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CHANGES IN THE ELECTRICITY SECTOR IN POLAND IN THE LIGHT OF ENVIRONMENTAL PROTECTION AND DEVELOPMENT CONDITIONS OF AGRICULTURE AND RURAL AREAS

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ABSTRCT: The aim of the article is to present the effects of changes in the electricity sector in Poland after the accession to the EU, taking into account the environmental protection and the development of agriculture and rural areas. The paper presents the ideas of the energy and climate policies in the European Union and their effects on the environment and the development of agricultural areas in Poland. The changes in the electricity sector in Poland were presented by the author in the context of the development of agriculture and rural areas. The analysis indicated that the transformation in the electricity sector had a strong impact on both the environment and agriculture and rural areas. The main effects are the increase in the production of energy crops, tax effects for rural communities and landscape changes caused by the appearance of sources of energy renewable plants.

KEY WORDS: electricity industry, energy and climate policies, energy crops, rural areas

JEL: Q48, Q28, Q01

Introduction

Since the beginning of the 1990s, the electricity sector, as have other parts of the economy, experienced drastic changes that were not only the result of systemic change, but were related to the adaptation of this sector to the requirements of the European Union. These changes were related to the re-regulation, restructuring, liberalization and ownership processes and to the implementation of the economic policy objectives pursued by the European Commission. The latter, in relation to the electricity sector, was concerned with energy and climate policies. The result was the creation of an electricity market, the adoption of environmental targets of 3×20% (European Parliament and the Council, 2009a) and the inclusion in the definition of electricity safety of the environmental aspect (European Commission, 2000).

The aim of the electricity policy is to ensure the safety of the electricity sector, while preserving the sustainable development of the country, at national, regional and local level. Therefore, electricity sector security is understood as an uninterrupted supply of energy at reasonable and low prices, whilst maintaining care for the environment. This goal was driven by changes in the power sector, and their end result was to increase competitiveness in this part of the economy, maintaining sustainable development at local and regional level. As a result, the process of modernization of energy plants in Poland has begun. It aimed to reduce pollutant emissions into the environment and to build installations using renewable energy sources (RES), especially from wind, biomass and biogas. It affected not only the environment, but also agriculture and rural areas.

The aim of the article is to present the effects of changes in the electricity sector in Poland after the accession to the EU, in the context of environmental protection and the conditions of the development of agriculture and rural areas. The paper will present the targets of the energy and climate policies in the European Union, their impact on the environment and the development of agricultural areas in Poland. Attention will be focused on both the changes in the area of environmental protection and the promotion of renewable energy sources. Energy and climate policies are also related to the development of energy crops and changes in the surrounding local environment, so the changes in the electricity sector in Poland are presented by the author in the context of the development of agriculture and rural areas.

The paper is descriptive and analytical and based on the observational method, basic statistical methods such as dynamic analysis and time analysis and deduction method. The main source of data is the Central Statistical

Office of Poland and Eurostat. The research period in the empirical part is the period after the accession to the European Union, and for the assessment of climate change period from 1990 to 2014.

Energy and climate policies and changes in electricity sector in Poland

Transformations in the electricity sector in Poland began in 1990, the decision was made to dissolve the Energy and Coal Industry (Wspólnota Energetyki i Węgla Brunatnego) and to create transmission, distribution and generation sub-sectors within the electricity sector (later was also trading). Another important element of the change was the enactment of the Act of Energy Law (Ustawa Prawo energetyczne, 1997) and subjecting the electricity market under sector regulation. Since then, it began the process of commercializing the electricity business, and it created the foundations for privatization and long-term restructure and consolidation processes. The result is that the electricity sector is dominated by three entitles (PGE SA, Tauron PE SA and Enea SA, which together put more than half of the total volume of electricity in Poland). The most important event, however, was Poland's accession to the European Union. This has led to the need to adapt to EU requirements and to adopt directives introduced by the European Commission. Particularly important are the directives implemented in the framework of energy policy and those related to climate Policy. The implementation of electricity directives has resulted in the separation of network activity from sales and generation, the wholesale market has been established and developed, and final customers have acquired the opportunity to change their electricity supplier. This has led to the development of competition, and the business decisions of businesses (other than „incumbent energy companies" which are regulated in the pricing process) have started to be made on the basis of economic calculation. The most important are the two components: pricing for customers and investment plans. The result of the first component is that there is business freedom for suppliers to set prices, and consumers have the option of choosing a supplier. The second element has an impact on the security of electricity system and the nature of these investments and their location. The result of these changes is the construction of power plants and the production by companies of those manufacturing technologies that are most cost-effective and economically efficient. Another result of energy policy is promotion of distributed generation, which unfortunately is slowly developing in Poland (Combined heat and power generation as % of gross electricity generation was 16.76% in 2005 and 16.09% in

2015 (Eurostat, 2017b). Another element are electricity "prosumers", whose development build more and more energy micro-installations. In Poland, on July 1, 2016 came into force the amendment to the Act on RES (Ustawa o odnawialnych źródłach energii, 2015), in which the concept of „prosumer" was defined and in relation to earlier proposals, it was decided to cancel for prosumers the possibility of resale of unused produced electricity and it was replaced by a system of mutual settlements. In return for tariffs guaranteed for surplus power produced, prosumers will be able to get discounts from power plants to the energy they receive. Regardless of whether these changes are beneficial to "prosumer program", or vice versa, it will undoubtedly affect its development and thus rural areas, because prosumers are mainly in agricultural communities.

The second type of economic policy influencing the development of the electricity sector, but also of agricultural and rural areas is climate policy. Under this policy, the first step was to implement the provisions of the Kyoto Protocol, and later the implementation of the 3×20% target set by the European Council in March 2007, according to which the greenhouse gas emissions in the EU compared to 1990 levels should be reduced by at least 20%, share of renewable energy in the final energy consumption should increase to 20% and should be improved energy efficiency by 20%. The reference target for RES for Poland is 15% (European Parliament and the Council**,** 2009b). All these climate targets resulted that in the EU on the one hand modernizing the existing generation capacities to reduce their negative impact on the environment was started, and on the other hand, withdrawing from operation „impure" ecological and energy-inefficient technologies and building power plants using renewable energy sources. Similarly implementation occurred in Poland.

The broader use of renewable energy sources is the main driver for achieving these goals. How big changes have occurred as a result of such energy and climate policies is shown in figure 1. It is worth noting that since 2000, in net electricity installations in the EU only the electricity from RES is more (figure 1 top panel). The only exception to conventional energy carriers is natural gas, which, however, is a carrier with a relatively low negative impact on the environment. Among the technologies that use „green energy", the electricity installations for wind energy, solar panels and biomass are being primarily built. It should also be stressed that the environmental targets imposed by the European Commission have led to a significant increase in the share of RES in the consumption of electricity in each EU country (Figure 1 bottom panel). It is worth adding that the current effects of this policy have caused the goals of the European Commission to go much further. So in the directive 2009/28/EC (European Parliament and the Council, 2009b)

the targets for renewable energy are set out, while in the Green Paper (European Commission, 2013), published in March 2013, the European Commission has created the impetus to start a discussion on the environmental targets and policies after 2020. As a result, targets for greenhouse gas emissions up to 2050 have started to be established, according to which the initial assumption of 80-95% reduction of these gases was taken (European Commission, 2011).

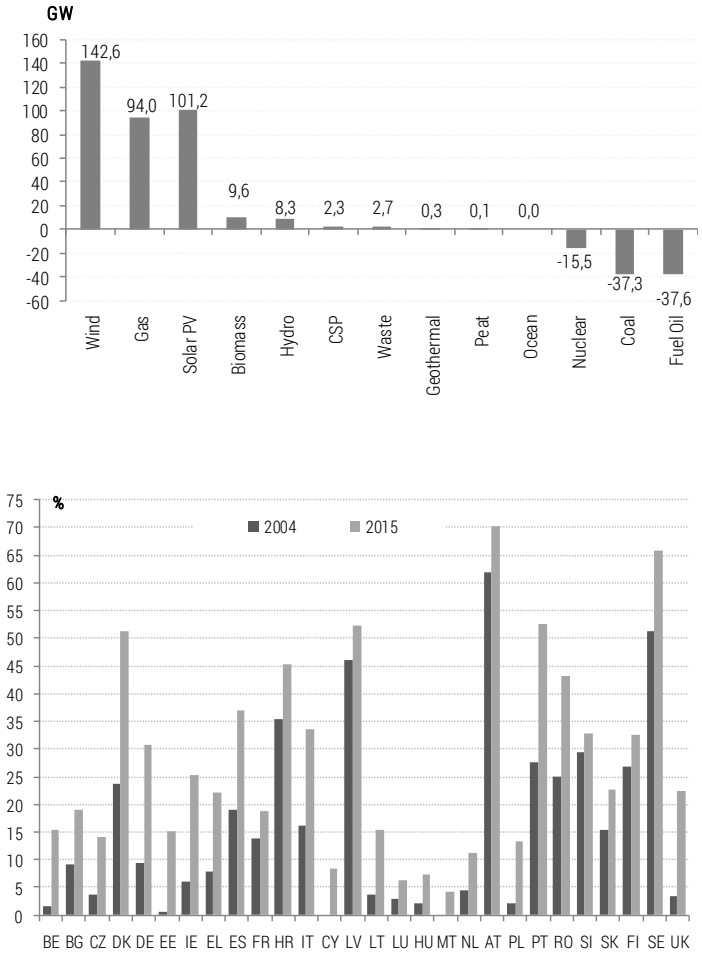

Figure 1. Net electricity installations in the EU in 2000-2016 (top panel) and the share of RES energy in electricity consumption in the EU Countries in 2004 and 2015 (bottom panel)

Source: (EWEA, 2017 p. 14); (Eurostat, 2017a).

The result of these actions at EU level in Poland have been various systems of support for projects using renewable energy in the form of green certificates and subsidies for investments, which are currently funded by the EU funds from the Regional Operational Programs 2014-2020 and the Infrastructure and Environment Operational Program for the years 2014-2020 and funds from the national programs of the National Fund for Environmental Protection and Water Management (NFOŚiGW). Also, more ambitious targets are proposed for energy efficiency. At the end of November 2016, the European Commission proposed to extend the energy savings requirements after 2020 and raised the energy efficiency target to 30% by 2030 (European Commission, 2016). These proposals will lead to the promotion of distributed energy and high-efficiency cogeneration technologies.

Electricity sector versus environment and agriculture

The investments and transformations that have taken place in the electricity sector and the electricity policy have caused that, apart from changes in the structure and regulation of the electricity sector, there have also been changes in its impact on the environment. The tangible result of this was a decrease in pollutant emissions (figure 2).

Energy industry in Poland, especially power generating plants, has made very large investments since 1990, resulting in a significant reduction in emissions of key air pollutants and greenhouse gases. The main investment outlays were made in the 1990s, so that the share of power generation in total emissions of the economy decreased significantly for each type of pollutant emitted. However, even after joining the EU, despite the fact that the shares in the economy did not change so much, the level of emissions dropped significantly (in 2005-2014 for sulphur dioxide from 879.9 to 446.5 thousands of tons, for nitrogen oxides from 327.0 to 255.2 thousands of tons, for particulates from 52.2 to 18.1 thousands of tons, and for carbon dioxide from 180.6 to 159.8 millions of tons) (see figure 2). This resulted in cleaner air, and also having a less negative impact on the soil, which is the basis of good agriculture.

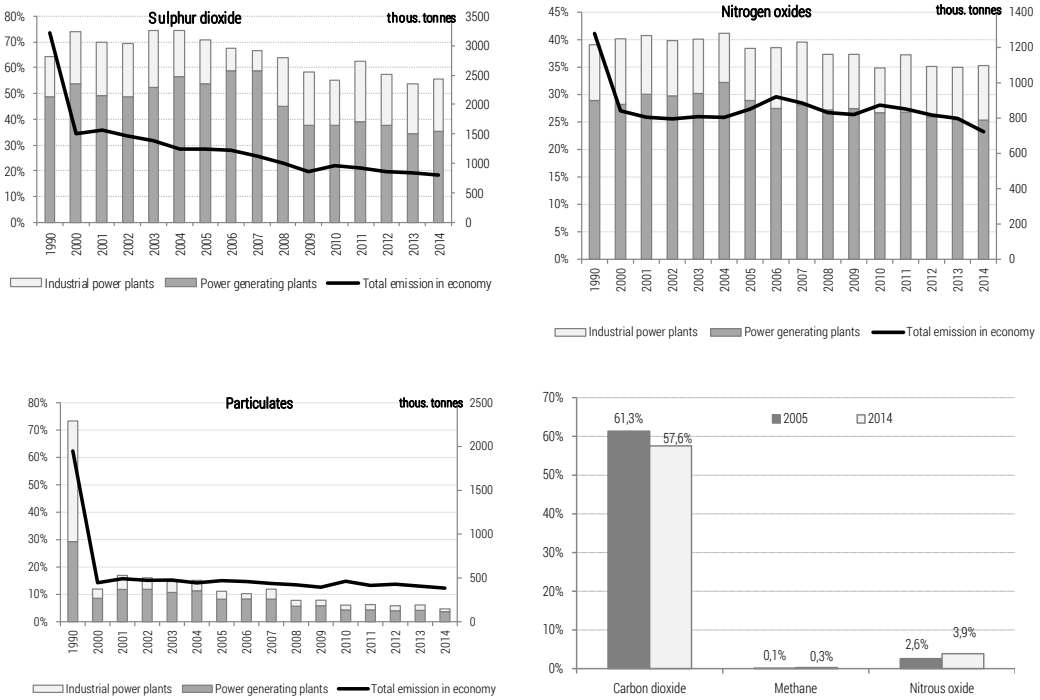

Figure 2. Share of electricity sector in the emission of major air pollutants in Poland in 1990-2014 and in greenhouse gas emission in the economy in 2005 and 2014

Source: (GUS, 2007b, p. 231, 234); (GUS, 2008, p. 233); (GUS, 2009, p. 229, 232); (GUS, 2010, p. 227); (GUS, 2011, p. 228); (GUS, 2012b, p. 225); (GUS, 2013, p. 228, 231); (GUS, 2014, p. 229, 232); (GUS, 2015, p. 221, 224); (GUS, 2016b, p. 218, 221).

The main influence of the electricity sector on agriculture as whole and rural communities is, however, takes place in a different way. Firstly, through energy agriculture, which involves the production of plants used as biomass for the production of electricity, which is co-incinerated with coal in existing power plants and CHP plants. For this purpose in Poland were established energy plantations, among which are: willow, Virginia mallow, miskantus, Rosa multiflora, sakhalin rdest, perennial grass and oilseeds such as rape or tuberous sunflower. As a result, the area of energy crops grows steadily (Grzybek, 2015). As a result, electricity from biomass is growing. While in 2004 it was 768.2 GWh, in 2015 it was 9027 GWh (GUS, 2007a, p. 37; GUS, 2016a, p. 41). Energy crops are related to energy investments, which in Poland are the result of the development of low-emission technologies and using renewable energy sources. As in the whole European Union, the share

of renewable energy in the consumption of electricity in Poland is constantly growing (figure 3 top panel). While in 2004 it was only 2.2% then in 2015 it was already 13.4%.

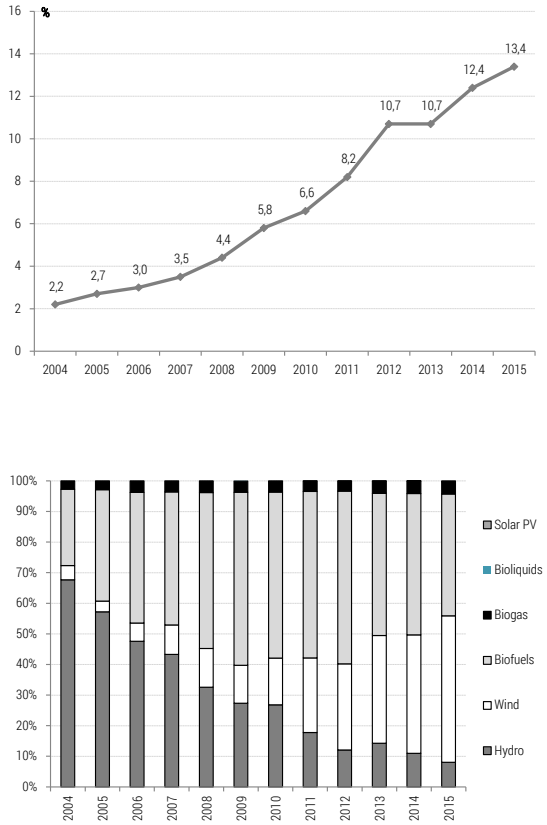

Figure 3. Share of RES energy in the consumption of electricity in Poland in 2004-2015 (top panel) and structure of the share of renewable energy in electricity production in Poland in 2004-2015 (bottom panel)

Source: author's own work based on (Eurostat, 2017a); (GUS, 2007a, p. 37); (GUS, 2012a, p. 58); (GUS, 2016a, p. 41).

In Poland, the EU's reference climate targets have not yet been met, but „green" energy carriers are becoming more and more important in the electricity sector and will be more widely used in electricity generation. This means even further development of energy crops, which implies an increase in their area and in incomes for agriculture. Although the share of biomass in total RES used in electricity production in Poland since 2013 is already

decreasing (Figure 3 bottom panel), however, this share is still very high (39.8% in 2015) and the volume of electricity produced from biomass in absolute quantities is increasing. The most important renewable energy source in Poland, as well as having the highest growth rate, is the wind energy (47.9% in 2015). This is due, on the one hand, to the fact that this technology is relatively inexpensive, next to that of biomass or waste. The second factor is the support system. In the period up to 2015, green certificates were the main source of support for which led to the development of two technologies in particular: co-firing of biomass in existing coal power plants and offshore wind power plants. The third energy carrier with significant growth dynamics was biogas.

Biogas is a technology that has been given a high priority and has received legal, political and financial support in recent years. Thus in Poland there is an increase in the amount of agricultural biogas, which is another element of the impact of energy and climate policies on agriculture and rural areas. Agricultural biogas plants produce biogas from plant biomass, from various types of waste and feces from food, plant or animal origin and from sewage. This gas, in turn, is used to produce electricity. Within the framework of the energy and climate policy in Poland is driven development of agricultural biogas plants. For this purpose the document was produced by the Ministry of Economy (in cooperation with the Ministry of Agriculture and Rural Development) and adopted by the Council of Ministers in July 2010 a strategic program in this field for 2010-2020 (Ministry of Economy, 2010). According to him, the aim is to build an average of one agricultural biogas plant in each municipality using agricultural biomass by 2020. This means the desire to build approx. 2.5 thousands such installations in Poland. Figure 4 shows a map of existing and planned biogas projects in Poland.

It can be noted that biogas plants are being built, or are being planned for their construction, throughout Poland, although practice indicates that there are numerous obstacles in this regard. These are often, apart from the administrative-legal-spatial conditions, the social resistance of the local residents. They result most often either because of the reluctance of having such a type of installation near the home or fear of change and lack of reliable and complete information on the benefits and risks. However, the construction of new biogas plants results in the development of energy crops, which in turn expands the sales opportunities of agricultural output outside the food market, ie. the energy market. As part of support for producers of electricity in agricultural biogas plants are used various incentives and financial and legal support. In mid-2016 was introduced in the Act on RES (Ustawa o odnawialnych źródłach energii, 2015), for producers being the subject to registration into regulated activity, the possibility of separating the so-called „Blue duty"

(the electricity produced in installations using agricultural biogas) from the „green duty" (Obligation to obtain and submit to the President of the Energy Regulatory Office to write off certificates of origin of electricity generated in RES or pay a substitute fee). In addition, the possibility of fulfilling the „green duty" and „blue duty" by paying the substitute fee was seriously limited. In this way incentives were created for the production of electricity in installations using agricultural biogas. Since mid-2016, according to article 223 point 1 of the RES Act, it is no longer possible to start building new installations or activities based on a green certificate system. It has been replaced by an auction system for new renewable energy generation capacity that promotes other energy carriers than wind and biomass. Advertised auctions for 2016 (Rozporządzenie Rady Ministrów ..., 2016) and 2017 (Minister of Energy, 2016) show that other technologies, mainly agricultural biogas and bio-waste, are to be supported.

Figure 4. Map of biogas projects in Poland in 2016

Source: (Bio Alians, 2016).

It is worth noting that installations using agricultural biogas are becoming more and more common (table 1). Moreover, these increases amounts are every year at a rate of over ten percent. This means that more and more electricity is produced from agricultural biogas and, on the other hand, there is a need to produce more and more energy crops.

Table 1. Number of installations in Poland using renewables energy sources

Period	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Installations using biogas*	11	74	87	103	125	144	156	170	189	196	200	206
Installations using biomass	2	6	7	11	15	18	19	27	33	36	38	41
Installations using biomass solar energy	0	0	0	0	1	3	6	9	17	119	268	473
Installations using wind energy	28	104	160	227	301	413	526	696	835	931	1039	1193
Installations using hydro energy	112	684	694	710	724	727	746	770	784	756	752	761
Install.using biomass co-combustion tech., bioliquids, biogas or agricultural biogas with other fuels	8	n.a.	n.a.	28	38	41	47	43	41	44	44	35
Total	161	868	948	1079	1204	1346	1515	1715	1899	2082	2341	2709

* It does not include biogas plants subject to registration in the register maintained by the President of ARR
Source: URE data in reports for the years from 2005 to 2016: *Sprawozdanie z działalności Prezesa Urzędu Regulacji Energetyki*, http://www.ure.gov.pl/pl/urzad/informacje-ogolne/sprawozdania/2916,Sprawozdania.html [08-09-2017].

The last element of the electricity sector's impact on agriculture is the financial element. Changes in the electricity sector caused an increase in installations using RES. It should be remembered that such installations are located in rural areas, i.e. near the energy input.

On the one hand, this results in a change of landscape in these areas and on the other hand generates revenue for municipalities in the form of taxes paid by the companies that produce electricity in these plants. Another income element for farmers is income from energy crops. They enable farmers to diversify their income. It should also be remembered that some of the crops, such as beet and rape, are used for food and for energy purposes. As a result, higher demand causes an increase in the prices of these energy crops, which translates into higher income of farmers.

Conclusions

The analysis carried out in the article indicated that the changes that occurred in the electricity sector in Poland also had implications for agriculture and rural areas. This was achieved on the one hand by the lower emission of pollutants into the air, thus lowering the negative impact on soil qual-

ity, and by promoting renewable energy sources in the country. The latter resulted in an increase in the number of installed power plants, after the accession to the EU several dozen times, and above all in the volume of energy crops. The latter enabled farmers to diversify their sources of income and increase their income. For municipalities, however, it has benefited in the form of tax revenues. The effects of the energy and climate policies of the European Commission indicate that electricity in Poland, like in other EU countries, will have an increasingly stronger impact in this area of the Polish economy. It seems that increasingly important role of climate policy and promotion of prosumers will cause us in the coming years to face the emergence of energy cooperatives and municipalities that will play the role of both producers and energy providers. This research area will certainly require more study and provide a new field for hypotheses.

Literature

Bio Alians (2016), *Raport Biogaz 2016: Rynek biogazowni rolniczych w Polsce*, Bio Alians

European Commission (2000), *Green Paper: Towards a European strategy for the security of energy supply, COM(2000)769 final***,** Brussels 2000, http://aei.pitt.edu/1184/1/enegy_supply_security_gp_COM_2000_769.pdf [15-11-2017]

European Commission (2011), *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Energy Roadmap 2050, COM(2011) 885 final*, Brussels

European Commission (2013), *Green Paper: A 2030 framework for climate and energy policies, COM(2013)169 final*, Brussels

European Commission (2016), *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank: Clean Energy For All Europeans, COM(2016) 860 final*, Brussels 2016, https://ec.europa.eu/energy/sites/ener/files/documents/com_860_final.pdf [15-11-2017]

European Parliament and the Council (2009a), *Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020* (OJ of the EU, L 140 of 5.6.2009)

European Parliament and the Council (2009b), *Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/ECand 2003/30/EC* (OJ of the EU, L 140 of 5.6.2009)

Eurostat (2017a), http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_ind_335a&lang=en [22-08-2017]

Eurostat (2017b), http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tsdcc350&plugin=1 [15-11-2017]

EWEA (2017), *Wind in power: 2016 European statistics*, WindEurope, https://windeurope.org/wp-content/uploads/files/about-wind/statistics/WindEurope-Annual-Statistics-2016.pdf [30-08-2017]

Grzybek A. (2015), *Bioenergia w Polsce. Uprawy energetyczne w Polsce – stan obecny. Referat na seminarium Uprawy energetyczne w Centralnej i Wschodniej Europie*, Warszawa, http://www.pimot.eu/attachments/article/753/Anna%20Grzybek%20-%20ITP%20POLBIOM.%20Bioenergia%20w%20Polsce.%20Uprawy%20energetyczne%20w%20Polsce%20-%20stan%20obecny.pdf [01-09-2017]

GUS (2007a), *Energia ze źródeł odnawialnych w 2006 roku*, Warszawa

GUS (2007b), *Ochrona środowiska 2007*, Warszawa

GUS (2008), *Ochrona środowiska 2008*, Warszawa

GUS (2009), *Ochrona środowiska 2009*, Warszawa

GUS (2010), *Ochrona środowiska 2010*, Warszawa

GUS (2011), *Ochrona środowiska 2011*, Warszawa

GUS (2012a), *Energia ze źródeł odnawialnych w 2011 roku*, Warszawa

GUS (2012b), *Ochrona środowiska 2012*, Warszawa

GUS (2013), *Ochrona środowiska 2013*, Warszawa

GUS (2014), *Ochrona środowiska 2014*, Warszawa

GUS (2015), *Ochrona środowiska 2015*, Warszawa

GUS (2016a), *Energia ze źródeł odnawialnych w 2015 roku*, Warszawa

GUS (2016b), *Ochrona środowiska 2016*, Warszawa

Ministry of Economy (2010), *Kierunki rozwoju biogazowni rolniczych w Polsce w latach 2010-2020, Warszawa 2010*, http://www.pigeor.pl/media/js/kcfinder/upload/files/Kierunki-Rozwoju-Biogazowni-Rolniczych-w-Polsce-na-lata-2010-2020.pdf [15-11-2017]

Ministry of Energy (2016), Projekt rozporządzenia Rady Ministrów w sprawie maksymalnej ilości i wartości energii elektrycznej z odnawialnych źródeł energii, która może być sprzedana w drodze aukcji w 2017 r.

Rozporządzenie Rady Ministrów z dnia 27 października 2016 r. w sprawie maksymalnej ilości i wartości energii elektrycznej z odnawialnych źródeł energii, która może zostać sprzedana w drodze aukcji w 2016 r. (2016), Dz.U. z 15.11.2016 poz. 1846

Sowiński J. (2014), *Koszty energii elektrycznej z odnawialnych źródeł energii*, "Przegląd Elektrotechniczny" Vol. 90 No. 8, p. 127-131

Ustawa z dnia 20 lutego 2015r. o odnawialnych źródłach energii (2015), Dz.U. z 2015 r. poz. 478, 2365, z 2016r. poz. 925, 1579

Ustawa z dnia 10 kwietnia 1997r. Prawo energetyczne (1997), Dz.U. z 1997r. nr 54 poz. 348, z późn. zm.