

White Paper

THE RENEWABLE ENERGY SECTOR IN POLAND

F R O S T & S U L L I V A N

In cooperation with



POLISH INFORMATION AND
FOREIGN INVESTMENT AGENCY

Published by Frost & Sullivan and the Polish Information and
Foreign Investment Agency (PAIIZ)

October 2008

About This Document

The following whitepaper outlines the findings of a study conducted by Frost & Sullivan for the Polish Information and Foreign Investment Agency (PAIiIZ) on the Renewable Energy Sector in Poland. The paper focuses on the recent trends and developments in the sector, the market drivers, including the EU and Polish legislation, and the potential shown by individual renewable energy sources in Poland. It also discusses prospects for the further development of the sector.

ABOUT THIS DOCUMENT	2
EXECUTIVE SUMMARY	3
1. OVERVIEW OF THE RENEWABLE ENERGY SECTOR IN POLAND	4
2. MARKET DRIVERS AND RESTRAINTS	8
2.1. LEGAL DRIVERS	8
2.2. ECONOMIC DRIVERS	12
2.3. MARKET RESTRAINTS.....	13
3. POTENTIAL SHOWN BY INDIVIDUAL ENERGY SOURCES	14
3.1. HYDROPOWER	14
3.2. GEOTHERMAL ENERGY	14
3.3. SOLAR ENERGY	15
3.4. BIOMASS.....	16
3.5. WIND.....	16
4. INVESTMENT SUPPORT AVAILABLE IN THE SECTOR	18
5. OUTLOOK FOR RENEWABLE ENERGY SECTOR DEVELOPMENT IN POLAND	20
ABOUT FROST & SULLIVAN	21
ABOUT PAIiIZ	22

Executive Summary

The renewable energy sector in Poland has been undergoing extensive changes. This has been a result of various factors, but, particularly, the influence of the EU Green Energy policy. The recent EU policy requires Poland to achieve 15 per cent share of renewable energy in final energy consumption by 2020. This target is very ambitious for Poland and is expected to drive the sector's growth significantly in the coming years.

Renewable energy still accounts for a small share to primary energy production and use in Poland. The energy sector is still dominated by the hard coal and lignite industry, as Poland is rich in these natural resources. Among renewable energy sources (RES), the most widely produced and used sources are biomass and hydro. Other sources such as solar, geothermal and wind are getting more importance in the Polish primary energy balance. The prospective to develop the use of renewable sources is bright, as the country possesses large renewable resources, particularly in the form of biomass, wind and geothermal energy sources.

In Poland renewable energy is increasingly being used for electricity, heat and biofuels production. Utilisation of geothermal and solar energy for heating is becoming an increasing interest to individual investors. Production and consumption of biofuels has also been on the rise in Poland. This sector is set for further dynamic development with the new target of 10 per cent share of biofuels in the final energy consumption in transport to be achieved by 2020.

Green electricity has been the fastest growing segment. There has been a constant growth of installed capacities for electricity production from renewable energy and a prominent increase in the amount of green electricity generated. The most spectacular growth was observed in wind segment; notable increase was also seen for biomass and biogas utilisation. Introduction of supporting mechanisms such as Green Certificates and Power Purchase obligations in October 2005 was positively received by the market, which has witnessed a boost in investments since then.

In order to achieve specified renewable energy targets, significant private investment is needed. Realising that additional financial support is necessary to make the RES projects profitable, the EU and the Polish Government has developed a number of supporting mechanisms. In detail, investors in the renewable energy sector can obtain financial assistance in the form of grants and preferential loans in Poland. The most prominent financial support is envisioned from the EU funds and programmes. Prior areas for financial assistance are projects aimed to build or increase capacity of wind farms, biomass and biogas power plants, small hydro production, heat production from geothermal and solar energy and biofuels projects.

In sum, favourable investment atmosphere, presence of large renewable resources, combined with financial support and market mechanisms, should encourage the development of the renewable energy sector on a large scale. Renewable energy has a potential to become one of the fastest growing sectors of the Polish economy.

1. Overview of the Renewable Energy Sector in Poland

Primary Renewable Energy Production and Consumption

The Polish energy sector is still dominated by hard coal and lignite energy sources. Primary energy structure is heavily leaned towards hard coal and lignite production. Coal power and combined heat and power (CHP) remain the dominant energy producers. Poland has also been exporting a large share of the coal produced. Primary energy consumption also depends on hard coal and lignite sources with a share of 61.2 per cent. Dependency on energy imports is among the lowest in the EU as oil and gas contribution to energy use is relatively smaller¹.

The renewable energy sector has a relatively recent history in Poland and the contribution of renewable energy sources (RES) to primary energy use and production is still small. In 2007, RES share in primary energy production was 7.7 per cent, while its share in primary energy consumption was 5.6 per cent.

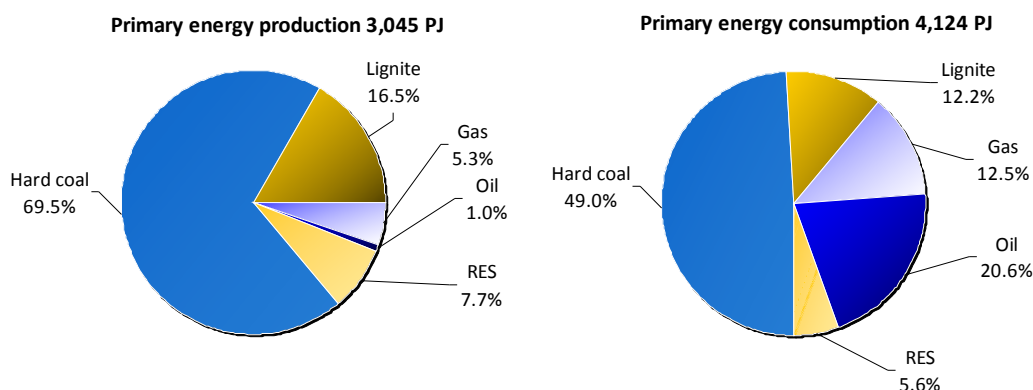


Figure 1: Structure of Primary Energy Production and Consumption in 2007

Source: National Statistics and Frost & Sullivan Analysis

Energy generation from RES is heavily leaned towards biomass. Frost & Sullivan estimates that about 90 per cent of renewable energy produced in Poland is from biomass. The majority of this biomass is utilised for local heating by individual households; however, its use in other spheres is under constant development. Another source that has a long tradition of use in Poland is hydropower, which, currently, contributes about 3.5 per cent of the total RES production. However, of late, Poland is focusing more on using other RES such as wind, solar and geothermal for energy generation. Biofuels and biogas production is also constantly gaining in importance, though they currently contribute a small share of about 4.8 per cent to total RES production.

¹ The differences between energy production and consumption are determined by energy imports, exports and stock change. Currently, Poland consumes more energy than it produces and fulfils its energy needs by imports of such sources as oil and gas.

Electricity Generation from RES

In the recent years, Poland has emerged as a country with one of the most dynamically developing green electricity sector in Central and Eastern Europe. There has been a notable increase in electricity generation capacity from RES. Frost & Sullivan estimates that the market was marked with an additional 150 MW installed capacity, bringing the total installed capacity to 1,528 MW in 2007. The majority of this capacity expansion was driven by spectacular development of wind energy utilization with an additional capacity build of 113 MW. Frost & Sullivan expects that about 200 MW would be installed in 2008, with most of these additional capacities attributed to wind farms.

Over the last years, solid growth has also been seen for capacity expansion for biomass and biogas plants. Only biomass plants' capacities grew about 5 times since 2004, while that of biogas plants grew about 2 times. The lowest dynamics has been observed for hydropower, which grew on an average by only 1-2 per cent.

Table 1: Total Installed Capacity for Electricity Generation from RES (MW)

Energy Source	2002	2003	2004	2005	2006	2007*
Biomass	1	17	52	190	239	260
Biogas	15	18	22	33	35	48
Wind	59	60	65	124	173	286
Hydro	840	873	881	922	931	934
Total	915	968	1,020	1,269	1,378	1,528

*Source: Ministry of Economy, Frost & Sullivan Analysis, *Frost & Sullivan Estimate*

The amount of electricity generated from RES has also witnessed a solid growth in the last few years. Currently, it produces about 2.3 times more green electricity than in 2003. Frost & Sullivan estimates that a total of 5185 GWh of electricity was generated in 2007, which is about 23 per cent higher than the previous year. Spectacular growth rates in green electricity generation were observed for wind farms, whose production in 2007 almost doubled since the previous year. In absolute terms, biomass energy sources contributed the most to the increase in green electricity generation (additional 500 GWh were generated in 2007). The largest part of this biomass utilisation was contributed by co-firing biomass with coal in coal power plants.

As a result of the above-mentioned processes, the structure of green electricity generation has undergone a dramatic change in the country. Hydropower, though still contributing a very large share of RES electricity, has gradually lost its dominant position. In 2007, biomass overtook hydropower with a larger contribution (45 per cent and 43 per cent, respectively). Though wind utilisation is still taking place on a small scale, its share is growing significantly. Frost & Sullivan forecasts that the share of wind energy would grow from its current 9 percent to about 30 per cent in 2010.

The biggest producers of green electricity in Poland are energy group Enea, Elektrownia Połaniec S.A. (group Electrabel), Południowy Koncern Energetyczny (The Southern Poland Power Company), International Paper Kwidzyn and Mondi Packaging Świecie.

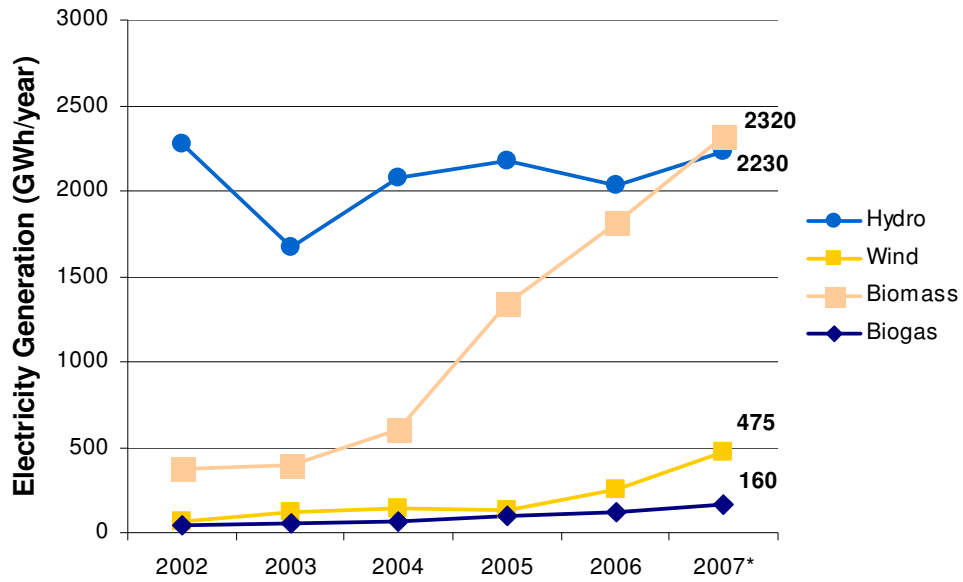


Figure 2: RES Electricity Generation

Source: National Statistics and Frost & Sullivan Analysis, *Frost & Sullivan Estimate

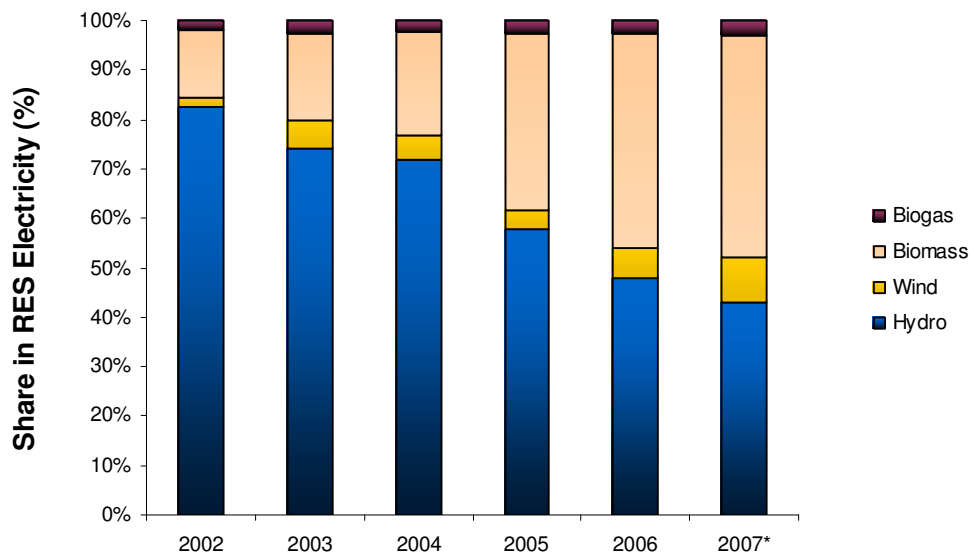


Figure 3: Structure of RES Electricity Generation

Source: National Statistics and Frost & Sullivan Analysis, *Frost & Sullivan Estimate

Heat Generation from RES

Renewable energy as a source of heat production has also been increasing in Poland. Frost & Sullivan estimates that there were 4,790 TJ produced from RES in 2007, which represents a 10 per cent growth over the previous year. Currently, the major RES source for heat production is solid biomass. Utilization of geothermal and solar energy sources has been on a small scale but constantly growing in Poland. Currently, the country is engaged in activities to discover the potential of alternative sources such as biogas, geothermal and solar energy in heat generation.

The companies which operate in the RES heat generation sector include Elektrociepłowni Warszawskie S.A. (group Vattenfall), Poldanor S.A., Dalkia Group and Praterm Group.

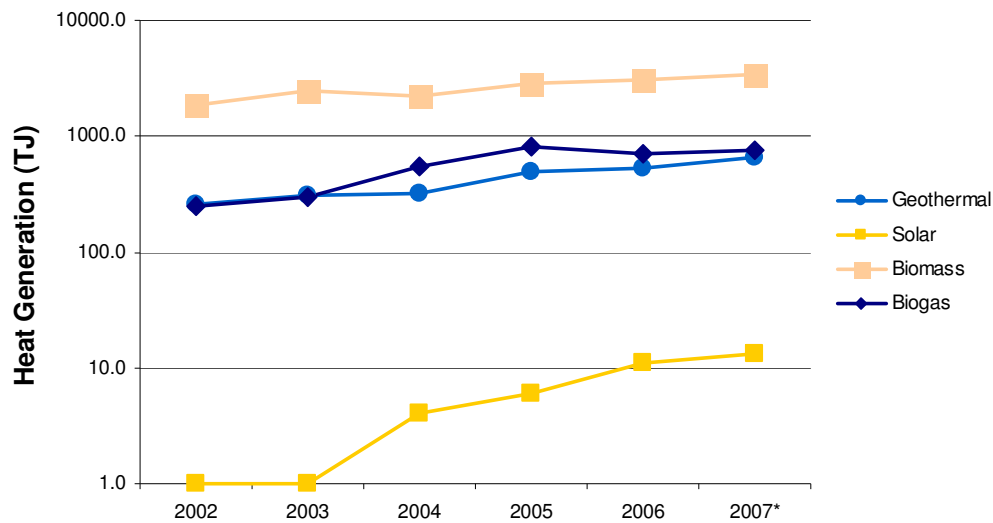


Figure 4: RES Heat Generation

*Source: National Statistics and Frost & Sullivan Analysis,*Frost & Sullivan Estimate*

Biofuels Production from RES

Poland has witnessed an increasing interest for biofuels production and utilisation and this is driven by a number of factors. Poland, like other member states of the EU, is obliged to reduce considerably its greenhouse gases (GHG) emissions and gradually shift its transport system to eco-friendly alternatives. This task is feasible, as Poland has enough raw materials to produce biofuels. Besides, biofuels and biofuel mixtures are nowadays less expensive to manufacture and therefore much cheaper than they were a few years ago. Moreover, biofuels usage in engines and boilers is both economical and safe. Also, biofuels reduce the demand for conventional gasoline and fuel blends, and can thus significantly contribute to Poland's energy independence and security of supplies.

Poland has experienced a significant rise in biofuels production. Since 2005, biofuels production has increased by more than 1.5 times. Bioethanol production increased the most and its growth rate exceeded that of total biofuels production.

Frost & Sullivan estimates that in 2007, 229,225 tonnes of biofuels were produced in Poland, up by about 10 per cent over 2006. Growth rates of the production have presently slowed down because many Polish biofuels companies stopped production, as a response to postponed subsidies by government and cuts in tax incentives.

Poland has not only become a large exporter of biofuels to neighbouring markets such as Germany, but has also experienced a considerable rise in domestic consumption. Since 2005, consumption of biofuels has increased by more than doubled. Frost & Sullivan estimates that there were 150,176 tonnes of biofuels placed on the market in 2007, which represents a growth rate of about 20 per cent over 2006. The biggest share of biofuels consumption was attributed to bioethanol, as a large portion of biodiesel was exported to neighboring markets. Still, it is observed that biodiesel consumption is increasing in Poland at impressive growth rates. It almost doubled in 2006 in comparison to the previous year and continues to show solid growth rates surpassing that of biofuels consumption.

The Polish biofuels market is highly concentrated with only a few major participants that dominate the market. The most prominent companies include Akwawit-Brasco, Rafineria Trzebinia, Elstar Oils, Lotos Biopaliwa and Solvent Wistol. In addition, there are a few newcomers such as J&S, Petrostry and Biopal.

2. Market Drivers and Restraints

2.1. Legal Drivers

EU Renewable Energy Policy

Legislation imposed by the European Union has been the main driving force for the growth of the renewable energy sector not only at the overall EU level but also at the individual member state level. The reasons behind EU policy's focus on renewable energy sources (RES) development are soaring prices on traditional fuel, growing dependence on imported energy sources, as well as environmental concerns. Increase of RES in the total energy balance is seen as a way to strengthen EU energy sustainability and to address ecological issues such as climate changes and CO₂ emissions. RES development also leads to the creation of new jobs, allows to stimulate investments and to bring new dynamism to the EU economy.

As a member of the Kyoto Protocol, the EU has agreed to upon 8.0 per cent reduction of greenhouse gas emissions during the period 2008 to 2012 from the 1990 levels. Europe is facing the worst climate change in the world as a result of global warming, which is caused by greenhouse gas emissions. The average global temperature increase over the previous century was 0.7 centigrade while the increase in temperature in Europe was 0.95 centigrade. This alarming increase in temperature is driving the need for an immediate shift to cleaner alternative energy sources.

The critical component of EU Energy Policy was a White Paper of the European Commission on Renewable Energy issued in 1997. This paper underlined the importance of renewable energy development and established targets regarding RES share in the EU's total energy consumption. A target of 12 per cent was set to be achieved by 2010.

However, the target is too high to be achieved, despite the certain progress, which the EU countries have made. There have been a number of reasons for this including administrative problems, weak regulatory framework, as well as lack of legally binding targets. Variations in national energy policies caused the progress to be very uneven between member states.

In order to address these issues and to add long-term vision to the renewable energy sector, the European Commission adopted a Renewable Energy Roadmap in 2007. New binding target for the EU was set at a level of 20 per cent RES share in final energy consumption in 2020. Moreover, binding national targets for member states in consistence with the overall EU target have been announced. Each member state is obliged to adopt a national action plan to achieve its target by March 31, 2010.

Apart from mandatory targets, the proposal establishes a common framework addressing electricity, transport, heating and cooling sectors for the promotion of renewable energy. It lays down rules relating to administrative procedures, guarantees of origin, electricity grid connection from renewable energy sources, and environmental sustainability criteria for biofuels. The European Council has also made commitments to reduce CO₂ emissions by 20% and to reach 20% energy efficiency by 2020.

The commitment of 20% share in final energy consumption to be shared by member states is arrived at by a flat-rate approach modulated by respective GDP's to reflect fairness. Poland is to achieve a national target of 15 per cent RES share in the final energy consumption in 2020. In addition to this target, the country is obliged to reach 10 per cent share of biofuels in final energy consumption in transport. These binding legal targets are ambitious for Poland, but would function as a driver for the development of the renewable energy sector and should further stimulate investments.

Promotion of electricity generation from RES is seen by the EU as a primary way to achieve the binding targets. The European Directive 2001/77/EC from 2001 requires that all member states should set the national indicative targets for the consumption of the electricity produced from renewable sources. Member states are obliged to take the appropriate steps to endorse greater consumption of electricity produced from renewable sources². As a part of the Accession Treaty, Poland is obliged to promote electricity from RES and to achieve a target of 7.5 per cent RES share in gross electricity consumption in 2010.

² The European Directive 2001/77/EC

Green Energy Policy of Poland

Poland has developed its own policies to foster the renewable energy sector and comply with the EU standards and objectives. The primary document, which underlines energy policy of the Polish Government is the Guidelines for Poland's Energy Policy till 2020, endorsed by the Council of Ministers in 2000. The document articulates the importance of RES promotion in Poland.

The next important regulative document is called the Development Strategy of Renewable Energy Sector approved by the Polish Parliament in 2001. The document sets targets for RES share at the level 7.5 and 14 per cent in primary energy balance to be achieved in 2010 and 2020, respectively. The objective to reach 14 per cent RES share is further confirmed by the Long-Term Strategy of Sustainable Development for Poland till 2025, which was endorsed in 2002.

There are additional policies in place, which support the promotion of renewable energy sector in Poland. The Polish Energy Law Act adopted in 1997 and amended in 2002, 2003, 2004, 2005, 2006, 2007 is the milestone for regulations in the energy sector. Regarding RES, the Law stipulates the following:

- **Power Purchase Obligations from Renewable Sources.** Energy enterprises that sell electricity to end consumers in the territory of Poland are obliged to prove a minimum share of energy produced from RES in their total annual sale (5.1 per cent in 2007, 7.0 per cent in 2008, 8.7 per cent in 2009 and 10.4 per cent in 2010). The target of 10.4 per cent in 2010 corresponds to 7.5 per cent in gross electricity consumption (target, which was set by the EU). No differentiation between RES used for green electricity generation is made.
- **Compliance with Power Purchase Obligations.** If power purchase obligations specified above are not complied with, distribution companies pay “a compensation fee” instead of buying electricity produced from RES. If companies neither buy green electricity nor pay the compensation fee, they are forced to pay an administrative fee, which is at least 30 per cent higher than the compensation fee.
- **Green Certificates.** Green Certificates were introduced in October 2005 and became instruments of electricity support obtained from RES. Green Certificates of origin have to be presented by distribution companies to the Polish Regulatory Energy Office. Green Certificates are traded on the Polish Power Exchange. The Polish Power Exchange was founded in 1999 with the first transaction made in 2000. The Polish Power Exchange provides a platform for trading the energy contracts between market participants: buyers, sellers and financial intermediaries. The objectives of the Polish Power Exchange include monitoring and control of the wholesale power exchange, improvement of efficiency of the Polish power sector and adapting it to competitive environment and requirements of the EU. The Polish Power Exchange also provides auxiliary services for market players including transaction clearing and brokerage services³. Green Certificates which are now can be traded at the Polish Power Exchange became a driver for the Polish Green Certificates market development.

³ Polpx.pl

- **Obligation of Total RES Electricity Purchase.** All green electricity generated should be purchased. Green electricity is sold at an average market price of traditional electricity from the foregoing year. Average market price is declared by the Energy Regulatory Office. In 2007, the average market price was established on the level of 128.8 PLN/ MWh.
- **Two Sources of Revenues for Investors and Green Electricity Producers:** The first source come from green electricity sales at the market price and the second source arise from sales of property rights on Green Certificates at the Polish Power Exchange. The cost of Green Certificate is about twice the average market price for electricity. The first source ensures 35% of the total revenue while another 65% is derived from the sales of Green Certificates.
- **Grid Connection Costs.** Costs to the grid connection are lowered to 50 per cent for electricity produced from RES.
- **Excise Tax Exemption.** Ordinance of the Minister of Finance on the Excise Tax in 2002 stipulated an exemption from the excise tax on electricity produced from RES. Currently, the excise tax on electricity amounts to 0.02 PLN for 1 KWh.

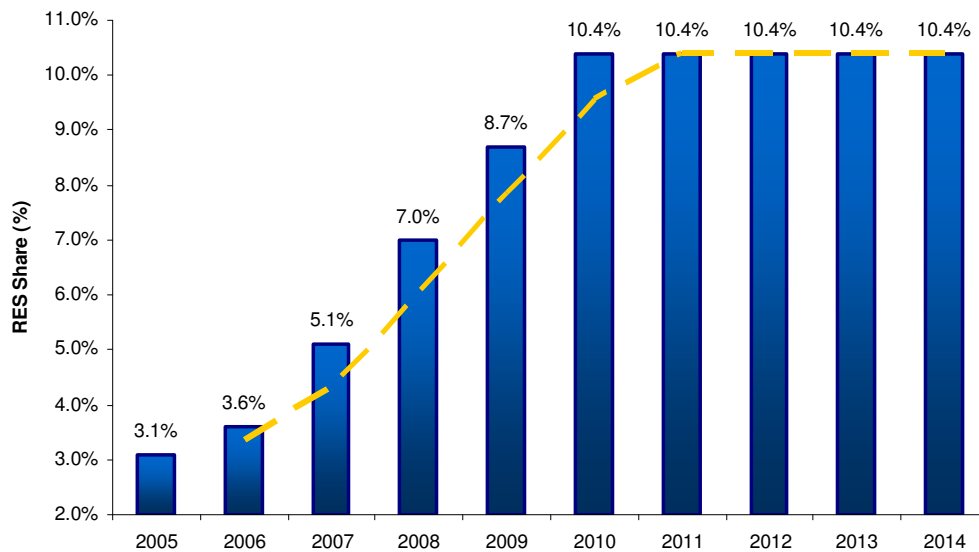


Figure 5: Required RES Share in Electricity Sold to Final Consumers

Source: Ministry of Economy, 2006, Frost & Sullivan

Table 2: Major targets set for Polish Renewable Energy Sector

Origin	Quantitative Target
EU mandatory target	15% share of renewable energy sources in the final energy consumption in 2020
EU mandatory target	10% share of biofuels in the final energy consumption in transport in 2020
EU indicative target	7.5% share of renewable energy sources in gross electricity consumption in 2010
EU indicative target	5.75% share of biofuels consumption in petrol and diesel use for transport in 2010
National short-term target	7.5% share of renewable energy in the primary energy balance by 2010
National long-term target	14% share of renewable energy in the primary energy balance by 2020

Source: Frost & Sullivan analysis

2.2. Economic Drivers

In addition to the most powerful legislative factors, the renewable energy sector in Poland is driven by key economic factors, such as:

- Rising prices of traditional energy sources, particularly of oil and gas (prices for oil more than tripled between January 2004 and March 2008⁴). Oil and gas import plays an important role in the Polish energy balance and souring prices mean increasing costs to the Polish economy. This drives movement to switch to cheaper and more reliable alternative energy fuels.
- RES are expected to be economically competitive over traditional energy fuels in the middle- and long-term. There has been a continued trend of reduction in the cost of renewable energy over the last 20 years. For instance, the cost of wind energy per kWh has fallen by 50% over the last 15 years⁵.
- Costs of investment in the renewable energy sector have been falling. This includes declining installation and generation costs. This would low entry barriers for market participants in terms of capital required. As an example, now the solar photovoltaic systems are more than 60% cheaper than they were in 1990⁶.
- Poland can adapt the most efficient and up-to-date technologies which have been developed by other EU countries – leaders in renewable technologies. Better technology allows getting more utility out of the installed systems per year.

⁴ World Bank, 2008

⁵ The Renewable Energy Roadmap, 2007

⁶ The Renewable Energy Roadmap, 2007

- Poland is determined to follow a strong example set by its Western European neighbours (Denmark, Spain, Germany), which have experienced a spectacular growth of the renewable energy market.
- Development of the renewable energy sector might bring enormous economic benefits in terms of increased employment and renewable energy technology exports.

2.3. Market Restraints

There is a number of restraints which the Polish renewable energy sector is facing. Some of them are:

- At present, generally the cost of renewable energy exceeds that of conventional energy sources. Electricity generated from renewable energy sources is unfairly priced as against electricity generated from fossil fuels. Electricity generated from fossil fuels is not charged for the pollution they cause.
- Majority of renewable technologies require higher initial capital investment compared to traditional technologies. The installation costs range from 900 Euro to 1,150 Euro per kW for electricity generated using wind energy to as high as 3,953 Euro per kW for electricity generated using solar photovoltaic technology.
- Poland still has a poor transmission infrastructure and experiences problems with grid connection. The Polish infrastructure still requires significant investment to ease the connection to power grid of various energy sources including renewable energy.
- Administrative barriers and red tape has also been a barrier for investors. Overcoming such barriers can be very complicated and time consuming. Investors still have to allocate a lot of time getting the documents approved by authorities and obtaining expert analysis and reports. In the wind sector, issues arise from the acquisition and lease of the private land. Additionally, many areas are not available for development as they are under the environmental protection program Natura 2000⁷.
- Lack of financial assistance for investment to individuals investors (for example, in the solar thermal sector, there is lack of small grants for individual investors for installation of solar collectors).
- Lack of political will to change. Strong commitment to renewable energy use is required on all governmental levels. Poland needs to execute a stronger will to cut its coal dependency and switch to less polluting energy sources.
- There is a need for policies that aim to increase the role of RES not only in the electricity market but also in the heat systems. So far, electricity production from renewable energy has become a priority to reach the renewable targets for both the EU and Poland. Stronger policies accompanied by support programs are needed to enlarge the use of renewable sources for heat generation.

⁷ Puls Biznesu, 2008

3. Potential Shown by Individual Energy Sources

3.1. Hydropower

Hydropower has been used in Poland for long, in spite of relatively low hydropower resources. In general, Poland is a flat country with relatively disadvantageous distribution of precipitation and high soil permeability. Most of the hydropower plants are concentrated near the river Wisła, on the right side of the coast. Favourable conditions for small hydropower development exist in Karpaty, Sudety, Roztocze, on rivers of Baltic region and on river Odra. The major hydropower plants are Żarnowiec, Porąbka-Żar, Włocławek, Żydawo, Solina and Niedzica.

Table 3: Hydropower economic potential

Source	Potential (CWh/a)
Main rivers	11 950 GWh/a
Small hydropower production	1 700 GWh/a
Rivers of Baltic region	280 GWh/a

Source: Polish Energy Regulatory Office

Development of big hydropower plants is inhibited by ecological concerns expressed by the local community. In contrast, there has been a notable increase in the number of small hydropower plants with a capacity of less than 2 MW. In Poland, there are 424 small hydro power plants out of which 75% belong to the private sector⁸. This trend is likely to continue and there is unlikely to be any construction of big hydropower plants in the country in the near future.

Energy derived from water is solely used for electricity production. Though losing its dominant position, hydropower still contributes a large share of 43 per cent to total electricity production from RES.

3.2. Geothermal Energy

Poland has a huge potential for geothermal energy as the country is rich in geothermal low enthalpy deposits. These deposits are contained in three sedimentary provinces, which cover about 80 per cent of the total territory of Poland. Resources are distributed evenly across the territory and are easy for extraction. In total, they amount for about 6,600 km³, with a temperature range of 25-150 Celsius.

⁸ ecologia.pl

Currently, contribution of geothermal energy to heat production from renewable energy is small but is constantly growing. According to the EuroObserv'ER⁹, in 2006, a cumulated installed capacity for direct use of geothermal energy excluding heat pumps amounted to 92.9 MWth. Additionally, there were 8,300 installed heat pumps with a cumulated installed capacity of 106.6 MWth.

The number of private households, which use geothermal sources for dwelling and water heating, is constantly increasing in Poland. Geothermal energy is most popular in Zakopane and Podhale regions. Frost & Sullivan estimates that about 250 thousands of private households as well as 90% of hotels in Zakopany use the geothermal energy for heating. In Poland, several geothermal plants have been installed: in Podhale (district heating for nearby towns), Pyrzyce (district heating for 14,000 residents), Mszczonów (district heating for 6,000 residents) as well as in Bańska Niżna and Słomniki. In Uniejów, a geothermal plant (with the use of both geothermal energy and biomass) is under development till 2010. The projects have been private and municipal initiatives with the financial support from the EU funds and non-governmental organizations such as World Bank. Prospects for further market development are promising as individual investors start to realise that initial investments associated with installation would be profitable in the long term.

There are also experimental projects proving the potential of geothermal resources use in farming, greenhouse heating and timber drying. In Poland, geothermal energy sources are virtually not used for electricity production.

3.3. Solar Energy

Poland is characterised by uneven distribution of solar energy throughout the year with 80 per cent of sunlight being attributed to spring-summer period. Solar energy is mostly harnessed in central part of Poland which has an annual capacity of 1,022-1,048 KWh/m². The least capacity is shown in northern, eastern and mountainous southern regions with 1000 KWh/m² and less annually.

In Poland, solar energy is mainly used for heat generation purposes by private households. The solar thermal market is still small, but is constantly growing. According to the EuroObserv'ER¹⁰, cumulated total capacity of installed collectors in 2006 was about 164,000 m² with 114.7 MWth. About a quarter of this total capacity was installed in 2006.

Usage of solar energy for electricity generation is still at a very small scale in Poland. According to the EuroObserv'ER¹¹, in 2007, 0,200 MWP were installed in Poland, bringing cumulative photovoltaic capacity to 0,638 MWP. Dynamic development of this market strongly depends on the cost effectiveness of photovoltaic technologies to investors and producers.

⁹ Geothermal Energy Barometer – 2007

¹⁰ Solar Thermal Barometer – 2007

¹¹ Photovoltaic Barometer – 2008

3.4. Biomass

Poland is one of Europe's leading countries, and is privileged, in terms of potential for biomass energy. The biomass sector in the country occupies a dominant position among other renewable energy sources, and is considered one of the most promising assets of the country.

Poland is among the leading European countries with the largest biomass resources. There are noteworthy opportunities for biomass technology in the forestry, wood processing and agriculture sectors. Consequently, the biomass sector emerges as a basic renewable energy source in the country and is not only beginning to play a crucial role in fulfilling the energy needs of the country, but is expected to continue being a primary energy source in the upcoming decades.

The large biomass potential of Poland is due to the fact that almost 60 per cent of its land is devoted to agricultural production (area of 18.3 million hectares). Furthermore, forest area amounts to over 28 per cent of the country (around 8.9 million hectares), and is estimated to increase to 33 per cent by 2025. Consequently, there are considerable biomass feeds available from agricultural surpluses or wastes, plus various opportunities for specific energy cropping.

The areas that show the biggest potential for biomass and biogas production are northern and western regions of Poland, rural regions, mountainous regions and the eastern border with Belarus.

Currently, biomass is mostly used for local and district heating. However, there is a trend toward using biomass for other purposes including electricity generation, biogas and biofuels production. Particularly, co-firing biomass with coal at existing coal power plants has become a widely used method for green electricity generation. The Polish Government views co-firing biomass with coal as a priority and expects that 4 per cent of energy production would be derived from this energy source by 2010. Additionally, the Government has stipulated that a large part of biomass should come from sources other than forestry or the wood-processing industry (20 per cent in 2010 and 60 per cent in 2014).

Due to the increasing role of biomass, the structure of green electricity production has dramatically changed. Biomass has overtaken hydropower and contributed about 45 per cent to total green electricity generation in 2007.

Biogas is also increasingly gaining in importance as a source for electricity and heat production from renewable energy. Though its contribution is still small, biogas utilisation is expected to grow constantly in the upcoming years; where landfill biogas has the highest potential for growth.

3.5. Wind

Poland is one of Central and Eastern Europe's leading countries, in terms of potential for wind energy development. With excellent wind conditions, Poland boasts of high average wind speeds varying between 5.5 and 7 m/s at 50 metres

above the ground. Many profitable locations and development possibilities, combined with an estimated potential of about 281 PJ/year (of which 65 PJ/year is off-shore potential) contribute to an investor-friendly and rapidly growing wind energy market.

Thus far, Poland generated 475 GWh of electricity from wind farms in 2007, which was 9 per cent of the total electricity generated that year from RES¹². In 2007, there were 35¹³ wind farms under commercial operation with cumulated capacities of 286 MW.

There have been a number of remarkable investment projects in the Polish wind sector. Recent examples include a project of a Spanish private equity fund Taiga Mistral. The fund invests 300 million euro in construction of a network of wind farms with a total capacity of 250 MW. The project is expected to be completed in the next 3-4 years. Also, RWE Innogy has announced plans to build wind farms of the capacity of 300 MW which would bring total installed capacities of RWE Innogy' wind farms in Poland to 580 MW. Other examples include NEO Energia which bought a Polish wind energy company for 54 million euro and recently invested 228 million euro for wind turbines purchasing for its Margonin wind farm in Poland.

Table 4: The largest wind farms in Poland

Localization	Capacity (MW)
Tymień	50
Kisielice	40,5
Jagniątkowo	30,6
Kamieńsk	30
Zagórze	30
Puck	22
Cisowo	18
Lisewo	10,8
Barzowice	5

Source: Polish Wind Energy Association

¹² Frost & Sullivan estimates

¹³ Polish Wind Energy Association

4. Investment Support Available in the Sector

In order to achieve targets on renewable energy sector development set by the EU and the Polish Government, significant investment particularly in the private sector is needed. However, additional financial support is necessary in order to make projects in renewable energy source (RES) profitable. In order to induce private investment, appropriate support programmes and mechanisms have been developed. Such programmes are available in Poland in the form of grants and preferential loans. The main organisations that provide financial support to projects in the RES sector are the following:

- **Thermo-Modernisation Programme and Fund.** The Thermo-Modernisation Programme and Fund has been functioning since 1999. The Fund is under operation of the Bank of National Economy (BGK). It provides technical and financial support for improvements in energy use in residential buildings. The fund also supports projects aimed to reduce energy losses and to substitute conventional energy sources by non-traditional sources, including renewable energy. Financial support is available to all investors including owners of housing, who would like to improve thermal properties of their housing, as well as to proprietors of small local heating networks, who are determined to modernise their networks. Investment projects that qualify for support (the critical conditions are energetic audit and creditworthiness) are granted with 25 per cent final loan repayments. The fund also provides support in the form of guarantees of up to 50 per cent for loans aimed to finance energy efficiency investments.
- **EcoFund.** The EcoFund was founded in 1992 by the Ministry of Finance. The EcoFund is not-profitable organization and supports environmental projects that are of both regional and national importance for Poland. Funds of EcoFund are accumulated by debt-for-environment swap activities. The total contribution to the EcoFund for the years of operation (1992-2009) is expected to reach 545 million dollars. The main objective of the EcoFund is to ease the implementation of projects, which would bring environmental benefits, such as reduction of gas emissions, reduction of air pollutant emissions, protection of endangered flora and fauna and so on. Additionally, the fund facilitates transfer of best available technologies to the Polish market and stimulates development of the environmental protection industry. The EcoFund gives priority to the use of RES, such as biomass, wind, solar energy, geothermal energy, as part of climate protection environmental objective. Projects are subsidised in the form of grants, which can cover 10 to 30 per cent of the project costs for private investors and up to 50 per cent of the project costs for municipalities. Since 2002, the fund has also provided low interest loans.
- **Environmental Protection Bank.** The Environmental Protection Bank is a commercial bank, which specialises in financing projects in the areas of environmental protection and water management. The bank supports investments in renewable energy sector and provides soft loans to geothermal plants, heat pumps and solar collectors, small hydro plants, biomass boilers of installed capacity less than 5 MW and production of biofuels. Soft loans are provided with a discounted interest rate of 0.5 per cent and for a lending period

of up to five years. The lending conditions are formulated through adjustment to the specific character of particular projects, in a client-friendly manner. The credit facilities can be utilized by entrepreneurs, local governments and retail clients¹⁴.

- **National Fund of Environmental Protection and Water Management.** The National Fund of Environmental Protection and Water Management was established in 1989 and it is aimed to support projects that help to protect environment at the national and regional level. Funds are generated from environmental charges and fees, including compensation fees associated with Quota Obligations and the Green Certificates System. The National Fund promotes the use of RES and assists projects in this area in the form of loan funding, subsidy and equity funding. Funding is available to enterprises, municipalities, institutions and non-governmental organisations. The conditions for granting of financial assistance include: accordance of the project with the list of priority programmes, ability of the applicant to fully cover the costs of the planned projects. In 2007 the National Fund has allocated about 450 million Euro for financing the environmental protection projects. Among the largest projects which have been financed is the construction of the wind farm with a capacity of 30 MW in Kamiensk (with the allocation of about 13 million Euro)¹⁵.
- **The EU Structural Funds.** Poland receives 67.3 billion Euro for the country's development under the EU Structural Funds for the years 2007-2013. In particular, opportunities arise under the programme "Infrastructure and Environment" with a budget of 27.9 billion Euro. The funds which can be used for the renewable energy projects include the "Development of environmentally-friendly infrastructure and energy efficiency" with 1,403 million Euro and "Development of energy independence, including diversification of the energy sources" with 1,693 million Euro. Those funds are administered by the Ministry of Economy and by the Institute for Fuels and Renewable Energy which deals directly with the projects' application and selection¹⁶. The financial resources of those programmes can be directed to projects aimed to produce energy from renewable sources, to generate biofuels from renewable energy, to develop power grid connections for renewable energy and to develop industries for the renewable energy' sector. In addition, there is the Regional Operational Program, as a part of EU Structural Funds, with the budget of 16.6 billion Euro. The programme is aimed to foster regional development and should be also of interest for investors in the renewable energy sector on a local scale.

¹⁴ bosbank.pl

¹⁵ nfosigw.gov.pl

¹⁶ ipieo.pl

5. Outlook for Renewable Energy Sector Development in Poland

Overall, the future for the renewable energy market in Poland looks promising. Legislation imposed by the EU and the Polish Government should secure stable growth in the mid and long terms. The target of 15 per cent share of renewable energy in final energy consumption to be achieved by 2020 looks ambitious for Poland to achieve and most probably, Poland would not be able to reach this target. However, the target would serve as an expansion driver for the sector. Combined with economic factors, it can be expected that demand for energy derived from renewable sources would greatly increase. In turn, this should further boost private investments in order to meet this growing demand.

Green electricity is the most promising sector in Poland. Green electricity is treated as the primary source to achieve overall renewable energy targets and the sector has been widely promoted on the EU and the national level. Thus far, visible success in the sector's development has been achieved. Obligations imposed by the Polish Government on green electricity purchase were fulfilled with a surplus in 2006. In order to fulfil those obligations, significant investments were made in the sector, particularly in the expansion of capacity for wind farms and for biogas and biomass utilisation. The flow of investments is expected to increase and the sector is set to demonstrate prominent growth in the upcoming years.

Heat generation from geothermal and solar energy also looks attractive. This sector is particularly lucrative for individual investors that have started to recognise the cost benefits associated with geothermal and solar energy utilisation for dwelling and water heating. The natural conditions in Poland are favourable for development, particularly from geothermal energy perspective. A number of instalments are expected in the near future, contributing to an increase in the share of geothermal and solar energy in overall heat generation from RES.

Biofuels is another sector with great prospects in Poland. This is because biofuels have become a focus of particular attention from the EU and national governments with the new quotas and obligations set. New targets are expected to drive the domestic demand and increase attractiveness of the Polish market for biofuels realisation. Therefore, Poland has a potential to not only further increase its exports of biofuels production, but also to grow its domestic consumption. With a very favourable natural condition resulting from a wide availability of biomass, Poland is likely to considerably increase its biofuels production in the upcoming years.

About Frost & Sullivan

Frost & Sullivan, a global growth consulting company, has been partnering with clients to support the development of innovative strategies for more than 40 years. The company's industry expertise integrates growth consulting, growth partnership services and corporate management training to identify and develop opportunities. Frost & Sullivan serves an extensive clientele that includes Global 1000 companies, emerging companies and the investment community by providing comprehensive industry coverage that reflects a unique global perspective and combines ongoing analysis of markets, technologies, econometrics and demographics. For more information, visit <http://www.frost.com>.

About PAIiZ

The Polish information and Foreign Investment Agency (PAIiZ) has been serving investors for 15 years. Its mission is to increase Foreign Direct Investment (FDI) by encouraging international companies to invest in Poland. It guides investors through all the necessary administrative and legal procedures along the way to setting up their business in Poland.

PAIiZ offers investors: quick access to comprehensive information about the economic and legal environment, assistance in finding appropriate partners and investment locations and support at every phase of the investment process.

Another one of PAIiZ's roles is the creation of positive image of Poland and the promotion of Polish products and services abroad by organizing conferences, visits for foreign journalists and trade missions. PAIiZ also promotes Poland's regions. It has established a network of Regional Investor Assistance Centres throughout Poland. Their goal is to improve the quality of regional services for investors and to provide access to the most up-to-date information, such as the latest investment offers and regional microeconomic data. These specialized offices are staffed by PAIiZ trained employees and financed from local funds.

In order to help support and encourage FDI, the Polish government has passed many new resolutions this year. 90 billion Euro of EU funds has been allocated to Poland for the years 2007-2013. There has never been a better time to invest in Poland.

Come and see for yourselves. We are here to help you!

Contact us to learn more about how your company can profit from the unique business potential of Poland.

Contact details:

The Polish Information and Foreign Investment Agency (PAIiZ)

ul. Bagatela 12

00-585 Warsaw, Poland

tel. (+48 22) 334 98 00

fax (+48 22) 334 99 99

e-mail: post@paiz.gov.pl

www.paiz.gov.pl