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Renewable Energy and Bio-fuel Situation in Poland

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Biofuels

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Report Highlights:
In Poland energy from renewable sources is gradually rising. In 2011 energy production from renewable sources accounted for 11.2 percent of total primary energy production.

Poland has not transposed the Renewable Energy Directive (2009/28/EC) (RED) as the government has not come to agreement on a Renewable Energy Act. Further, Poland has not fully transposed Directive 2009/30/EC on fuel specifications and quality monitoring into national law also because of lack of agreement within the government.

Among renewable sources, the wind energy sector is growing most rapidly.

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General Information:

I. Renewable Energy – Policy and Programs

The national basic legal acts that regulate obligations concerning usage of renewable energy sources (RES) and biofuels in Poland are:

- Energy Act (published on April 10, 1997; Journal of Laws of 2006, No 89, item 625), as amended,
- The Act of 25 August 2006 on bio-components and liquid biofuels (Journal of Laws of 2006 No. 169, item. 1199, as amended),
- The Act of 25 August 2006 on monitoring and controlling the quality of fuels (OJ of 2006 No. 169, item. 1200, as amended),
- The Act of 27 May 2011 amending the Act on monitoring and controlling the quality of fuels and certain other acts (Journal of Laws of 2011, No. 153, item. 902),
- Regulation of the Minister of Economy of 17 December 2010 on the quality requirements for bio-components, test methods and quality bio sampling method (Journal of Laws of 2010, No. 249, item. 1668),
- Regulation of the Minister of Economy of 22 April 2010 on the methods of testing the quality of liquid biofuels (Journal of Laws of 2010, No. 78 item. 520),
- Regulation of the Minister of Economy of 19 March 2010 on the procedure for the certification of quality bio by accredited certification bodies (Journal of Laws of 2010, No. 61 item. 379),
- Regulation of Minister of Economic Affairs concerning detailed scope of requirements for obtaining certificates of origin and purchase of electric energy and heat stemming from renewable energy sources (published on August 14, 2008; Journal of Laws of 2008, No 156, item 969),

The European Union basic legal acts are:

- Directive of the European Parliament and of the Council 2009/28/EC of 23 April 2009 on the promotion of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.
- Directive of the European Parliament and of the Council 2009/30/EC of 23 April 2009 amending Directive 98/70/EC as regards the specification of petrol and diesel fuels and introducing a

mechanism to monitor and reduce greenhouse gas emissions and amending Council Directive 1999/32/EC as regards the specification of fuel used by inland waterway vessels and repealing Directive 93/12/EEC.

The EU Directive 2009/28/EC on the promotion of renewable energy sources and Biofuels (RED) has been not yet transposed to the Polish national low, although the time frame of implementation set by the EU was December 5 of 2010. The directive deals with such issues as electric energy, warm energy and transport fuels. The Polish Ministry of Economy prepared a draft amendment to the Law on bio-components and liquid biofuels (The Act of 25 August 2006 on bio-components and liquid biofuels, Journal of Laws of 2006 No. 169, item. 1199, as amended).

The project is still discussed because of different points of view among political parties. The reason for delay was mostly the lack of agreement on the implementation of the National Indicative Targets and changes in the mechanisms of support. According to experts the policy on biofuels - in particular the imposition of a very high level of NIT – is resulting in increased prices of liquid fuels in Poland. Further promoting the use of biofuels such as B100 will result in a further increase of costs and thus retail prices of fuels.

It is most likely that the new law will come into force not earlier than in 2013. The European Commission has initiated a formal investigation against Poland which can result in substantial financial penalties.

The Long-Term Project for the Promotion of Biofuels or Other Renewable Fuels (2008-2014) is a document prepared by Ministry of Economics where the general incentives to enhance domestic production of bio-components were laid. The mechanisms, which were introduced to ensure that bio-components and liquid biofuels production process will be economical, were:

- support for bio-components production in regard to tax system and fuel charge;
- support for cultivation of energy crops as a feedstock for bio-components production;
- financial support from EU fund and national public funds for the investments regarding bio-components and liquid biofuels production;
- actions intended to encourage the increase in demand for liquid biofuels;
- scientific research activities concerning liquid biofuels and informative and educational activities in regard to liquid biofuels.

The support for bio-components producers concerning tax incentives, which enabled the use of lowered excise duty on motor petrol or diesel fuel containing at least 2 percent of bio-components and tax deduction for producers of bio-components, applied only until April, 30 2011; the government decided not to extend the program.
(Sources: www.wnp.pl; http://www.e-petrol.pl/index.php/uslugi/spotkanie-branzy-petrochemicznej/SBP11BIO-Spotkanie-Branzy-Biopaliw-2011; *The Long-Term Project for the Promotion of Biofuels or Other Renewable Fuels (2008-2014)*, Ministry of Economics)

Poland has still not managed to make a full transposition of Directive 2009/30/EC on fuel specifications and quality monitoring. The term of implementation ended on December 31, 2010. A part of Directive requirements has been implemented to the national low, but still there is no one consistent low

regulation. A project of the new Act on monitoring fuel quality, prepared by The Ministry of Economy is waiting for approval of The Council of Ministers, which is planned on the first quarter of 2013. (http://bip.kprm.gov.pl/portal/kpr/form/r199/Projekt_ustawy_o_zmianie_ustawy_o_systemie_monitorowania_i_kontrolowania_jakosci.html)

Support for electricity from renewable sources

To promote the development of electricity production from renewable sources, the government introduced the mechanism obliging the enterprises selling electricity to end-users to obtain the specified amount of certificates of origin of energy produced from RES (Green Certificates) or to pay a substitution charge.

The required share of RES in total annual sales of electricity to final customers by the company shall be not less than: 10.4 percent in 2012, 10.9 in 2013 and 11.4 in 2014.

Mandatory EU targets for renewable energy

According to the EU Directive 2009/28/EC Poland is ought to achieve by 2020 mandatory target of increasing the share of renewable energy to at least 15 percent of the gross final energy consumption. Moreover, the target concerning required share of fuels from renewable sources used in transportation sector is 10 percent by 2020 and the target concerning share of electricity from RES in gross national electricity consumption is 20 percent by 2020.

Voluntary sustainability schemes approved by the European Commission (EC)

The sustainability of biofuels production and usage has to be checked by Member States (national schemes) or through voluntary schemes which have been approved by the European Commission (EC).

Poland approved following voluntary sustainability schemes for biofuels: International Sustainability and Carbon Certification (ISCC), Red Cert. National scheme is currently being prepared by The Oil and Gas Institute in Warsaw/Poland.

II. Energy Situation in Poland

Energy production

After many years of decline acquisition of primary energy began to grow in Poland and amounted to 2,906.5 PJ in the 2011. Coal mining has been showing a downward trend. However, usage of the renewable energy sources is increasing. Coal is the most important source of energy (62 percent of total primary energy in 2011). The second-largest source of energy is lignite with the share of 18 percent. The share of other sources is as follows: natural gas 6 percent, oil 1 percent, and other, mostly renewable energy, more than 13 percent.

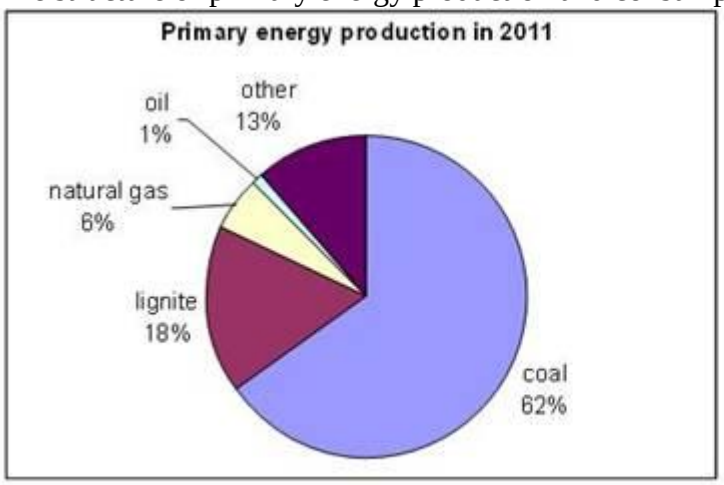
The structure if primary energy production in 2010 was following: coal – 65 percent, lignite – 17 percent, natural gas – over 5 percent, oil – ca. 1 percent and others, mainly renewable energy sources – over 11 percent.

Energy consumption

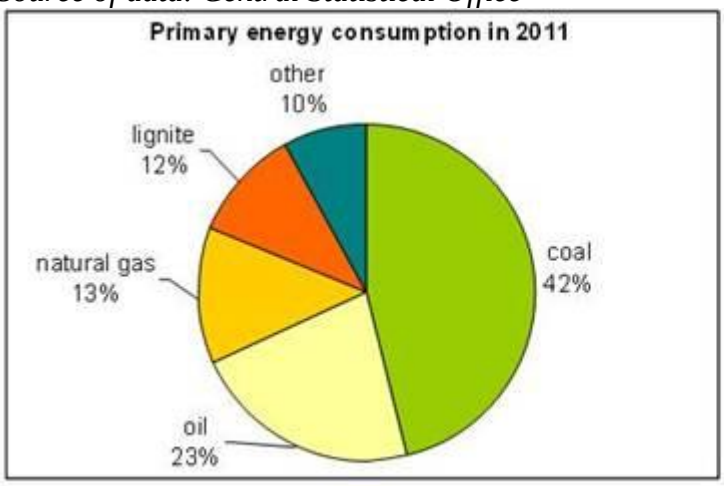
Domestic consumption of primary energy in 2011 was over 50 percent higher than production and amounted to 4,409.9 PJ. Coal was major energy resource; its share in total consumption was 42 percent. The share of oil was 23 percent, natural gas – 13 percent and lignite – 12 percent. The remaining 10

percent referred to other energy carriers. In comparison with previous years, the share of coal is decreasing in favor for oil and renewable energy sources.

The structure of primary energy production and consumption was presented on the charts below:



Source of data: Central Statistical Office



Source of data: Central Statistical Office

III. Renewable Energy Sources (RES) in Poland

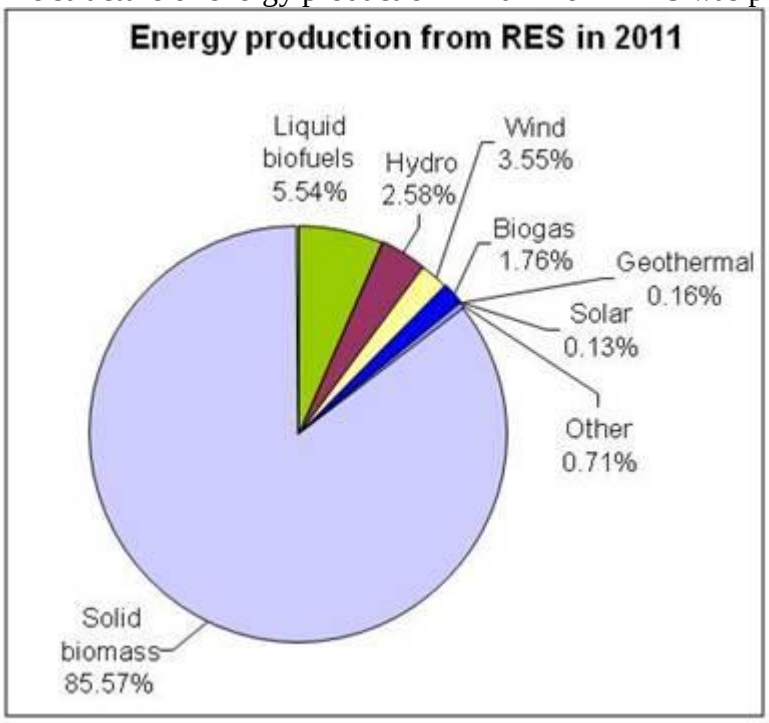
Due to the large area of agricultural terrains, Poland has a great potential to use renewable energy. The main renewable energy source in Poland is biomass. Hydro- and wind energy have also great potential and their share is increasing steadily.

Production and consumption of energy from RES

In 2011 production of energy from renewable sources accounted for 11.2 percent (325.5 PJ) of the total primary energy production (2,906.5 PJ).

Among all renewable energy sources included in the energy balance, the highest share was constituted by the solid biomass (85.57 percent). The following shares were: liquid biofuels (5.54 percent), hydro-energy (2.58 percent), wind energy (3.55 percent), biogas (1.76 percent), municipal wastes (0.41 percent), heat pumps (0.29 percent), solar irradiation (0.13 percent) and geothermal energy (0.16 percent).

The structure of energy production in 2011 form RES was presented on the chart below.



Source of data: Central Statistical Office

Consumption of renewable energy carriers in 2011 was 346.3 PJ; it was higher that production due to imports of bio-components for bio-ethanol and biodiesel production.

The increasing usage of energy from renewable sources may be illustrated by the change in number of installations using renewable energy sources and their installed power. The recent changes of number of installations for electricity production from RES are presented in the table 1; table 2 presents changes in installed power.

Table 1 - Number of installations for electricity production from RES in 2006 – 2011

Type of RES	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Biogas	74	87	103	125	144	149
Biomass	6	7	11	15	18	19
Wind	104	160	227	301	413	453
Hydro-energy	684	694	710	724	727	737

Photovoltaic	0	0	0	1	3	4
Co-Firing	N/A	N/A	28	38	41	42
Total	**868**	**948**	**1,079**	**1,204**	**1,346**	**1,404**

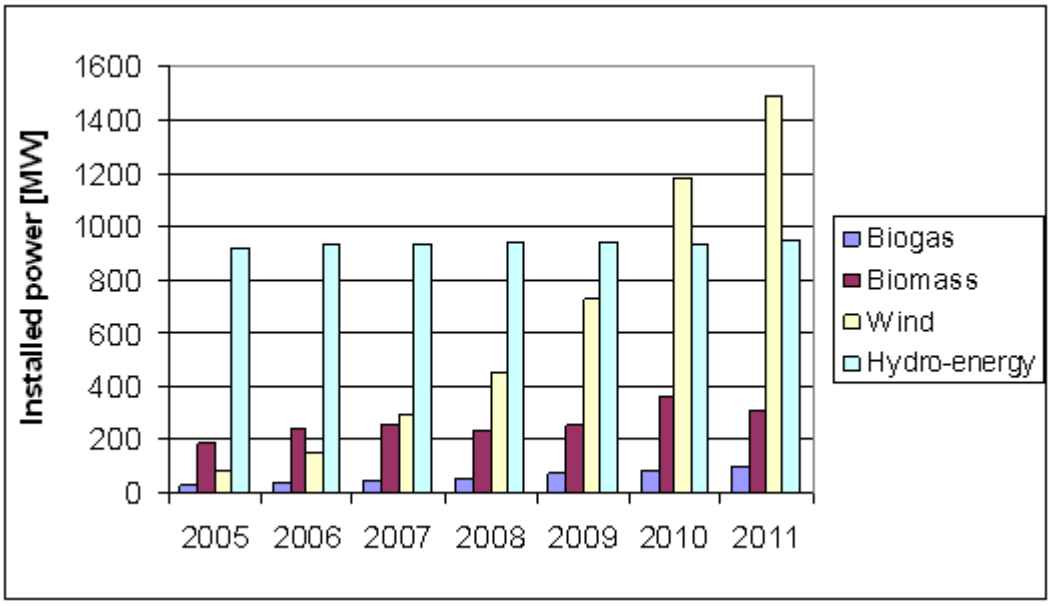
Source: Energy Regulatory Office: http://www.ure.gov.pl/

Table 2 - Installed power (MW) from RES in 2005 – 2011

Type of RES	**Power [MW]**						
	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Biogas	32.0	36.8	45.7	54.6	71.6	82.9	95.7
Biomass	189.8	238.8	255.4	232.0	252.5	356.2	309.7
Wind	83.3	152.0	287.9	451.0	724.7	1,180.3	1,489.7
Hydro-energy	922.0	931.0	934.8	940.6	945.2	937.0	949.0
Total	**1,227.1**	**1,358.6**	**1,523.8**	**1,678.2**	**1,994.0**	**2,556.4**	**2,844.1**

Source: Energy Regulatory Office: http://www.ure.gov.pl/

The chart below shows changes in installed power from different types of RES in 2005 – 2011



Source of data: Energy Regulatory Office: http://www.ure.gov.pl/

1. Biomass

Poland has a huge potential of biomass production as it has 1.6 million ha of agricultural land utilized for biomass production. Forestry biomass is also widely available as the forested area constitutes 29.1 percent of Poland's territory (which is over 9 million ha).

In Poland, the different types of biomass are used for other purposes:

- Forestry biomass (e.g. fuel wood, wood wastes, pellets, briquettes) is used for heat production, both in households and power plants,
- Crops and rapeseed are used for bio-components production,
- Agricultural by-products (e.g. straw and other plant parts which cannot be used for food production) and energy crops are used for biogas production.

According to the data provided by the Institute of Renewable Energy, the real economical potential of biomass in Poland is estimated at the level of 600,168 TJ in 2020; however, the market potential is estimated at 533,188 TJ. This market potential is constituted from various types of biomass:

- solid waste (ca. 149,338 TJ), - wet wastes (designated for biogas production – ca. 72,609 TJ),
- firewood (24,452 TJ) and energy crops (286,718 TJ). The latest data shows that in 2009 biomass production were at the following levels:
- solid biomass (217,302 TJ), liquid biofuels (17,847 TJ), biogas (4,104 TJ) and municipal wastes (29 TJ).

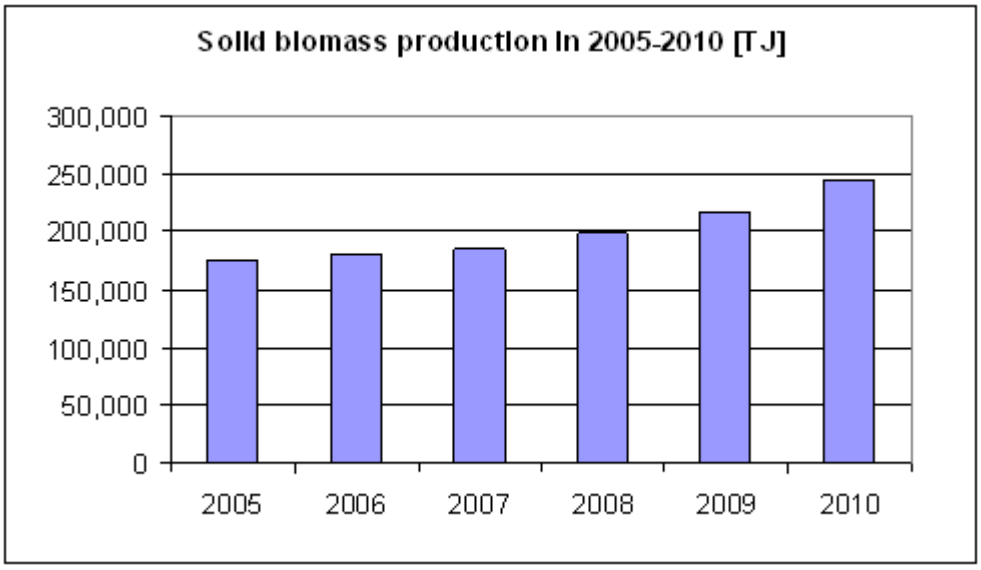
As the evaluation of the Ministry of Agriculture and Rural Development suggest, in 2009 there were imported from the third countries around 800,000 tons of biomass for energy purposes while in 2010 it was almost twice that much, ca. 1,5 million tons of biomass.
(Source: http://www.pigeo.org.pl)

In recent years, usage of biomass as renewable energy source has been gaining in importance. The table and chart below present the rising trend in biomass production.

Table 3 - Solid biomass production 2005-2010 [TJ]

	2005	**2006**	**2007**	**2008**	**2009**	**2010**
Solid biomass production	174,431	181,108	184,917	198,401	217,302	245,543

Source: Central Statistical Office



Source: Central Statistical Office

According to the Energy Regulatory Office, in 2011 in Poland there were 19 installations using biomass as a raw material for energy production. The total installed power was 393.1 MW.

In Poland usage of biomass for energy purposes is increasing. The power stations make investments in biomass. At the end of January 2012 in Szczecin Power Plant the biomass boiler started to operate. Its heat capacity is 183 MW. The installment will use almost 700,000 tons of biomass annually.

Another company, GDF Suez, is building in Polaniec Power Plant the biomass boiler, which capacity will be 205 MW. (Primarily, the plan assumed 190 MW but during the first stage of investment the capacity was increased to 205 MW). In boiler both, the solid biomass and agricultural biomass (mainly straw pellets) will be burned. The investment is expected to become operational in December 2012.

Although usage of biomass for energy purposes is gaining in importance, there are still some barriers on the Polish market, e.g. lack of subsidies for energy crops cultivations or lack of simple support system for common usage of individual biomass installations (small heat plants and heat and power plants). Another important issue is the lack of long-term predictability in the current support system for electric energy production from renewable energy sources and cogeneration.

Combined heat and power (CHP)

Combined heat and power is more and more popular in Poland. Electricity production in CHP is increasing fast in Poland. Within the last 5 years the amount of electricity produced from cogeneration has over tripled as data from Central Statistical Office shows. In 2010 approximately 5,600 GWh of electricity was produced in CHP. As the Energy Regulatory Office claims, it was 20 percent up compared to the previous year.

Fuel pellets market in Poland

The latest available data on pellet production in Poland shows that in 2009 there were 25 pellet producers in Poland. Their annual production capacity in 2009 was 640,000 tons. Pellet production in 2009 was 410,000 tons, consumption – 230,000 tons and export – 180,000 tons.
Fuel pellets market is increasing in Poland. In March 2012 the Fiten – Greenargo will launch its new pellet manufacturing plant in Tulowice. The plant will produce 30,000 tons of pellets per year. The main raw material used for pellet production is to be corn straw. By 2015 the company wants to increase production to 100,000 tons of pellets per year by building more plants.
(Sources: www.komunalny.home.pl/archiwum/?mod=tekst&id=11427; www.wnp.pl/odnawialne_zrodla_energii/fiten-rusza-z-nowym-zakladem-pelletu,163007_1_0_.html)

2. Biofuels

Fuel sector in Poland - overview

According to Energy Regulatory Office, in Poland two largest fuel producers, PKN Orlen and Lotos

Group are responsible for wholesale of about 75 percent of fuels.

Retail sale of fuels is done at the petrol stations. In Poland there are approximately 6,750 petrol stations. Most of it belongs to PKN Orlen (about 1,700 petrol stations). Second biggest polish operator is Lotos Group which owns about 300 petrol stations. In Poland, there are over 1,350 petrol stations that belong to foreign companies (BP: about 400; Shell: over 380; Statoil: about 300; Lukoil: about 110 and Neste: over 100). There are also about 3,200 petrol stations that are owned by independent operators.

Biofuels – policy and market situation

In accordance with the National Renewable Energy Action Plan for Poland, to achieve a target of 10 percent share of energy from renewable sources in transport sector by 2020, there were stated National Indicative Targets for next year (default numbers presented in the table 4).

Table 4 - National Indicative Targets on biofuels for transport sector in Poland

Year	2008	2009	2010	2011	2012	2013	2020
National Indicative Target [%]	3.45	4.60	5.75	6.20	6.65	7.10	10

Source: Central Statistical Office

The target for 2012 was set at 6.65 percent and for 2013 at 7.10 percent. However, in May 2011, the regulation amending the Fuel Quality Monitoring and Control Act entered into force, which initiated the possibility to use the reduction constant and lower National Indicative Targets in 2012 and 2013. The reduction constant was set at 0.85, which means that the lowered targets are: 5.65 percent for 2012 and 6.04 percent for 2013. To use those lowered targets, companies must prove the usage of at least 70 percent of bio-components which meet the criteria specified in the regulation (bio-components must stem from agricultural feedstock cultivated at the area of State that belong to the European Economic Area (EU or EFTA).
Currently, it is not easy to assess whether the fuel companies would chose to fulfill the obligation to sell the fuels form renewable energy sources at the standard or the lowered level due to requirement on origin of feedstock.

In February 2012 the amended regulation on quality requirements for liquid fuels entered into force. The regulation allows usage of B7 (oil with 7% of esters).The B7 biofuel should facilitate the achievement of the National Indicative Targets in upcoming years. Also, Ministry of Economics is working on the draft of the regulation amending the law on the monitoring and control of fuel quality; the draft includes part concerning the possibility of selling the E10 (gasoline with 10% of ethanol) in Poland, even though there is still no EU norm on the E10 fuel. The draft is to be given for the public consultation in the first half of 2012. The objective of that regulation is to implement the Fuel Quality Directive (2009/30) into the Polish law.

The government is currently working on regulation amending the Fuel Quality Monitoring and Control Act, which will regulate the issue of introduction of the bio-components certification system.

The current situation of domestic bio-components producers is not favorable, to large extent due to high costs of feedstock, tough competition with foreign producers, lack of complex support system for development of the sector, gaps in legal acts concerning taxes and excise duty, international trade and

classification of commodities but also problems with financing the investment in its early stages.

(Source: Presentation "Domestic biofuels market in light of amendments to the Fuel Quality Monitoring and Control Act. The upcoming challenges for the bio-components producers" by Adam Stępień, the Director of National Biofuels Chamber. International Conference "Renewable energy sources as a future of modern economy", Warsaw, September 22-23, 2011.)

Biofuels production and consumption

In recent years an increasing trend in biofuels production and consumption can be seen. Consumption is rising significantly faster than production, which means that much of the lacking bio-components must be covered by the increased imports.

The figures confirming trend in biofuels production and consumption were presented in the tables 5 and 6.

Table 5 - Biodiesel balance in 2006 – 2010 [tons]

Biodiesel	**2006**	**2007**	**2008**	**2009**	**2010**
	tons				
Production	89,126	47,447	263,729	364,832	379,802
Import	142	0	94,094	151,535	397,689
Export	51,528	19,440	0	8,343	13,060
Consumption	39,022	27,900	350,415	510,416	760,963

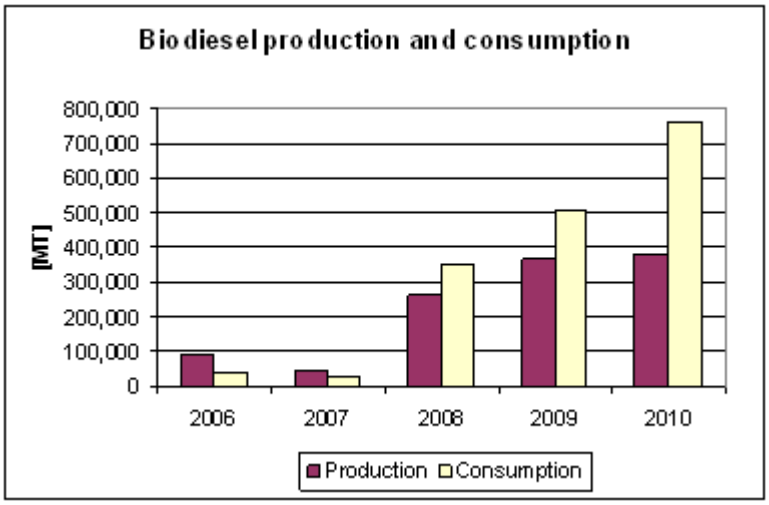
Source: Central Statistical Office

Table 6 - Bio-ethanol balance in 2006 – 2010 [tons]

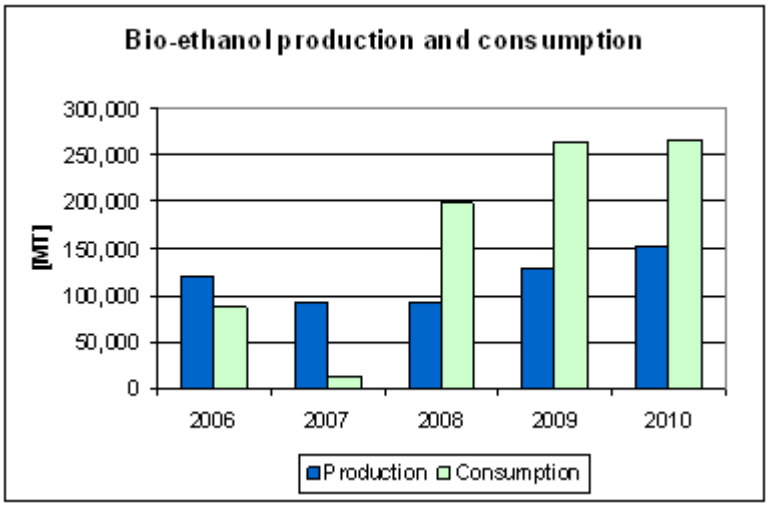
Bio-ethanol	**2006**	**2007**	**2008**	**2009**	**2010**
	Tons				
Production	119,261	92,679	92,088	127,344	152,799
Import	2,232	22,392	113,376	136,873	118,027
Export	33,302	1,509	400	0	1,450
Consumption	86,135	11,687	198,158	264,297	266,285

Source: Central Statistical Office

Production and consumption of biofuels were also presented graphically on the charts.



Source: Central Statistical Office



Source: Central Statistical Office

The preliminary data on 2011 indicates that biofuels production dropped in 2011 compared to 2010; however, biofuels consumption was higher. The Indicative Target for Poland for 2011 was 6.2 percent and it was not easy to meet that target with the then qualified types of blending (E5, E85, B5, B20 and B100). Therefore, PKN Orlen sold not cost-effective B100 to increase the consumption of fuels from renewable sources and meet the target. Not meeting the Indicative Targets would mean for the companies severe fines. Since February 2012 usage of B7 (instead of B%) is allowed in Poland.

Feedstock

In Poland bio-ethanol is made mainly form cereal (rye and wheat) and from corn. Esters for biodiesel production are made from rapeseed.

According to the analysis performed in the Institute of Soil Science and Plant Cultivation in Puławy (IUNG PIB), the area that can be allocated to 2020 for bio-components production, without harming food production, is 0.6 million hectares of cereals for bio-ethanol production and 0.4 million ha for production of rapeseed for biodiesel.

Biofuels facilities in Poland

In 2011, in Poland there were registered 13 bio-ethanol producers (15 plants) and 20 producers of esters.

The tables below list the bio-components producers registered by the Polish Agricultural Market Agency (ARR). The tables contain also the annual production capacity potential of the plants.

Table 7 - Bio-ethanol producers and production capacity

No	Name	Localization	Annual production capacity	
			[million l]	[MT]
1	AKWAWIT-POLMOS S.A.	Leszno	95	74,980
2	AKWAWIT-POLMOS S.A.	Wrocław	70	55,249
3	Destylacje Polski Sp. z o.o.	Oborniki	150	118,390
4	BIOAGRA S.A.	Nysa	140	110,497
5	Destylarnia SOBIESKI	Starogard Gdański	70	55,249
6	PHP Wiesław Wawrzyniak	Niedźwiady	50	39,463
7	Polski Koncern Spirytusowy Sp. z o.o.	Ińsko	45	35,517
8	BIOETANOL AEG Sp. z o.o.	Chełmża	19	14,996
9	BIOETANOL AEG Sp. z o.o.	Nowa Wieś Wielka	20	15,785
10	Komers International Franciszek Madry	Straszyn	32	25,257
11	SOLANUM Sp. z o.o.	Kutno	20	15,785
12	ORTUS Przedsiębiorstwo Obrotu Paliwami	Lenarty	16.8	13,260
13	Wielkopolskie Zakłady Farmaceutyczne BIO-WIN S.A.	Murowana Goślina	13	10,260
14	Podlaskie Gorzelnie SURWIN Sp. z o.o.	Suchowola	12	9,471
15	WIRASET	Promna	11	8,682
	TOTAL		**763.8**	**602,841**

Source: Agricultural Market Agency

Table 8 - Biodiesel producers and production capacity

No	Name	Annual production capacity	
		[million l]	[MT]
1	BIOAGRA-OIL S.A.	226	198,944
2	WRATISLAVIA - BIO	170.087	149,724
3	BIOPALIWA S.A.	120	105,634
4	LOTOS Biopaliwa Sp. z o.o.	113.25	99,692
5	Rafineria Trzebinia S.A.	110	96,831
6	EUROSERVICE ZPT	100	88,028
7	PPHU AS- GOLD	50	44,014
8	AGROPIN Sp. z o.o.	25	22,007

9	JK EKO-ENERGY Sp. z o.o.	17	14,965
10	BIOESTRY Sp. z o.o.	10	8,803
11	ALEKS-FRUIT Sp. z o.o.	10	8,803
12	SOLVENT WISTOL S.A.	6	5,282
13	POLMAX POLSKA S.A.	4	3,521
14	PPHU GES	1.5	1,320
15	PHP KAREX	0.75	660
16	Zaklad Doswiadczalny Instytutu Zootechniki	0.075	66
17	Krzysztof Boguszewski	0.024	21
18	Firma U-H Krzysztof Kosalka	0.01104	10
19	Podlaski Osrodek Doradztwa Rolniczego	0.0047	4
20	Zdzislaw Nosek	0.00079	0.7
	TOTAL	**963.7**	**848,330**

Source: Agricultural Market Agency

3. Biogas

Polish biogas sector is growing very fast. In 2011 there were 144 biogas plants with the capacity of 96 MW. The updated data provided by Energy Regulatory Office (URE) shows that at the end of February, 2012 there were 171 biogas plants (electrical capacity: 103.5 MW). Most of the biogas plants are relatively small. The existing biogas installations in Poland are designed to produce electricity in combination with heat.

Raw materials

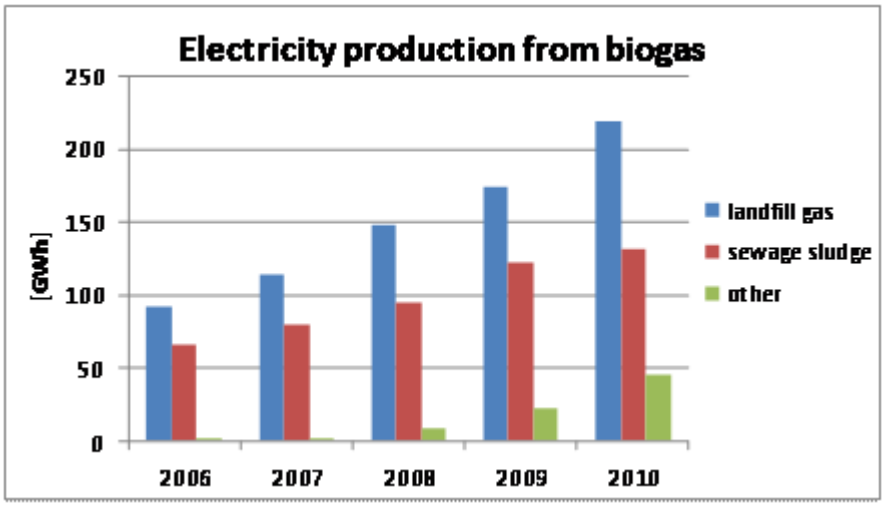
In Poland most of the biogas is produced sewage sludge (over 50 percent) and landfill gas (almost 40 percent). The remaining part of biogas is produced from other feedstock (e.g. energy crops, plant and animal wastes, animal production and plant production wastes).

The statistical data on biogas production in 2006-2010 was presented in the table and chart below. The biogas sector is developing fast in Poland. At the same time, the structure of shares of various feed stock for biogas production is changing. In recent years, biogas production from agricultural feedstock is gaining in importance. In accordance with the Agricultural Market Agency, which is responsible for registering the agricultural biogas producers, as of March 12, 2012 there were 22 installations (installed electrical capacity: 23.7 MW) producing biogas from agricultural feedstock whereas at the end of 2010 there were only 8 of them.

Table 9 - Electric energy production from biogas in 2006 – 2010 by type of feedstock [GWh]

	2006	2007	2008	2009	2010
Total production	160,1	195,2	251,6	319,2	398,4
landfill gas	92	113,6	148,4	174,8	219,9
sewage sludge	66,7	79,5	94,9	122,7	132,4
Other	1,5	2,1	8,3	21,7	46,1

Source: Central Statistical Office



Source: Central Statistical Office

Table 10 - Installed power in biogas in 2006 - 2010 [MW]

	2006	2007	2008	2009	2010
Biogas – total	33	40	52	68	81
landfill gas	25	29	31	38	44
sewage sludge	7	10	19	24	31
Other	1	1	2	5	6

Source: Central Statistical Office

Development of biogas sector – policy

The general directions for development of biogas sector in Poland are included in the following strategic documents:

- *Polish Energy Policy until 2030 (PEP 2030)*
- *Guidelines for the development of agricultural biogas plants in Poland in 2010-2020*
- *National Renewable Energy Action Plan (NREAP)*

The PEP 2030 sets out the need to implement directions on construction of agricultural biogas plants, assuming that on average one biogas plant in each municipality should be created by 2020.

To meet the assumptions and create conditions for the implementation in Poland around two thousand of agricultural biogas plants by 2020, the document *Guidelines for the development of agricultural biogas plants* were created. According to the principles included in the document, in most of the rural municipalities, which are in hold of appropriate amounts of waste biomass, one biogas plant with an electrical capacity of about 0.5-1 MW may be developed. In the *NREAP* it is assumed that by 2020 the installed electrical capacity of biogas plants (including the installation on wastewater treatment plants, landfills and agricultural biogas plants) is to be 980 MW. It also assumes electricity production at the level of 4,018 GWh per year by 2020.

Difficulties to biogas development

In Poland biogas investments often encounter various protests. Many investments in biogas plants

cannot be carried out as investors do not get permission for the construction. There is strong resistance from the society – local inhabitants and communities or ecologists. They claim the biogas investments will result in bad smell from biogas production, water and arable land contamination, decrease in the land prices or lowered chances for agro-tourism development.

4. Hydro-energy

In Poland the terrain is mostly lowland which is not favorable for construction of large hydropower plants. Nevertheless, it is water which still has a significant share in electricity production from renewable sources. In 2010 it was 26.8 percent.

Given the hydrological conditions, the development of hydropower sector in Poland is associated mainly with small hydroelectric power stations. According to the data provided by Energy Regulatory Office, at the end of 2011 there were operating 737 hydro-electric power stations; their installed electric capacity was ca. 946.3 MW. Most of them are small hydroelectric power stations. The number of those small power plants is increasing steadily. The revised data by Energy Regulatory Office shows that as of March 2012 there were 746 small hydro plants (electric capacity: 951.4 MW).
(Source: http://www.zielonaenergia.eco.pl/index.php?option=com_content&view=article&id=164:stan-rozwoju-energetyki-wodnej-w-polsce-i-na-wiecie&catid=50:woda&Itemid=216 http://www.ure.gov.pl/uremapoze/mapa.html)

The statistical data on installed power and electricity production from hydro-resources was showed in the tabled 10 and 11.

Table 11 - Installed power in plants using renewable energy sources in 2006 - 2010 [MW]

	2006	2007	2008	2009	2010
Hydro-power plants	925	922	929	932	936
plants with installed power < 1 MW	72	72	74	77	78
plants with installed power from 1 MW to 10 MW	181	178	183	184	185
plants with installed power > 10 MW	672	672	672	672	673

Source: Central Statistical Office

According to the *NREAP*, the planned installed power in 2020 is 1,152 MW, out of which:
- small hydro stations < 1MW : 142 MW;
- hydro stations from 1 MW to 10 MW : 238 MW;
- Hydropower plants > 10 MW : 772 MW.

Table 12 - Electric energy production from hydro-resources in 2006 - 2010 [GWh]

	2006	2007	2008	2009	2010
Hydro-electricity production	2,042.3	2,352.1	2,152.2	2,375.1	2,919.9
plants with installed power < 1 MW	247.9	306.3	290.2	292.2	516
plants with installed power from 1 MW to 10 MW	566.6	658.1	605.4	627.9	667.2
plants with installed power > 10 MW	1,227.8	1,387.7	1,256.6	1,455	1,736.7

Source: Central Statistical Office

According to the *NREAP*, hydroelectric potential in Poland is relatively small. The theoretical potential is estimated at 23 TWh per year, the technical potential at 12 TWh per year, and economic potential at

8.5 TWh per year.

Country's hydroelectric potential is distributed unevenly. About half of this potential (6,177 GWh per year) is attributed to the Vistula River; its right bank tributaries, including the Dunajec (814 GWh per year), San (714 GWh per year) and Bug (309 GWh per year) also have a huge potential. Hydroelectric potential of the Oder is much lower and is estimated at approximately 10 percent of total capacity.

5. Wind energy

Wind energy sector is currently developing most dynamically among all renewable energy sources in Poland.

According to Energy Regulatory Office, at the end of 2011 there were in Poland 526 licensed sources producing wind energy with the total installed power attaining 1,616.4 MW. The number of wind energy installations is growing fast. The data from September 2011 shows that than there were 484 licensed sources producing wind energy with the installed power of 1,489 MW. In 2011 there were existing 59 wind farms in Poland and 10 were under construction.

The statistical data on development of wind energy sector was presented in the tables 13 and 14 and graphically on the chart.

Table 13 - Installed power in wind energy in 2006 - 2010 [MW]

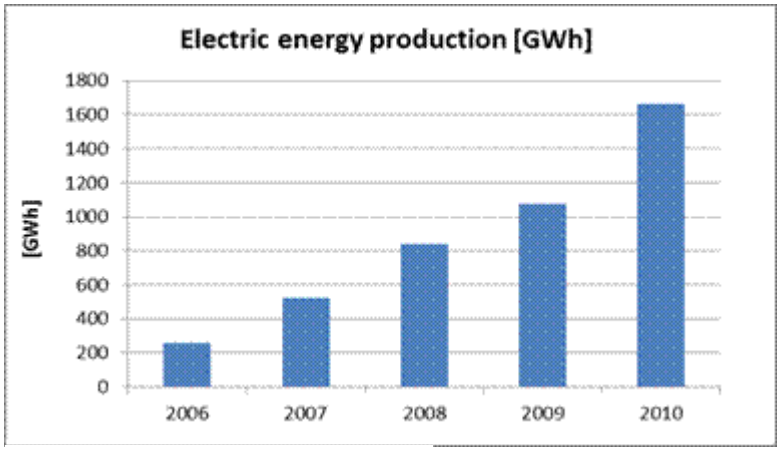
	2006	2007	2008	2009	2010
Installed power [MW]	172	306	526	709	1,108

Source: Central Statistical Office

Table 14 - Electric energy production in wind installations in 2006 - 2010 [GWh]

	2006	2007	2008	2009	2010
Electric energy production [GWh]	256.1	521.6	836.8	1,077.3	1,664.3

Source: Central Statistical Office



Source: Central Statistical Office

The best conditions for the development of wind energy sector are at the northern and central part of Poland. In the *NREAP* the following parts of Poland were mentioned to be particularly preferable for wind energy investments:

- The Baltic coast, especially in its eastern part,
- North-eastern part of Poland (around Suwalki and Gołdap)
- Open areas of Warmia, Mazury and Pomerania,
- South Polish mountainous areas (mainly Podkarpacie and Lower Silesia).

The National Renewable Energy Action Plan envisages that in 2020 the total installed power in wind energy will be 6,650 MW, out of which: on-shore wind farm: 5,600 MW, off-shore wind farm: 500 MW and small installations in wind energy: 550 MW. The total electric energy production forecasted in the *NREAP* is 15,210 GWh.

Challenges for wind energy sector

Polish wind energy sector is facing many challenges. The main problem for the Polish sector of wind energy is the issue of difficulties with obtaining the technical conditions for connection to the network grid and defining the reasonable cost of the connection. Other problems concern: poor infrastructure in rural areas, lack of proven methods to avoid conflict with the protection of the landscape or a long period to obtain the required permits. Many problems concerning obtaining permits for the construction and very long administrative procedures are due to the lack of local development plans and difficulties with validation of the environmental impact studies of the planned investments.

6. Solar energy

In Poland, solar radiation density on a horizontal plane is ranging from 950 to 1,250 kWh per m2 annually and it is distributed unevenly throughout the year. Approximately 80 percent of the total annual insulation is received during six months in spring and summer – from April to September. In Poland, the most favorable areas in terms of solar radiation is the southern part of the Lublin province and the central part of the country; annual irradiation is ranging there from 1022 to 1048 kWh per m2. The area receiving low sunlight is the north coastal strip.

Currently, solar energy is used in Poland mainly as a source of heat through solar collectors. Solar installations are mainly small and located at the top of the buildings. Solar collectors are commonly used in houses or public buildings. According the Internet portal ioze.pl, the total area of solar collectors is estimated at 1,500 m2. Statistical data on heat production from solar energy is presented in the tables 15 and 16.

Table 15 - Heat production in solar collectors in 2006 - 2010

	2006	2007	2008	2009	2010
Production [TJ]	11	15	54	83	100

Source: Central Statistical Office

Direct production of electricity using photovoltaic panels in Poland is marginal at the moment. Photovoltaic panels, for economic reasons, are used only on a small scale. However, the *National Renewable Energy Action Plan* assumes an increase in installed power in photovoltaic up to 3 MW by 2020. As the data provided by Energy Regulatory Office shows, at the end of 2011 in Poland there were 6 photovoltaic installations with the total capacity of 1.124 MW.

7. Geothermal energy

In Poland, the temperatures of geothermal resources available for use for heating purposes are relatively high. The geothermal waters generally occur in Poland at depths from 700 to 3,000 m; their temperatures range from 20 to 100 degrees C. The most suitable seems to be the use of geothermal waters within the Podhale Basin and the district Grudziądz-Warsaw and Szczecin. So far in Polish operates eight geothermal district heating companies.
Statistical data on heat production is shown below.

Table 16 - Heat production from geothermal energy in 2006 - 2010

	2006	2007	2008	2009	2010
Production [TJ]	535	439	531	600	563

Source: Central Statistical Office

Due to the fact that Poland is situated outside the areas of modern tectonic and volcanic activity, the usage of deep steam to produce electricity is currently uneconomical in Poland. It is confirmed by the guidelines in the *NREAP*, which assumes no electricity production from geothermal resources by 2020.
(Sources: http://www.mae.com.pl/odnawialne-zrodla-energii-energia-geotermalna.html http://www.pga.org.pl/geotermia-zasoby-polskie.html)

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- Polish Economic Chamber of Renewable Energy: http://www.pigeo.org.pl/
- Agricultural Market Agency: http://www.arr.gov.pl/
- Polish Wind Energy Association: http://psew.pl
- http://ioze.pl
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Legal Acts:
- *The Long-Term Project for the Promotion of Biofuels or Other Renewable Fuels (2008-2014),* Ministry of Economics
- *Polish Energy Policy until 2030 (PEP 2030)*
- *Guidelines for the development of agricultural biogas plants in Poland in 2010-2020*
- *National Renewable Energy Action Plan (NREAP)*

Presentations:

- *"Domestic biofuels market in light of amendments to the Fuel Quality Monitoring and Control Act. The upcoming challenges for the bio-components producers"* by Adam Stępień, Director of National Biofuels Chamber. International Conference *"Renewable energy sources as a future of modern economy",* Warsaw, September 22-23, 2011.