of their production [18]. Large exports can also be observed in the biofuel sector both regarding the produced biofuel and raw materials or feedstocks of its production. According to the biofuel balance sheet, only biodiesel was produced in Latvia in 2014 (i.e. no production of bioethanol recorded), out of which export was 88 % [18]. Production of rape seeds also exceeds the domestic consumption in Latvia by about 75 % [16; 18]. Import prevalence can be mainly observed in ethanol for biofuel products group.

Considering that the majority of the bioelectricity sector value is funded from the public money, it was further evaluated how the support to the bioelectricity sector affects other production sectors in Latvia. It was done by analyzing the impact of the public service obligation (PSO) on the manufacturing sector in Latvia.

The total public service obligation (PSO) in Latvia in 2014, for mandatory RES electricity purchases during 2013, was 0.00942 EUR·kWh^{-1} [23]. According to the structure of the purchase costs of RES electricity [24], arising from feed-in tariffs above the market price, electricity from biogas plants accounts for slightly more than a half of the total RES electricity public costs, while biomass plants make up 27 % of the costs; with the total public support granted to biogas and biomass plants being 39.3 million EUR and 20.4 million EUR, respectively. Therefore, PSO that can be attributed to bioelectricity was about 0.0076 EUR·kWh^{-1} in Latvia in 2014.

Costs of the mandatory RES electricity purchase in Latvia are covered by all end users proportionally to their electricity consumption. According to the electricity consumption structure from the electricity balance sheet, 27 % of the PSO is covered by households, 25 % refer to industry and construction, of which the manufacturing sector is the main consumer, and the remaining part is covered by other consumers (public sector and other commercial sectors) [17].

In order to evaluate the impact of bioelectricity and its promotion on the manufacturing sector, the share of bioelectricity PSO in the electricity price and cost structure of manufacturing enterprises were analyzed [17; 20; 23]. According to the obtained results, PSO boosts the price of electricity in manufacturing enterprises by about 8 %, while making only 0.2 % in the analyzed costs structure (Figure 2). The total costs arising from PSO of bioelectricity consumed by manufacturing enterprises in 2014 were about 12 million EUR.

On the EU level, it is argued that industries facing higher energy prices produce less, hence, reduce the demand and income from these industries or sell their products at higher prices, which, in turn, reduce the demand and thus their production [25; 26]. Duscha with co-authors [25] argue that, generally, a price increase has a negative effect and slows down economic activities.

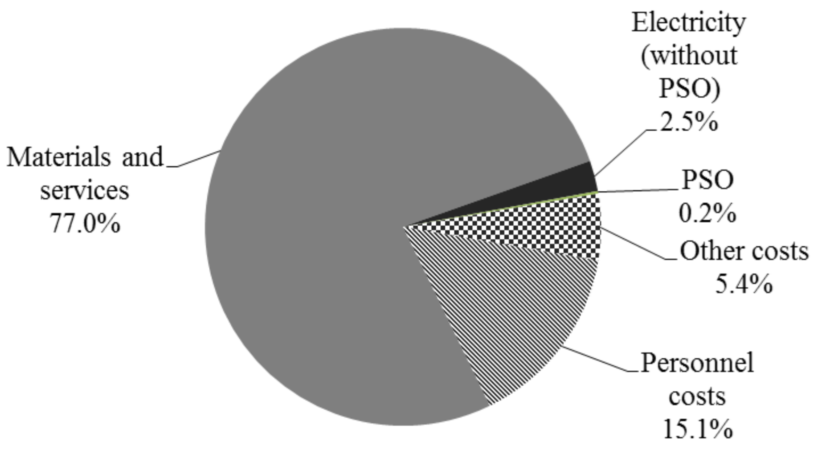

Fig. 2. **Cost structure of manufacturing enterprises in Latvia in 2013 (intermediate and personnel costs are considered; PSO of 2014 is used)**

At the same time, electricity prices of large industrial consumers in Latvia are higher than the EU average by about 6-9 % (Table 2); electricity prices of smaller industrial consumers are also by about 5-7 % higher in Latvia than in Lithuania; the difference between electricity prices of industrial consumers in Latvia and Estonia is very explicit – 20-27 %; Polish enterprises, especially larger industrial producers, also enjoy lower electricity prices, which affects the cost competitiveness of the Latvian manufacturing sector [20].

Table 2

Comparison of electricity price levels of industrial consumers between Latvia and other EU countries in 2014*

Country	Annual electricity consumption, GWh					
	< 0.02	0.02 < 0.50	0.50 < 2.0	2.0 < 20.0	20.0 < 70.0	70.0 < 150.0
Latvia	100 %	100 %	100 %	100 %	100 %	100 %
Lithuania	93 %	95 %	99 %	110 %	112 %	n/d
Estonia	73 %	77 %	79 %	80 %	73 %	75 %
Poland	99 %	86 %	70 %	67 %	64 %	67 %
EU-28	125 %	111 %	102 %	100 %	91 %	94 %

*prices, excluding VAT; second semester of 2014

In addition to burdens, the authors also tried to evaluate the total gain from the gross consumption of fuelwood stemming from the lower price of fuelwood versus natural gas [19]. The savings have been obtained replacing fuelwood prices (expressed per gigajoule – GJ) per fuelwood gross consumption category (expressed in GJ) by natural gas price and calculating the difference between the existing gross consumption value of fuelwood and the calculated value in prices of natural gas.

Thus, if merely price per energy content unit is considered, theoretically approximately 407 million EUR has been saved due to the use of fuelwood (mainly firewood) instead of natural gas in Latvia in 2014. The present value spent on natural gas could also be lower if the current large consumption of this fossil fuel had been replaced by fuelwood, of which exports of wood pellets offer the most substitution possibilities (Figure 3). Even though being expensive fuelwood, wood pellets are still cheaper than natural gas.

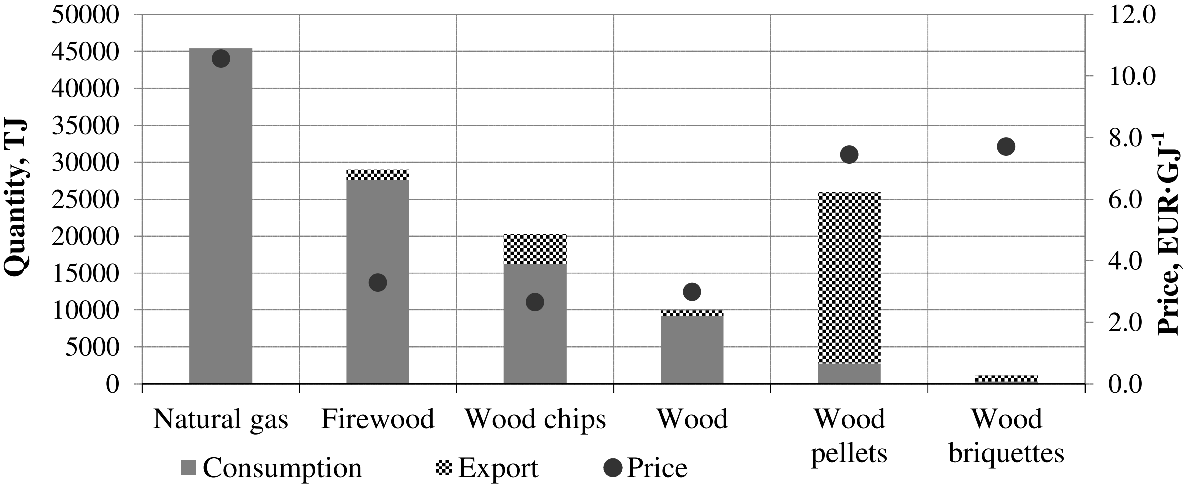

Fig. 3. **Gross consumption, export and prices of the main fuels in Latvia in 2014 (average prices (without VAT) for final consumption used)**

Besides, the advantages of wood pellets are in their increased consistency, bulk density, and energy efficiency compared to unprocessed fuelwood. Although approximately twice the cost of unprocessed wood, the energy content of wood pellets also doubles and, moreover, wood pellets represent twice more energy content compared to the unprocessed fuelwood [27].

Conclusions

1. According to the evaluation, the total bioenergy sector production value in Latvia was about 689 million EUR in 2014. The majority of this value (476 million EUR) is generated by the heat sector (heat produced from fuelwood; consumption of fuelwood by industry, construction, and households; export of fuelwood), followed by the biofuel sector (produced biofuels; export of

rape seeds) – 117 million EUR, and the bioelectricity sector (mandatory purchase of electricity from biogas and biomass plants) – 95 million EUR.
2. Latvian bioenergy sector is export-oriented to a large extent. There is especially high value of the export of fuelwood, mostly wood pellets, export of which accounts 93 % of their production volume. Large exports can also be observed in the biofuel sector both regarding produced biofuel and raw materials (rape seeds).
3. The public service obligation boosts the price of electricity in manufacturing enterprises of Latvia. At the same time, electricity prices of large industrial consumers in Latvia are higher than the EU average; and some price disadvantages also exist in comparison with other Baltic countries and Poland, which negatively affects the competitiveness of manufacturing sector's enterprises.
4. Th theoretic value saved due to the use of fuelwood (mainly firewood) instead of natural gas arising from the lower price of fuelwoods versus natural gas was somewhat 407 million EUR in Latvia in 2014. The present value spent on natural gas could also be lower if fossil fuel had been replaced by fuelwood, of which wood pellets offer the most substitution possibilities.
5. The subsidies or support by public financing plays an important role in the development of the bioenergy sector. Considering it, further studies should be necessary for more detailed evaluation of the social and economic impact, *inter alia*, on jobs' creation; and on competitiveness of other sectors.

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References

1. European Commission. State of play on the sustainability of solid and gaseous biomass used for electricity, heating and cooling in the EU, SWD (2014) 259 final, Brussels, 28.7.2014. [online] [05.02.2016]. Available at: http://ec.europa.eu/energy/en/topics/renewable-energy/biomass.
2. European Commission. Renewable Energy: Progressing towards the 2020, COM (2011) 31 final, 31 January 2011. [online] [05.02.2016]. Available at: http://eur-lex.europa.eu/
3. Abdmouleh, Z., Alammari, R.A.M., Gastli, A. Review of policies encouraging renewable energy integration & best practices. Renewable and Sustainable Energy Reviews, vol. 45, 2015, pp. 249-262.
4. Valodka, I. The Impact of Renewable Energy on the Economy of Lithuania. Procedia – Social and Behavioral Sciences, vol. 213, 2015, pp. 123-128.
5. Alonso, P.M., Hewitt, R., Pacheco, J.D., Bermejo, L.R., Jimenez, V.H. et. al. Losing the roadmap: Renewable energy paralysis in Spain and its implications for the EU low carbon economy. Renewable Energy, vol. 89, 2016, pp. 680-694.
6. European Council. Conclusions on 2030 Climate and Energy Policy Framework, 2014. [online] [08.01.2016]. Available at: http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/145356.pdf.
7. Galik, C.S., Abt, R.C. Sustainability guidelines and forest market response: an assessment of European Union pellet demand in the southeastern United States. GCB Bioenergy, vol. 8, 2016, pp. 658-669.
8. European Commission. State of play on the sustainability of solid and gaseous biomass used for electricity, heating and cooling in the EU. SWD (2014) 259 final. [online] [15.03.2016]. Available at: https://ec.europa.eu/energy/en/topics/renewable-energy/biomass.
9. Soderberg, C., Eckerberg, K. Rising Policy Conflicts in Europe over Bioenergy and Forestry. Forest Policy and Economics, vol. 33, 2013, pp. 112-119.
10. Blumberga, D., Veidenbergs, I., Romagnoli, F., Rochas, C., Žandeckis, A. Bioenergy Tehnologies. Rīga: RTU Vides aizsardzības un siltuma sistēmu institūts, 2011. 272 p.
11. Dubrovskis, V., Kotelenecs, V., Zabarovskis, E., Celms, A., Plume, I. Biogas Production Potential from Agricultural Biomass and Organic Residues in Latvia. Proceedings of 12th International seecientific Conference: Engineering for rural development, 2013, pp. 446-450.

12. Melece, L., Krievina, A. Assessment of Socio-Economic and Environmental Impact of Bioenergy in Latvia. 15th International Multidisciplinary Scientific Geoconference SGEM 2015, Ecology, Economics, Education and Legislation Conference Proceedings, vol. III, 2015, pp. 101-108.
13. Melece, L., Krievina, A. Bioenergy Resources in Latvia. Environment. Technology. Resources. Proceedings of the International Scientific and Practical Conference, vol. 2, 2015, pp. 190-196.
14. Pilvere, I. Potential of Utilised Agricultural Area for Bioenergy Production: the Case of Latvia. AASRI Procedia, 2012, vol. 2, pp. 134-141.
15. Priekulis, J., Aboltins, A., Laurs, A. Amount of manure used for biogas production. Agronomy Research, vol. 13 (2), 2015, pp. 396-404.
16. CSB of Latvia. Agricultural Statistics Database. [online] [06.01.2016]. Available at: http://data.csb.gov.lv/pxweb/en/lauks/lauks__ikgad__03Augk/?rxid=cdcb978c-22b0-416a-aacc-aa650d3e2ce0.
17. CSB of Latvia. Energy Statistics Database. [online] [05.01.2016]. Available at: http://data.csb.gov.lv/pxweb/en/vide/vide__ikgad/?rxid=a79839fe-11ba-4ecd-8cc3-4035692c5fc8.
18. CSB of Latvia. Foreign Trade Statistics Database. [online] [05.01.2016]. Available at: http://data.csb.gov.lv/pxweb/en/atirdz/?rxid=a79839fe-11ba-4ecd-8cc3-4035692c5fc8.
19. Eurostat. Energy Statistics Database. [online] [08.01.2016]. Available at: http://ec.europa.eu/eurostat/data/database.
20. Eurostat. Structural Business Statistics Database. [online] [08.01.2016]. Available at: http://ec.europa.eu/eurostat/data/database.
21. Alakangas E., Nikolaisen L., Sikkema R., Junginger M. Combined Nomenclature (CN codes) for biomass fuels. [online] [11.01.2016]. Available at: http://www.vtt.fi/inf/julkaisut/muut/2011/D2-4-EUBIONETIII_CN_code_report.pdf.
22. USDA Foreign Agricultural Service. EU Biofuels Annual 2015. Trade policy. [online] [11.01.2016]. Available at: http://www.appb.pt/public/files/RelAnual_BiocombustiveisUE.pdf.
23. Sabiedrisko pakalpojumu regulēšanas komisija. Par apstiprinātajām obligātā iepirkuma komponentēm (OIK) no 2014. gada 1. aprīļa (About approved public service obligation from January 1, 2014). (In Latvian). [online] [07.01.2016]. Available at: http://www.sprk.gov.lv/lapas/par-oik-no-2014gada-1aprila.
24. Ekonomikas Ministrija. Komersantiem 2013.gadā obligātā iepirkuma ietvaros izmaksātās summas (Paid amount to entrepreneurs within mandatory purchase in 2013). (In Latvian). [online] [06.01.2016]. Available at: https://www.em.gov.lv/lv/nozares_politika/atjaunojama_energija_un_kogeneracija/informacija_par_izdotajiem_lemumiem_par_elektroenergijas_obligato_iepirkumu/.
25. Duscha, V., Ragwitz, M., Breitschopf, B., Schade, W., Walz, R. et al. Employment and growth effects of sustainable energies in the European Union. Karlsruhe, Germany: Fraunhofer ISI, 2014, 199 p.
26. Jager-Waldau, A., Szabo, M., Scarlat, N., Monforti-Ferrario, F. Renewable Electricity in Europe. Renewable and Sustainable Energy Reviews, vol. 15, 2011, pp. 37033716.
27. Goetzl, A. Developments in the Global Trade of Wood Pellets. Washington D.C.: US International Trade Commission, 2015, 28 p.