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"Biogas, agricultural biogas and biogas plants in Poland - selected statistical and legal aspects"

Introduction

The situation in Poland in the years 2012/2013 in terms of the stability of legal regulations for the energy sector was far from the state of stability and predictability. The negative assessment of the work on the necessary amendments to the Energy Law does not apply to its objectives, since these are mainly determined by the EU regulations, they were also associated with the need to regulate the sector. The negative assessment, therefore, relates to the transparency and strategic vision of the changes – it is difficult to say that we were dealing with them in the period in question, which may be surprising, because at the end of the year the next Polish "energy policy" was to be prepared. Of course, it is impossible not to mention the fact that the prolonging work on the regulations in the energy sector was also influenced by activities of various interest groups, which tried to use this opportunity to secure a privileged "legal position" (RES sector, different types of renewable energy, conventional energy sector). All of these elements affected the lack of stability of the law, which after all should be the determinant of a democratic rule of law.

During 2012/2013 we deal with the intensification of work on the regulations in the energy sector. The work does not only concern the issue of renewable energy sources, however, the three major acts, namely the Energy Law, Gas Law and Renewable Energy Law significantly affect the processes of regulation of this sector and its financing. Other works were on the nuclear energy law or the transmission corridors act. New solutions and potential political decisions on the directions of adding variety to the "energy mix" will affect Polish energy security over the next decade.

A specific situation in the Polish energy structure should be noticed – if we consider production of electricity, the dominant carrier is hard coal and lignite (lignite and hard coal was more than 92% of the fuel mix in the power industry in 2011). In connection with the EU's energy and climate package this monoculture in the structure of energy sector becomes a threat to the implementation of the particular directives. In particular, the problem concerns the CO_2 emission, energy efficiency and the increase in energy diversification.

A big problem for Poland is also the structure of the energy obtained within the RES. Some success is the growth of renewable energy in electricity production – in 2005 it was 3760.3 GWh, while in 2013 already 13,843.6 GWh. However, in 2012 41% of the power in the renewable energy came from co-incineration (multi-fuel combustion), which means that with the biomass installations there was obtained 49% of the electricity in the RES.[1] Taking into account the need to achieve the objectives of the climate and energy package we can refer positively to these facts, however, we should pay attention to the environmental aspect – in this case, allowing biomass co-incineration in conventional energy environmentally makes no sense, only statistical. If you do not take into account co-incineration – another quantitatively important kind of renewable energy is the wind energy (32% of the production of electricity through renewable energy and 20% of installed capacity).[2] Thus, we deal with the lack of diversity in the structure of energy generation in terms of renewable energy sources. Hence the necessary direction of changes in the direction of the adjustment is to support renewable energy as part of the regulation of renewable energy sector is the support through legal and financial instruments of other types of renewable energy and dissipated energy (micro-installations and small installations). Of course, this does not preclude actions for strategic and focused investments in the renewable energy sector - it would be of importance concerning better preparation for this purpose of transmission infrastructure.

Biogas, agricultural biogas and the obtained from these energy and/or heat does not therefore constitute an important element in terms of quantity (the installed capacity of the RES is 136.3 MW, which is 2.9%).[3] However, one must pay attention to the considerable potential of development of if only installations of agricultural biogas production (more than 32 thousand farms in Poland could potentially be used for this). The advantage of the development of biogas plants and agricultural biogas plants is their ecological character even in the use of animal waste, food waste or sewage sludge. Therefore it is worth considering a coherent system of support for

[1] Data and calculations based on CSO and ERO data.
[2] Data and calculations based on CSO and ERO data.
[3] Data and calculations based on CSO and ERO data.

research into "biogas technologies" in Poland, because it could represent a support for economic development and sustainable development of the country.

It seems that in the case of Polish the development of the biogas sector based on micro biogas plants and small biogas plants could be considered, which help overcome the economic constraints (e.g. raw material procurement, connection at the level of distribution networks, lower installation costs).[4] Of course, after purification of biogas from impurities such as sulfur, it can be pumped it into the transmission or distribution network, however, the aspect of economic efficiency of these activities should be considered here.

I. The potential of biogas in Poland

There are different types of biogas potential: (1) theoretical, (2) economic, and (3) technical. The first dimension refers to the possibilities of the potential, assuming the availability of devices that meet the conditions for acceptable performance. In the second case, would be taken into account the technical potential the use of which would make economic sense. In the latter case, or in the case of technical capacity, would be taken into account the possibility of using existing in a given period technical devices.

In Poland in 2011 there were 5762 thousand head of cattle (including 2,626 thousand cows) and 13,509 thousand pieces of swine. However, in the case of poultry, that is just the hens, as of 2011 amounted to 139,964 thousand pieces.[5] In connection with the development of the poultry market and export, we have seen a significant increase in the number of hens within several years – it should be noted almost 190% increase in their number in 2011 compared to 2000.[6]

It is worth to introduce briefly the potential of using animals for the production of biogas. One cow fed in the barn can produce annually about 12 tons of manure, and – also due to anaerobic digestion in the stomach and manure tanks – a cow produces 280 liters of methane a day. The very methane emitted only from cow manure, in the whole year accounts for 17% of the emissions.[7] In addition, one cow produces 50-55 kg manure per day, which would give from 18 to 20 tons yearly. Thus, an adult cow can produce about 20 m^3 of manure a year – an average,

[4] Projects of biogas micro-systems developed under the "capital for energy," conducted by the Science and Technology Park Euro-Centrum. See page: http://www.euro-centrum.com.pl [Access: 25.05.2013].
[5] Data based on CSO data.
[6] Calculations based on CSO data.
[7] Detailed analysis of greenhouse gas emissions by cows in: Z. Podkówka, W. Podkówka, *Greenhouse gas emissions from cows*, „Przegląd Hodowlany" 2011, No. 3, pp. 1 – 4.

from 1 m^3 of cattle manure can be produced about 25 m^3 of biogas.[8] Thus, theoretically, it can be assumed that the production of one cow manure per year can give about 500 m^3 of biogas. Of course, it should be noted that not in all cases cattle is in the barn all year, so this potential is an estimate. For comparison, we can also provide estimates for a farm which holds 410 LU[9] (pieces of swine). In this case, the annual production of the farm gives 8200 m^3 of slurry.[10]

With the "biogas calculator" provided by http://www.biogazienergia.pl and http://www.mae.com.pl (Masovian Energy Agency) one may indicate the theoretical potential of production of biogas, methane, electricity and thermal energy from 20 tons of manure (cattle and swine) a year (see Tab. 1):

Table 1
Theoretical potential of biogas production of 20 tons of manure (cattle and swine).

	YEARLY			
	BIOGAS	**METHANE**	**ELECTRICAL ENERGY**	**HEAT**
CATTLE SLURRY	545 m^3	327 m^3	1109,6 kWh	1319,5 kWh
PIG SLURRY	502,7 m^3	301,6 m^3	1023,3 kWh	1216,9 kWh

Source: Own analysis.

In addition, global production of manure in 2011 in Poland was worth 1184.4 million of PLN.[11] It should be noted that for this reason Poland has a considerable potential for agricultural biogas plants development. In fact, a biogas producer can be a farmer who has acreage of 30 ha and can use to grow corn at least 1 ha. He or she can also have livestock production – for example, have about 40 head of cattle. It is a statistical assumption of rationality of the participation of farmers in the production of biogas – these conditions are met by more than 32 thousand farms in Poland.[12]

[8] cf. M. Marszałek, M. Banach, Z. Kowalski, *Utilization of Pig Slurry by Anaerobic and Aerobic Digestion - Production of Biogas and Compost*, „Czasopismo Techniczne. Chemia" 2011, Vol. 108, No. 2, pp. 143 – 158; E. Gorlach, T. Mazur, *Chemia rolna*, PWN, Warszawa 2011.
[9] LU - Livestock Unit.
[10] Z. Ginalski, *Substrates for agricultural biogas plants,* http://www.cdr.gov.pl/pol/OZE/substraty.pdf, [Access: 11.07.2013].
[11] Data based on CSO.
[12] Assumptions of viability and advisability of investing in biogas plants presented by A. Grzybek from Institute of Technology and Life Sciences in Falenty. Website of the Institute of Technology and Life Sciences: http://www.itep.edu.pl/ [Access: 25.05.2013].

This indicates that the most suitable regions for biogas plants are: Greater Poland (9.5 LU/100 ha of agricultural area), Masovia (7.7 LU/100 ha agricultural area) and Podlachia (5.3 LU/100 ha of agricultural area). The assessment of the potential for development of biogas in Poland can also include approximately 3,100 pig farms, 1,600 farms of dairy and beef cattle, about 1,100 poultry farms and about 220 mushroom producers.[13] To describe the possibility to use such poultry farms for the production of biogas, it should be assumed that a farm of 40 thousand chickens corresponds to 160 LU (cow = 1 LU).

In 2010 the Ministry of Economy in the assessment of the energy potential of domestic agriculture indicated that we have the potential to produce 5 billion m^3 of biogas. The ministerial plan of development of agricultural biogas plants anticipates an increase in their biogas production capacity to 2 billion m^3 in 2020. The potential is mainly due to the possibility of using: (1) agricultural byproducts, (2) liquid and solid manure and (3) byproducts and residues from the agro-food industry. Besides the above mentioned features, the importance of the production of energy crops for use on substrates in biogas plants should be emphasized – in this case the potential acreage have been set at 700 000 hectares. According to the Ministry of Economy the real energy potential for biogas production (with agricultural byproducts and residues from agro-food industry) is 1.7 billion m^3. Therefore it is concluded that the quantity of gas (after cleaning) can cover about 10% of the domestic demand for it.[14]

Important "products", in the production of biogas, are substrates. One of the top substrates in the fermentation process is maize, which is due to its significant energy efficiency. However, this performance is due to high amount of dry matter. In addition, maize is characteristic for an easy "assimilation" of bacteria which are responsible for the process of fermentation.

In 2011 Polish arable land for the cultivation of maize for grain was 333 000 ha, in 2012 it was already 544 000 hectares. Therefore we dealt with more than 63% increase in the arable land. The result was a corresponding increase in the production of maize grain, which reached 4 million tons.[15] In the case of maize for feed the area in 2011 amounted to 426 thousand hectares. For the biogas production process an important role has maize silage, which is based on whole plants, CCM (Corn-Cob-Mix), pickled and dried grain and straw.

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[13] W. Wasilewski, *Grants for biogas in practice*, „Czysta Energia" 2013, No. 3 [electronic version: http://www.zielona-energia.cire.pl/pokaz-pdf-% 252Fpliki% 252F2% 252Fdotacje_biogaz.pdf [Access: 11.06.2013].

[14] Assumptions regarding the potential based on: *Directions of development of agricultural biogas plants in Poland in the years 2010 - 2020*, Ministry of Economy, Warsaw 2010.

[15] Data based on CSO.

During anaerobic digestion organic substances decompose mainly to CO2 and methane, (about 60% of organic matter is converted into biogas). The fermentation time depends mainly on the type of material and its mass. The "loss" of the obtained biogas includes the need to use the obtained gas to maintain the temperature of the fermentation process – it is estimated that it could be about 20 - 50% of the obtained biogas.[16] The characteristics of the obtained biogas are of importance, i.e. it is of value concerning the possible use in the production of electricity, heat; moreover, to supply gas to the gas grid it must have a methane content over 40%.[17]

W. Kotowski claims that in Poland every year there is 13 million tons of municipal waste casted to landfill, which means that the potential of each donated ton is to get 290 - 400 m^3 of biogas. Then within a year one can get 3.8 billion m^3 of biogas, which is only a fraction of what could be obtained from the agro-food waste.[18] Using the "biogas calculator" it can be estimated that from 20 tons of organic waste can be achieved 4388.6 m^3/year of biogas (2633.2 m^3/year of methane), while in the case of 20 tons of kitchen waste and stale food one can obtain 2396, 4 m^3/year (1437.9 m^3/year of methane).[19]

According to data from the Central Statistical Office in 2011 Poland produced 123.5 million tons of waste, of which 12.12 million is municipal waste. It was 315 kg of generated municipal waste per capita, which placed Poland among the countries of the European Union which produce the least of this type of waste. Most of the so-called mixed municipal waste (69.8%) was collected in the household.[20]

II. Biogas and agricultural biogas

It is essential to identify what is **biogas** due to the legal definitions which were introduced by the Polish legislator. In the case of a draft law on *renewable energy sources*, the legislature has the following definition of the term**: gas derived from biomass, with the exception of wholesome grains, in particular from the treatment of animal or vegetable waste, sewage treatment plants and landfills** (Article 2, section 1, of the 2011 version of the Draft). The definition excludes the gas produced from biomass, which would be result from wholesome grains. This is the only exception, because further we deal with an exhaustive list of gasses

[16] W. Jabłoński, J. Wnuk, *Management of renewable energy sources. Economic and technical aspects,* WS Humanitas, Sosnowiec 2009, p. 346.
[17] Ibid.
[18] W. Kotowski, *Wasting 3.8 billion cubic meters of gas per year?,* „Energia Gigawat" 2011, No. 11.
[19] Calculations using the website: http://www.mae.com.pl.
[20] Data based on CSO.

obtained from biomass. The biogas in particular includes gas derived from biomass from processing of animal or plant waste, sewage treatment plants and landfills. In the next version of the Draft, the definition of biogas was more detailed, that means it presented a new legal definition: **gas, whose main component is methane derived from biomass, in particular animal or plant waste treatment plant, sewage treatment and landfill** (Article 2, section 1, version of the Draft of 2012.). The amendments relate to: (1) emphasizing the components, that is the presence of the main component of biogas which is to be methane, (2) emphasizing the importance of the processing process in the system, and (3) removal of the exclusion of the type of biomass derived from wholesome grains. The removal of this provision is pointless here because of the potential impact of the energy sector on the structure of the country's agriculture; however, it should be noted that the legislature has solved this problem in a different way – that is excluded the possibility of obtaining certificates of origin of RES in a situation when for the production of electricity was used full value wood or wholesome grains (Article 61 paragraph 3 PU RES version of 2012). A similar situation is with regard to the certificate of origin of agricultural biogas, i.e. it is not available when wood or wholesome grain were used in its production (Article 64 paragraph 1 PU RES version of 2012).[21]

A similar division of **biogas** was used by the Central Statistical Office, which in the statistical study called "Energy from renewable sources in 2011" identified the following types of biogas:

1) **Landfill gas** (obtained from the fermentation of waste in landfills).

2) **Gas from sewage sludge** (obtained from the anaerobic digestion of sewage sludge).

3) **Agricultural biogas** (obtained in the process of anaerobic digestion of biomass from energy crops, crop production residues and animal manure).

4) **"Animal waste" and "food industry" gas** (obtained by anaerobic digestion of biomass wastes in abattoirs, breweries and other food industries).[22]

The draft law on *renewable energy sources* there was also introduced a legal definition of **agricultural biogas:** ***a gas produced by the methane fermentation of agricultural raw***

[21] The clarifying of the meaning of the term "wholesome grains" in the new version of the Draft Law on renewable energy sources should be noted. By these grain are meant grains which meet the quality requirements in the purchase of intervention (Article 2, paragraph 42, of the 2012 version of the Draft Law.).
[22] See: *Energy from renewable sources in 2011*, CSO 2012, p. 15.

materials, agricultural byproducts, liquid or solid manure, byproducts, waste or residues from the processing of agricultural products or forest biomass, excluding gas fuel derived from raw materials from wastewater treatment plants and landfills (Article 2, section 2, of the 2011 and 2012 version of the Draft).[23] In this case we deal with a limited list of gases obtained by the fermentation of methane (i.e., agricultural raw materials; agricultural byproducts; liquid or solid manure; byproducts, waste and residues from the processing of agricultural products or forest biomass), from which the gaseous fuels derived from raw materials originating from sewage treatment plants and landfills were excluded. The use of such materials as animal manure makes it possible to reduce greenhouse gas emissions, as a result of which it determines environmental qualities of biogas technologies.[24]

III. The development of the biogas and agricultural biogas sector

The importance of biogas plants and methane fermentation processes, which are the main processes within the system, will increase due to the environmental aspect of the global carbon cycle. Methane fermentation in the biogas plants is an alternative in the waste management. Biogas plants are another opportunity to dispose of organic waste, they play an important role in the elimination of pathogens in the hygenisation of bacteria and viruses. In addition, the unprocessed material used in the fermentation process may be used to improve fertilization of fields, and thus helps to reduce the use of pesticides. It is also indicated that there is: (1) a significant (over 80%) reduction of waste in relation to the processing of livestock manure in biogas plants, (2) reduction of the pollution of surface water and groundwater, and (3) reducing emissions of greenhouse gases (especially methane).[25] Due to the environmental protection and appropriate use of the economic potential it is advised to process biogas in local CHP plants.

According to the Agricultural Market Agency (Agencja Rynku Rolnego) in 2012 the most important, in respect of the amount, were for agricultural biogas production the following materials: (1) slurry, (2) maize silage, (3) post-distillery fermented residue, (4) remnants of fruit and vegetables (5) pulp, (6) manure, (7) whey, (8) potato pulp, (9) a mixture of lecithin and soaps

[23] In fact, with the same definition of agricultural biogas we dealt with in the Energy Act of 1997. (Dz.U. 1997 No. 54, item. 348 with later amendments). The difference is one word: (1) "with the exception of **gas fuel** acquired ..." (EA), (2) "with the exception of gas acquired ..." (DLRES).

[24] cf. A. Kupczyk, A. Wójcik, M. Majkowska, *Selected problems of development of agricultural biogas in Poland*, F. Krawiec (ed.), *Renewable energy sources in light of the global energy crisis. Selected problems,* Difin, Warsaw 2010, pp. 86 – 87.

[25] Based on B. Igliński, R. Buczkowski, M. Cichosz, *Bioenergy technologies*, WN UMK, Toruń 2009, pp. 255 - 292, A. Kowalczyk-Juśko, B. Laursen, S. Rusak, *Agricultural biogas plant of the company Poldanor in Pawłówko*, „Czysta Energia" 2005, No. 10, p. 21.

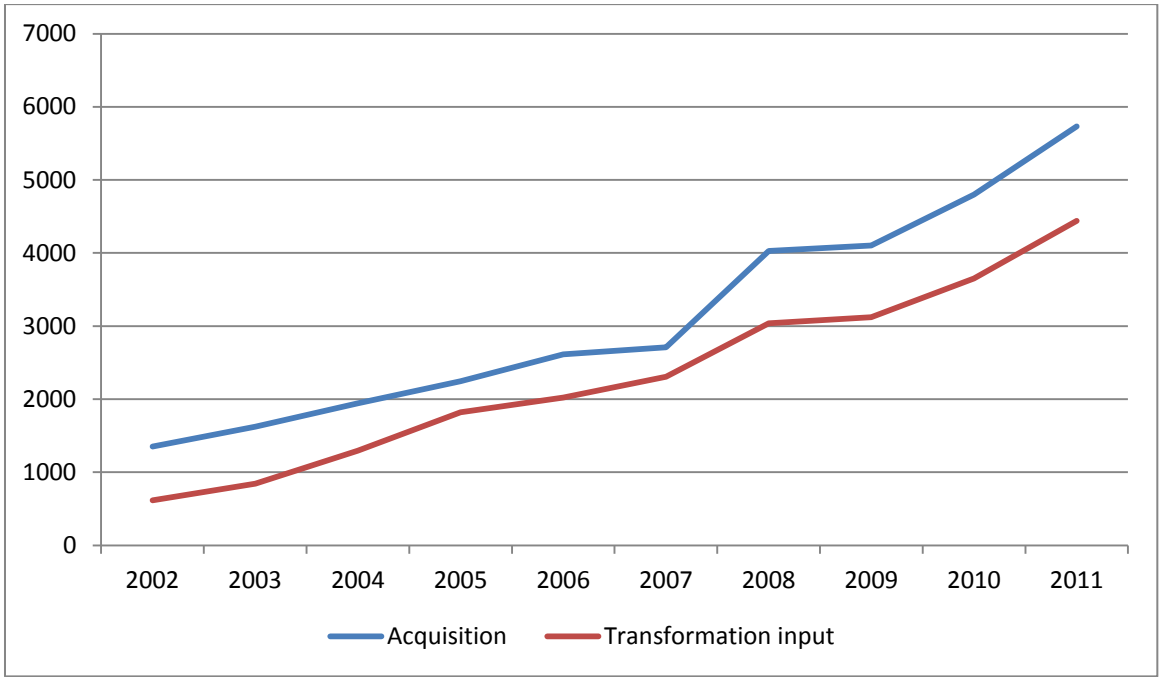
(10) fodder, (11) grass silage, (12) content of the stomach, (13) protein deposits.[26] However, according to the Energy Regulatory Office (Urząd Regulacji Energetyki) in 2012 electricity production from RES in biogas power plants was 3.8% (524.7 GWh).[27] Thus, the position of biogas in the context of other renewable energy sources was not significant, but it should be noted that the very biomass (electricity produced in power plants for biomass) accounted for 7.9%. At the same time it should be noted that co-incineration, which was released as part of the renewable energy sources, was 41.5%.[28]

Biogas should be placed within the structure of energy production from renewable sources. The percentage of biogas in the RES was 1.7% in 2010. Thus, the biogas was fifth after: (1) solid biomass (85.6%), (2) biofuels (6.7%), (3) hydro energy (3.7%), (4) wind energy (2.1%).[29] In the case of electricity production from renewable energy, biogas was on the 4th position (3.7%) after: (1) solid biomass (54.2%), (2) hydro energy (26.8%), (3) wind energy (15.3%).[30]

In the period analyzed by the Central Statistical Office (2002 - 2011), there was a continuous increase in the amount of obtained biogas [see Figure 1]. In 2011 there was 5732 TJ of biogas acquired, from which, in principle, the majority was for the input of energy transformations in industrial plants (77.1%). Final consumption accounted for 22.5%, with the majority in the trade and services sector (83.4%), while in the food and tobacco industry was only 11.2%.[31]

[26] *Information on the activities of energy companies engaged in the production of agricultural biogas in 2011-2012*, Agricultural Market Agency.
[27] *Production of electricity from RES in the years 2005 - 2013: On the basis of data issued by the Chairmen of the Energy Regulatory Office and certificates of origin, as at 23.04.2013*, ERO 2013.
[28] Percentage calculations based on data from the Energy Regulatory Office.
[29] *Energy from renewable sources in 2011,* CSO 2012, p. 24.
[30] *Ibid.*, p. 27.
[31] Data based on CSO.

Figure 1
Biogas acquisition and use for energy transformation input in the years 2002 - 2011 [TJ].

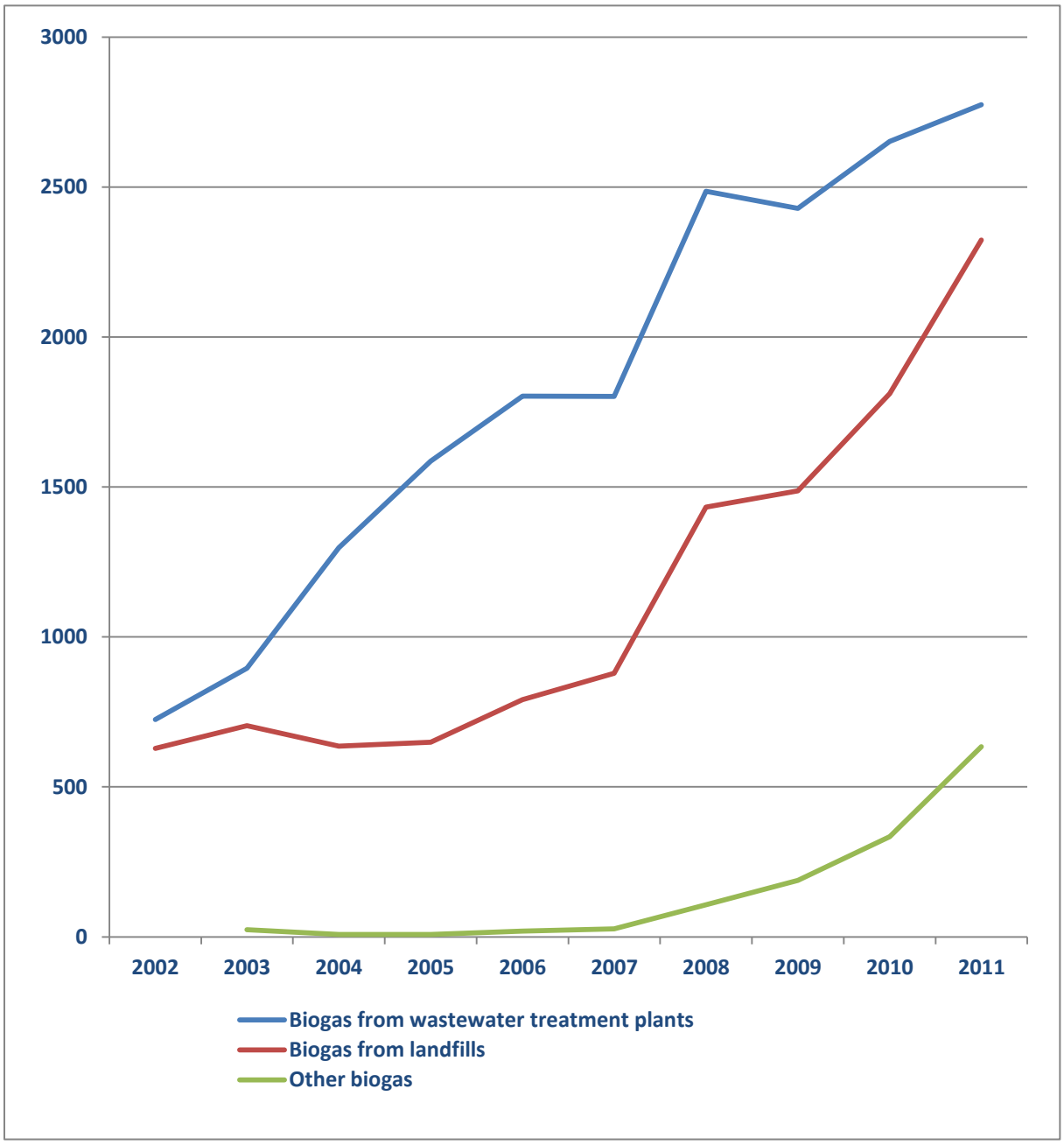


Source: Own calculations based on data and analysis of CSO.

The structure of biogas acquisition in 2011 was dominated by biogas from wastewater treatment plants (48.4%) and biogas from landfills (40.5%). In the case of biogas from landfills, to a large extent it was allocated for the energy transformation input in industrial power plants (89.7%). However, in the case of biogas from sewage treatment plants – 62% was allocated for the energy transformation input in general, and almost 38% accounted for final consumption (final). In both cases, in the period 2002 - 2011 we dealt with a continued growth of obtaining biogas [see Figure 2].[32] Despite the increase in acquired biogas, it should be noted that the potential of the renewable energy sector is not adequately used. The main factors limiting the development of biogas plants in Poland include the following: (1) organizational and legal factors, (2) technical and technological factors, and (3) the economic factors.[33]

[32] Calculations based on CSO data.
[33] cf. A. Kupczyk, A. Wójcik, M. Majkowska, *Selected problems of development of agricultural biogas in Poland*, op. cit, pp. 88 – 90.

Figure 2
Biogas production by type 2002 - 2011 [TJ].



Source: Own calculations based on data and analysis of CSO.

IV. Selected legal aspects of renewable energy / biogas

1. Economic activity in generation of "energy"[34] and agricultural biogas

In the case of the draft law on RES of 2011, the legislature indicated that it is not necessary to obtain a license to produce biogas, electricity produced from agricultural biogas, electricity produced in micro-installations (Article 3 section 2 of the draft law on RES of 2011). This provision specifically facilitated the possibility to conduct business within the renewable energy sector. This did not mean that we had to deal with the lack of regulations in this area, because the legislature determined that this activity is a regulated activity within the meaning of the Act of July 2, 2004 on the freedom of economic activity.[35] Thus, this type of activity required registration of companies producing agricultural biogas or generating electricity from agricultural biogas (Article 4 section 1 of the draft law on RES of 2011).[36] By a decision, upon a written request of an entrepreneur, the registration is made by President of the Agricultural Market Agency.

The extension of the formula for the production of biogas and electricity in shaping the company on the market – which is the prosumer should be emphasized here. This is reflected in specific regulations for smaller systems producing biogas or electricity. The legislature in the draft law of 2011, defined as **micro-systems: the system of a renewable energy source with an installed electrical capacity of up to 40 kW or of installed heat or cooling capacity to 70 kW or used to produce agricultural biogas or to generate electricity from agricultural biogas of installed electrical capacity of not more than 100 kW or of installed heat or cooling capacity of no more than 130 kW** (Article 2, paragraph 12 of the draft law on RES). However, already in the draft law of 2012 there is a division into: (1) micro-systems, and (2) small systems.

After distinguishing the two systems in the draft law of 2012 the legislature meant by micro-system: **a system of a renewable energy source with an installed total electric power capacity of up to 40 kW or total installed heat or cooling capacity to 70 kW** (Article 2, paragraph 15 of the draft law on RES of 2012) . However, the legislature understands a small system as: **a system of a renewable energy source with an installed total electric power capacity over 40 kW to 200 kW or total installed heat or cooling capacity over 70 kW to 300 kW** (Article 2, paragraph 14 of the draft law on RES of 2012). In both cases the classification

[34] Generation of electricity, heat or cold.
[35] Act on Freedom of Economic Activity of 2 July 2004 (Dz. U. 2010 r. Nr 220, poz. 1447, as amended).
[36] The authority maintaining the register is the Chairmen of Agricultural Market Agency (Article 4 section 2 DLRES).

of a plant is determined by the quantitative range of installed capacity, which at the same time determines the scope of the regulation of the activity of power generation. New regulations potentially increase the interest of companies in small systems, however, it is considered that they will not increase the growth of renewable energy development in order to achieve the objectives of climate and energy package. Despite this, it should be recognized that the position of prosumer will be strengthened in the range of facilities for micro-systems – including the expected connection fees exemption, mandatory purchases of energy produced in such systems. New solutions with the financial support under the protection of the environment will affect the development of integrated projects of biogas plants.

Determination of the activity due to the installed capacity, and therefore due to the fact if we deal with micro-systems, small system or perhaps other renewable energy system, determines the necessity of obtaining a business registration or a licence. And, **undertaking and pursuing economic activities for generation of electricity, heat or cooling from renewable energy sources in RES systems other than micro-systems and small systems require a licence** in accordance with the Draft of the Energy Law of 2012 (Article 3 of the draft law on RES of 2012).

In the case **of generating for their own use of electricity, heat or cooling from renewable energy sources in micro-systems** (by a manufacturer who is a natural person not conducting business activities) we do not deal with business activities within the meaning of the Act on freedom of economic activity of 2004 (AFEA), even selling excess energy which is not used and incorporated into the distribution network (Article 4 sections 1 - 2 of the draft law on RES of 2012). The situation is adequate for **generating electricity or heating or cooling from agricultural biogas** (Article 19 sections 1 and 2 of the draft law on RES of 2012).

However, as regards **economic activities in generation of electricity, heating or cooling from renewable energy sources in small systems, it has been classified as a regulated activity requiring registration in the "register of energy generators of small systems"** (Article 7 of the draft law on RES of 2012). This register is run by the Chairman of the Energy Regulatory Office (Article 8 section 1 of the draft law on RES of 2012).

In the case of (1) business activities for production of agricultural biogas by renewable energy systems, or (2) activities for generation of electricity or heating or cooling from agricultural biogas by renewable energy systems other than micro-systems, we deal with a regulated activity within the meaning of AFEA **requiring an entry in the "register of**

agricultural biogas producers" (Article 23, sections 1 - 2 of the draft law on RES). The register of agricultural biogas producers is run by the Chairmen of Agricultural Market Agency (Article 24 paragraph. 1 of the draft law on RES).

In terms of economic activity for production of "energy" and agricultural biogas the following situations can be indicated here (see Tab. 2):

1) **Undertaking and conducting economic activities for generation of electricity, heat or cooling from renewable energy sources by RES systems other than micro-systems and small systems require a licence** in accordance with the Draft Energy Law of 2012 (Article 3 of the draft law on RES of 2012).
2) **Production for own use of electricity, heat or cooling from renewable energy sources by micro-systems** (by a manufacturer who is a natural person not conducting business activities) **we do not deal with a business activity** within the meaning of the Act on freedom of economic activity of 2004. (AFEA) even selling excess energy which is not used and incorporated into the distribution network (Article 4 sections 1 - 2 of the draft law on RES of 2012).
3) **Production for own use of electricity or heating or cooling from agricultural biogas by micro-systems** (by a manufacturer who is a natural person not conducting business activities) **we do not deal with a business activity** within the meaning of the Act on freedom of economic activity of 2004 (AFEA), even selling excess energy which is not used and incorporated into the distribution network (Article 19 sections 1 and 2 of the draft law on RES of 2012).
4) **Economic activities for generation of electricity, heating or cooling from renewable energy sources in small systems has been classified as a regulated activity requiring an entry in the "register of energy generators of small systems"** (Article 7 of the draft law on RES of 2012). This register is run by the Chairman of the Energy Regulatory Office (Article 8 section 1 of the draft law on RES of 2012).

In the case of the draft law on renewable energy sources, the legislature shows two situations related to the installation of agricultural biogas systems, namely:

1) In the first case we deal with **renewable energy systems used for production of electricity, heat or cooling from agricultural biogas**.
2) In the second case, the legislature identified **renewable energy systems for production of agricultural biogas**.

Table 2
Types of activities in renewable energy

Type of production	System type	Range of regulation
"Energy" from renewable sources	other than micro-systems and small systems	CONCESSIONS
"Energy" - personal use	micro-systems	Not an economic activity by AFEA
Agricultural biogas - personal use	micro-systems	Not an economic activity by AFEA
"Energy" of renewable energy installations	small systems	REGISTER OF SMALL SYSTEMS (ERO)
"Energy" from agricultural biogas	RES systems other than micro-systems	REGISTER OF BIOGAS PLANTS (ARR)
Agricultural biogas	RES systems other than micro-systems	REGISTER OF BIOGAS PLANTS (ARR)

Source: Own analysis.

2. Installation of RES/biogas systems to transmission infrastructure

An important legal issue is also the installation of renewable energy systems and biogas systems to transmission infrastructure. In the first instance an entity who wants to install a biogas plant, should submit **an application to establish "the conditions of installation" to the network**. The legislature provides accurate dates of providing the conditions of connection, depending on the type of network. There was included a possibility of refusal to issue the connection conditions, for example due to technical issues and/or economic ones. Next, it is necessary to submit an "application of installation" of the system to the network together with the fulfillment of statutorily defined conditions.

In the case of a refusal of installation to the power grid (on the basis of the Energy Law of 1997) most often we dealt with technical problems, namely the lack of technical conditions for the connections (no connection power reserve, failure to meet the levels of voltage in power sequences, exceeding the criterion of short-circuit power at the connection point, exceeding the permissible voltage fluctuation rates, exceeding the permissible rate of dynamic voltage changes).[37]

[37] The reasons for refusal, based on the data of ERO.

A submitted application for connection is examined in the order of receipt. After it is accepted one can go to the next step which is signing the "agreement on installation" to the network and the technical implementation of the connection. There is a fee for connection to the transmission network. In the case of the connection we also deal with the obligation of concluding the agreement of connection to the network with the existence of technical and economic conditions of the connection (TPA principle). In the case of the draft law on renewable energy (version of the draft No. 2.0.1 of 04.10.2012) in art. 37 section 1 the legislator made the TPA principle extension with the priority to connect to the grid RES before others after the technical conditions are met:

> *An energy company conducting economic activities in the area of transmission or distribution of electricity is required to connect renewable energy systems to the network, subject to the priority of the connection of renewable energy systems before installing a system which does not constitute a renewable source of energy system, if there are technical and economic conditions for connection to the network.*

At this point one can ask a question – *Are environmental objectives a sufficient motive for the deconstruction of the doctrine of "essential facilities"*? The question is important because of the central idea, which is the desire to protect competition in different markets. The result is the we deal with the support of renewable energy at the expense of conventional energy sector, which with the certification system rather results in inequality of power companies, moreover, it results in a lack of "reality" in energy price formation on the market.

Conclusion

In 2013 Polish government have intensely worked on the changes in the energy law – including working on the draft law on the Gas Law and the draft law on RES. Poland as a member of the European Union did not sufficiently implemented the solution of the directives from energy packages and the climate-energy package – which was pointed out by the European Commission.

Work on the new arrangements was also the time when the shape of the Polish energy market was decided upon. However, there is a strong dependence of Polish in the process of electricity production on hard coal and lignite, which means that at least for 15-20 years any particular energy revolution should not be expected. Moreover, the cost of implementation of regulations related to the EU climate and energy package can destabilize Polish economy.

The problem of biogas and agricultural biogas should be regarded as one of the directions of development of renewable energy sources in Poland (of course not the only and main one). Biogas can be placed in the specificity of Polish renewable energy sources and determine the real potential of renewable energy sources.

The text presents an analysis of: (1) the potential of biogas in Poland, (2) the concept of biogas and agricultural biogas, (3) the possibility of development of biogas and agricultural biogas, (4) selected legal problems. In the latter case, the focus was on *de lege ferenda* regulations concerning: (1) business activities for generation of "energy" and agricultural biogas, (2) connection of RES systems/biogas plants to transmission infrastructure. Due to a specific dynamics of changes in the work on the draft laws, in this section the focus is only on signaling selected legal institutions.

Attachment: List of abbreviations

Abbreviations	
AMA	Agricultural Market Agency
CO_2	Carbon dioxide
LU	Livestock Unit
CSO	Central Statistical Office
GWh	Gigawatt hours
ha	Hectare
kW	Kilowatt
kV	Kilovolt
MWh	Megawatt hour
m^3	Cubic meter
RES	Renewable Energy Sources
Q	Quarter
TJ	Terajoule
TPA	Third Party Access
ERO	Energy Regulatory Office
Abbreviations of titles of documents and legal acts	
DLRES	Draft Law on Renewable Energy Sources
DLEA	Draft Law on Energy Act
DLGA	Draft Law on Gas Act
EA	Energy Act of 1997
AFEA	Act on freedom of economic activity in 2004

Source: Own analysis.