

GREEN ENERGIES FOR AGRICULTURE: COMPARATION STUDY FOR SLOVAKIA & THE NETHERLANDS

Zuzana PALKOVÁ¹, Michal PALKO²

¹Slovak University of Agriculture in Nitra, Tr. A. Hlinku 2, 949 76 Nitra, Slovakia, Email: Zuzana.Palkova@uniag.sk

² Comenius University in Bratislava, Odbojárov 10, 820 05 Bratislava 25, Slovakia

Corresponding author: Zuzana.Palkova@uniag.sk

Abstract

The primary role of agriculture is to produce food. However is the agriculture sector able to provide other activities? Exploitation of biomass and production of biogas from the waste of agricultural production shows that the farmer can become producers of energy. Two of the most typical agricultural countries in European Union are Slovakia and the Netherlands. This article was based to answer the question: What are the differences of using green energy in Slovakia and the Netherlands in agricultural sector? Comparison of information such as spread of land, population density, gross domestic product data on agricultural production, energy production and consumption in the agricultural sector showed that renewable energies are widely used in agriculture sector although approach in both countries is different, as a result of differences in the climate and geographical condition of these countries.

Key words: agriculture, Slovakia, the Netherlands, renewable energy sources, green energy

INTRODUCTION

Since the Industrial Revolution in the late 19th century made an industrial big power out of Netherlands, furthermore accelerated the industrial development in the Austro-Hungarian Empire, which also included Slovakia. Due to this fact, all parts of the economy became depended from electricity. Agriculture with livestock, crop and food production is no exception. However new technologies used in the production process are being labour-saving, they increases the dependence of the sector from electricity and fuel.

This article focuses on the differences in the use of green energy in agriculture in the Netherlands and the Slovak Republic. In order to answer mentioned question, following specific questions need to be answered: “*What are the general Country Data like an area, population, GDP?*”, “*What are the basic characteristic of agricultural sector in both countries?*”, “*What are the basic characteristics of energy consumption in both countries?*”, “*What is the actual installed capacity per technology and per sector?*”, “*What is the policy of both countries on green*

energy in agricultural sector?”.

This topic can be very interesting in connections with the problem in agriculture infrastructure of the rural areas. Indeed, many of them have no built infrastructure or it is significantly outdated. The need for large investments and lack of financial resources leads to raised unemployment and depopulation of rural areas. In these consequences, diversification into non-agricultural activities supporting the development of new, respectively existing forms of business, provide alternative types of employment in agriculture. In other words, alternative forms of energy largely contribute to sustainable rural and regional development (Krištofičová, 2011) [16]. Growing energy plants, biomass combustion in order to generate heat or biogas production from the waste of animal and crop production represent opportunities that can reverse these negative trends and to facilitate the sustainable development of local entrepreneurship based on local natural resources of renewable energy.

Renewable energy can be seen as a way to improve the economic situation of farms, in addition can help develop other companies

that are in any way involved in energy production, construction and operation of agro-bio-energy plants.

MATERIALS AND METHODS

In order to answer questions and sub-questions mentioned above desk research was conducted. A wide variety of sources were used to retrieve information including books, scientific publications and web resources regarding renewable energy.

To obtain basic data about each country a databases of World Population by Country and International Monetary Fund were used. Both databases are available online and include basic economic information on almost 190 countries. In addition, data from European Union's Eurostat allow to answer questions about the installed capacity, production and consumption of electric energy as well as the characteristics of the agricultural sector.

Legal documents, laws and regulations relating to the use of renewable energy were taken from the website of the European Commission.

The aim of the desk research was to gather qualitative and quantitative data, which will enable a debate about what is the state of exploitation of renewable energy in both countries as well as what the development of the situation is. Tables and graphs contained in the document allow comparison between figures, presenting the view on this issue.

RESULTS AND DISCUSSIONS

According to the latest statistics, population of the Netherlands is 16,901,693 citizens, which makes it the 62nd most populated country in the world (WPR, 2015) [19]. Whereas the Slovakia has an estimated 2015 population of 5,461,108 (WPR, World population review, 2015) [19]. Economy of the Netherlands is focus on agriculture and food processing, chemicals, petroleum refining, and electrical machinery, in contrary of this, the Slovak economy is oriented on manufactured goods, machinery and transport equipment. Total nominal GDP of the Netherlands is 749,365

billion \$, for Slovakia 87,528 billion \$ (IMF, 2015) [14].

The Slovakia and the Netherlands are in terms of area similar countries but with very different geographical conditions. The average altitude in Slovakia is 392 metres and up to 40% of its area is formed by mountains or highlands. The highest point is Gerlach with a height of 2,655 meters above sea level, oppositely the lowest is Streda nad Bodrogom with altitude 94 metres above sea level. Slovakia is a landlocked country, still a major European river Danube flows through the area. (Zem na dlani, 2015) [20].

The Netherlands is a lowland country, meaning major part of country area consists from plane. Mountains are just in the middle of the country. The highest lying point is Vaalserberg Hill, which is located at an altitude of 322.7 meters (Britannica, 2015) [2]. About half of the surface area is less than 1 metre above sea level (Europedia, 2015) [6], moreover large part of the country consists of polders - areas that arose by barricading the coast and drying of the sea. Typical canals that connect the rivers and provide shipping.

The Netherlands and Slovakia are in the matter of size very similar countries. Dutch population, however, is more than three times bigger than the population of Slovak Republic. The demographic factor significantly affects the primary production of electric energy - Netherlands produced three times more (in 1990), respectively 3.5 times more (in 2013) of electricity than the Slovak Republic (EuroStat, 2015) [8].

Primary production of energy by sources varies in both countries - 92% of primary electricity production in the Netherlands is sourced from natural gas, on the other hand in Slovakia the share of natural gas covers only 2%. And what is more, up to 66% share is covered in form of nuclear energy. Share of renewable energy in total production of electricity is 6.2% in the Netherlands, in contrast with 22.6% in Slovakia (EuroStat, Primary production, 2015) [10,11].

Fig. 1 shows the power consumption in both countries, in particular economic sectors. The most significant difference shows the energy consumption in the agricultural sector - more

than 6% in the Netherlands in comparison with the little over 1% in Slovakia. This also points to the different position of agriculture in both countries (EuroStat, Final Energy consumption by sector, 2015) [9].

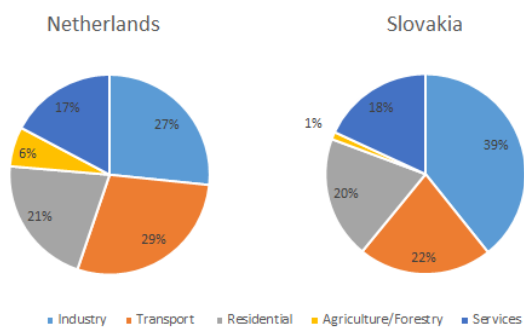


Fig. 1. Final energy consumption by sector (Mtoe)

Among the renewable energy sources we include wind energy, solar energy, hydro energy, geothermal energy, tidal energy, energy from biomass and biogas. Thus these energy sources currently represent an essential alternative to fossil fuels. In addition their exploitation helps to reduce greenhouse gas emissions from energy production and consumption, furthermore reduce dependence on imports of fossil fuels from often politically very unstable regions.

According to the website of the European Parliament (Kerebel, 2015) [15], the EU owns 40% of the world's patents relating to renewable energy. In these consequences, the European Union is considered as the leader in the development of technologies for renewable energy. Indeed, in 2012, almost half (44%) of world's electricity generation capacity from renewable sources (excluding hydropower) was produced in the European Union and this area of economy employs around 1,2 million people. (Kerebel, 2015) [15].

The basic document of the European Union for the use of renewable energy sources is Directive No. 2009/28/ES of the European Parliament and of the Council from 23 April 2009 on the support of energy from renewable sources and amending and subsequently repealing Directives 2001/77 / EC and 2003/30 / EC (EUR-Lex, 2015) [5]. Considering the fact that the primary energy sources and energy markets of the Member States of the European Union are different,

national governments had to adapt to this fact and their energy policies and the fulfilment of obligations under the Directive No. 2009/28/EC.

In addition the basic guidelines for the use of renewable energy sources, there are other documents that deal with the problem of green energy. For instance, the document "Renewable Energy Road Map", "Biomass Action Plan", "EU Strategy for Biofuels", "Motor vehicles: use of biofuels" or "Promotion of offshore wind energy". Finance investments in renewable energy development provide several programs - the "Intelligent Energy for Europe" program for the period 2003-2006, "The Global Energy Efficiency and Renewable Energy Fund" or "Support for electricity from renewable energy sources".

Under the Directive No. 2009/28/EC, the Netherlands and Slovakia have created National action plan that explains how they intend defined objectives achieved in 2020 (EC-Energy, 2015) [4]. This plan include information such as the share of renewables in the energy mix, which the state want to achieve, which technology it want to use, what policies want to achieve and how it will cooperate with local, regional and national authorities. Mandatory national target set in the Directive 2009/28/EC features for both countries 14 % share of RES in final consumption of energy. Share of renewable energy in gross final energy consumption in 2013 accounted for 4,5% in the Netherlands, in the case of Slovakia, 9,8%. (EuroStat, Share of renewable energy in gross final energy consumption, 2015) [12].

Current installed capacity by technology in 2013 is given in Table 1 (EuroStat, Primary production of renewable energy by type, 2015). [11].

Scientific work focused on the issue of renewable energy in the agricultural sector mainly focuses on the topics such as impact of policy on the use biofuels in agriculture (Banse, 2008) [1], (Demirbas & Balat, 2006) [3], the use incinerating waste in agricultural production (Werther & et al., 2000) [18] or the pros of anaerobic digestion (Holm-Nielsen, Oleskowicz-Popiel, & Al Seadi, 2009) [13].

Table 1. Renewable energy - Actual installed capacity per technology (kToe)

	Hydro power	Wind power	Solar thermal	Solar PV	Tide, wave and ocean	Solid biofuels	Biogas	Municipal waste	Biodiesels	Geothermal
Netherlands	9.8	483.8	26.0	44.4	0	1,113.5	311.7	798.8	1,215.1	23.7
Slovakia	416.9	0.5	5.6	50.6	0	768.6	54.9	15.5	94.8	6.5

In detailed report on impacts of renewable energy on European farmers (Pedroli & Langeveld, 2011) [17] is written that renewable energies can play a crucial role in the transformation of agriculture, as they provide a new source of income. Furthermore, the report examines the contribution of agriculture to renewable energy production and the impact of this new activity on the farms. Based on this analysis possible

development paths for the future are defined. Besides this, the statistical portal of the European Union (EuroStat, Agri-environmental indicator - energy use, 2015) [7] provides summary on the use of renewable energy in agriculture and forestry. The growing trend of energy from renewable sources in the agricultural sector highlights the significant contribution of agriculture and forestry to the objectives of the EU 2020.

Table 2. Production of renewable energy from agriculture and its share in total production of renewable energy (ktoe, %) in 2010

	Primary energy production of renewable energy from agriculture and forestry (ktoe)			Share of primary energy production of renewable energy from agriculture and forestry to total production (%)			Share of primary energy production of renewable energy from agriculture and forestry to total renewable production (%)			Share in total production of renewable energy (%)
	Agriculture	Forestry	Total	Agriculture	Forestry	Total	Agriculture	Forestry	Total	
Netherlands	582	1,033	1 615	0.8	1.5	2.3	19.8	35.1	54.8	19.8
Slovakia	143	740	883	2.4	12.4	14.8	10.2	52.7	62.9	10.2

With reference to this report, total primary energy production of renewable energy from agriculture and forestry, which was produced in year 2010 in the Netherlands (1,615 Ktoe) was twice as high as in Slovakia (883 ktoe). However, considering the fact that the Netherlands produces 3.5 times more electricity than Slovakia, the share of primary energy from renewable energy sources in agriculture and forestry in the total electricity production in Slovakia (14.8%) is about 7 times greater than in the Netherlands (2.3%). Moreover, the proportion of primary energy production of renewable energy from agriculture and forestry in the total production of renewable energy in Slovakia (63%) is larger than in the Netherlands (54.8%).

Due to geographical conditions of both countries, these findings may be considered. A large part of the Slovakia is covered by forests and usage of wood biomass for heating has long tradition in the country. On the other hand, despite the tradition of building

waterways and the presence of coastline, using the hydropower in the Netherlands is unexpectedly low. The probable reason is that the Netherlands concentrate more at land drying and using hydropower claim higher speed of water flow as is required for waterways, the main concept of channels in the Netherlands.

The basic finding of the research is the fact that both countries consistently fulfil the objectives set by the European Union for using renewable energy sources. Accomplishing the set target in the usage of renewable energy in the overall energy mix has been set for both countries on the same level - 14%. However, actual situation is better in the Slovak Republic. Contribution of the total energy production from renewable energy sources in agriculture and forestry is in the Slovak republic 7 times higher than in the Netherlands.

It needs to be said that any relevant scientific data that study case mentioned above have not

been found during the research. As shown in Table 2, the significant amount of electricity production from renewable energy in Slovakia is covered by small hydropower plants, as well as a by biomass and biofuels. These types of alternative energy sources have the greatest exploitation in the agricultural production.

CONCLUSIONS

The goal of the research was to present the current state of development regarding the use of renewable energy sources in agro sector in two EU countries - the Netherlands and Slovakia. Both countries are similar to the size of its territory, but with wide variations in population, climatic and geographic conditions.

Both countries accepted the Directive No. 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of renewable energy - basic document of the European Union for the use of renewable energy sources. Both of them also have prepared national action plans, which consistently define national targets for the share of renewable energy in the total energy mix for 2020 at 14%.

Total primary energy production of renewable energy from agriculture and forestry in 2010 was two times higher in the Netherlands than in Slovakia. However, considering the production of primary energy from renewable sources, the share in the agriculture and forestry sector is in Slovakia seven times higher as in the Netherlands. Likewise, the proportion of primary energy production from renewable energy from agriculture and forestry in the total production of renewable energy is higher in Slovakia than in the Netherlands.

REFERENCES

- [1] Banse, M., 2008, Will EU biofuel policies affect global agricultural markets? Review of Agricultural Economics, 117-141.
- [2] Britannica, E., 2015, Netherlands: Relief. Dostupné na Internet: Encyklopaedia Britannica (28. 11 2015).: <http://www.britannica.com/place/Vaalser-Hill>
- [3] Demirbas, F. M., Balat, M., 2006, Recent advances on the production and utilization trends of bio-fuels: a global perspective. Energy Conversion and Management, 2371-2381.
- [4] EC-Energy, 2015, National action plans. Dostupné na Internet: EC-Energy, (28. 11 2015), <https://ec.europa.eu/energy/en/topics/renewable-energy/national-action-plans> (28. 11 2015).
- [5] EUR-Lex, 2015, Promotion of the use of energy from renewable sources. Dostupné na Internet: EUR-Lex, (6. 8 2015), <http://eur-lex.europa.eu/legal-content/CS/TXT/?uri=URISERV:en0009>
- [6] Europedia, 2015, Europedia. Dostupné na Internet: Interesting facts about the Netherlands, (28. 10 2015), <http://www.eupedia.com/netherlands/trivia.shtml>
- [7] EuroStat, 2015, Agri-environmental indicator - energy use. Dostupné na Internet: EuroStat, (28. 11 2015), http://ec.europa.eu/eurostat/statistics-explained/index.php/Agri-environmental_indicator_-_energy_use
- [8] EuroStat, 2015, Electricity production, consumption and market overview. Dostupné na Internet: EuroStat, (28. 11 2015), http://ec.europa.eu/eurostat/statistics-explained/index.php/Electricity_production,_consumption_and_market_overview
- [9] EuroStat, 2015, Final Energy consumption by sector. Dostupné na Internet: EuroStat, (28. 9 2015), <http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tsdpc320&plugin=1>
- [10] EuroStat, 2015, Primary production. Dostupné na Internet: EuroStat, (28. 11 2015), http://ec.europa.eu/eurostat/statistics-explained/images/1/17/Energy_production%2C_2003_and_2013_%28million_tonnes_of_oil_equivalent%29_YB15.png
- [11] EuroStat, 2015, Primary production of renewable energy by type. Dostupné na Internet: EuroStat, (28. 9 2015), <http://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=ten00081&language=en>
- [12] EuroStat, 2015, Share of renewable energy in gross final energy consumption. Dostupné na Internet: EuroStat, (28. 9 2015), http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=t2020_31&plugin=1
- [13] Holm-Nielsen, J., Oleskiewicz-Popiel, P., Al Seadi, T., 2009, The future of anaerobic digestion and biogas utilization. Bioresource technology, 5478-5484.
- [14] IMF, 2015, International Monetary Fund. Dostupné na Internet: Data and Statistics, (6. 10 2015), <http://www.imf.org/external/pubs/ft/weo/2015/02/weodata/weoselco.aspx?g=995&sg=All+countries+%2f+Advanced+economies+%2f+Euro+area>
- [15] Kerebel, C., 2015, Renewable energy. Dostupné na Internet: European Parliament At your service, (1. 7 2015), http://www.europarl.europa.eu/atyourservice/en/displayFtu.html?ftuId=FTU_5.7.4.html
- [16] Krištofičová, D., 2011, Ministerstvo pôdohospodárstva a rozvoja vidieka Slovenskej republiky. Dostupné na Internet: Sekcia rozvoja vidieka, (7. 13 2011),

<http://www.mpsr.sk/index.php?start&navID=114&id=4831>

[17]Pedroli, G., Langeveld, H., 2011, Impacts of Renewable Energy on European Farmers. Wageningen, Wageningen, the Netherlands. Dostupné na Internete, (NA. NA 2011), <http://edepot.wur.nl/288641>

[18]Werther, J., et al., 2000, Combustion of agricultural residues. Progress in energy and combustion science, 1-27.

[19]WPR, 2015, World population review. Dostupné na Internete: Netherlands Population 2015, (1. 12 2015),

<http://worldpopulationreview.com/countries/netherlands-population/>

[20]Zem na dlani, 2015, Slovensko. Dostupné na Internete: Zem na dlani, (28. November 2015), <http://www.zem.wbl.sk/SLOVENSKO.html>