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The Influence of Market and Policy on Revenues in the Polish Biomass Energy Sector – Experiences from SME*

Abstract. *The aim of the study is to examine some of the factors that are crucial for revenue generation in the Polish industry of producing renewable energy from biomass. What is essential for the biomass energy sector is an adequate public policy, especially regulations which concern financial aspects. In addition, the market mechanisms which determine a company's revenue are also important aspect here. However, it is difficult to decide which of the two factors, public policy or market mechanisms, is a higher priority. The research will help define revenue volatility resulting from biomass energy production. Furthermore, a better understanding of the conditions of the Polish biomass sector will be useful in the process of policy adjustments and fostering the development of renewable energy. This study is one of the first attempts to investigate the issues concerning the financial performance of renewable energy companies on the Polish market. It will be based on a case study of small and medium-sized enterprises.*

Keywords: *renewable energy sources, biomass energy sector, solid biomass, innovative technologies, market mechanism, market regulation*

Introduction

Not only does renewable energy use up in its entire life cycle but it also releases relatively very few harmful substances and greenhouse gases. Therefore, as the only one among other energy technologies, it complies with ecological

* The paper translated by Małgorzata Bączyńska.

principles of sustainable development. According to most recent Eurostat data [2013], the share of energy derived from renewable energy sources (RES) in gross final energy consumption within the EU amounted to 13.0% in 2011. This share should amount to 20% in 2020. For some time the dynamic development of RES worldwide has been the result of adopting different energy strategies in particular countries and in the groups they constitute such as the EU. However, it should be remembered that in many countries RES are the only media of energy available there, therefore the idea of energy safety is based completely on them. Additionally, the development of RES sector is also driven by: technological progress and increasing awareness of the society which can see more and more benefits generated from the RES development for itself and the environment.

According to the information provided lately by Polish Ministry of Economy, the share of RES in the country's use of electrical energy exceeded 10.5% in 2012.[1] Until 2020 the share of energy obtained from RES in gross final energy consumption is to achieve the level of 15%. A special role in the process of transition into more environmentally friendly solutions is ascribed to the energy sector using biomass. Specialists emphasize that Poland has a very big potential as far as the majority of resources used in the bioenergy sector is concerned [Baum, Wajszczuk, Pepliński & Wawrzynowicz 2013; Burczy, Mirowski, Kalawa & Sajdak 2010]. They simultaneously indicate that in a short-term perspective there exists a wide spectrum of possible use of only a part of such resources. Rogulska, Oniszk-Popławska and Pisarek [2005] enumerate here the following types of biomass:

– timber, tree saplings, horticultural waste, short rotation coppices,
– straw and other side products and/or agricultural production waste,
– liquid/manure used in methane fermentation,
– esters obtained from processed seeds used as biodiesel; potatoes, crops and other plants or waste converted into ethanol.

The scope of this paper comprises only the energy obtained from solid biomass. It is due to the production specification of a chosen enterprise whose many years of business experience in the RES sector will be the groundwork for further analysis using a case study method.

Summarizing the terminology discussion hereabove, once again the terms used by GUS should be applied here, i.e. solid biomass understood as: "[...] organic, non-fossil fuel of biological origin which may be used as fuel to produce heat and electrical energy". The main solid fuel obtained from biomass is forest biomass (fuel wood) and forestry waste such as timber of non-standard size as well as waste generated by wood and paper industries. Another group consists of

[1] *W 2012 r. wzrosła produkcja energii elektrycznej z OZE*, www.bankier.pl/wiadomosc/W-2012-r-wzrosla-produkcja-energii-elektrycznej-z-OZE-2786202.html [access: 24.08.2013].

fuels generated from agricultural biomass obtained from plantations meant for energetic purposes and organic waste from agriculture and gardening. The last selected biomass solid fuel also includes charcoal.

The share of obtained "green energy" (Table 1) as well as the suitable classification from previous years illustrate well a clear dominance of biomass among RES available in Poland. The share of solid biomass is especially important, though in recent years this tendency has been said to decline slightly. Quite similar data is observable in the Baltic states excluding Sweden.

Table 1. The share of renewable commodities in the total obtaining energy from renewable sources in 2013 in Poland (2013) and in the EU-28 (2012) (in %)

Source of energy	Poland	EU-27
Solid biomass	80.03	47.19
Solar energy	0.18	5.13
Water energy	2.46	16.24
Wind energy	6.05	9.97
Biogas	2.12	6.81
Bio-fuel	8.20	6.50
Geothermal energy	0.22	3.21
Others	0.74	4.95

Sources: own analysis based on GUS 2013.

The main objective of the research is to analyze the influence of the prices for property rights ("Green Certificates") and the scope of the state support on the structure and volume of the revenues for a selected enterprise. The following research questions will be answered:

1. How does the volatility of market prices for "Green Certificates" influence the volume of revenues assuming that the state support will achieve 1:1 proportion, *ceteris paribus*.

2. How does the volatility of charcoal prices influence the structure and volume of the revenues.

1. Theoretical background: literature review

It seems that at least two clear tendencies may be distinguished among currently carried out research within which the conditions are strongly emphasized. The first research tendency focuses on the barriers and driving forces (stimulants and destimulants) for RES or its particular segments development. Such an approach is aimed at possibly complete identification of diversified developmental factors and their clear arrangement. The results may be quite general, though. The second tendency tries to diagnose the situation at its source. Therefore, businesses

and their environment have become the subject of a detailed analysis. The results here may, however, be somehow stigmatized with the peculiarity of analyzed subjects, which may impede the generalization of formulated conclusions.

According to White, Lunnan, Nybakk and Kulisic [2013], "the most important role of the government in the RSE market is to provide an environment through rules and regulations". Public authorities should ensure the system for market development, that will not require government intervention while maximizing social welfare. These regulations could lead companies toward achieving the government's aims for the RES. Later in the study, the authors focused on importance of policy consistency. They stated, that "policy inconsistencies cause problems for the industry in both the short and long term. Profitable businesses can rapidly be made unprofitable, and investments in the future development of the industry can become more difficult to obtain". Finally, they stressed the compatibility of these findings with basic economic theory, which states that uncertainty will have a negative impact on investment.

The role of public policy was also examined by Erlend Nybakk et al. [2011]. They found out, on the basis of a study of fourteen European companies operating in the wood bioenergy sector, that policy measures played an important role in the innovations of the companies. In previous studies [2009], Nybakk emphasized the importance of risk in innovation of SME.

As far as Polish publications discussing the conditions for the development of Polish RES are concerned, the article by Stanisław Bielski [2011] should be mentioned here. Not only did he focus on presenting economic and legal conditions but he also introduced technological conditions for processing biomass. In conclusion, he noticed that the introduction of legal regulations in Poland concerning RES was mainly the consequence of adjusting the state's law to the EU requirements. Due to the general character of EU directives, state solutions could be modified with a relative freedom. Bielski also assumed that in future the importance of forests as a source of biomass would be diminished and the importance of the sources possible to be obtained from agriculture would increase. He noticed that this process might also pose some dilemmas. For instance, due to limited biomass resources, there is a risk of much more intensified competition with the food production sector and, as a result, the increase of food prices.

A very interesting conclusion referring to the formulation of public policy in terms of RES was introduced by Gawlik, Mokrzycki and Ney [2007]. They stated that renewable energy sources in Poland are strictly connected with local societies. Therefore, the development of RES should be adjusted to the conditions dominating in a given region. In this sense, there is no justification for the same scale or pace of RES development in the whole country.

Igliński, Iglińska, Kujawski, Buczkowski and Cichosz [2011] conducted a series of a dozen or so interviews with the producers from different RES areas

operating in Poland. Unfortunately, there is no room left for presenting all the conclusions drawn in the article, however, having imposed some limits and selecting only those mentioned by the authors in the conclusion, it is worth mentioning the following:

– high costs of investment in RES technologies and preparing investment against running costs;

– no precisely determined economic and tax mechanisms (no financial policy for RES);

– no defined strategies, programs and schedule of spending money from ecological and par budget funds (difficulties for the sector to develop with lowest costs);

– insufficient support from the authorities as well as no training and workshops for bioenergy producers.

– despite difficulties, bioenergy producers in Poland are planning to increase their activity in the forthcoming years.

Jarosław Mielcarek [2014] presented the economic aspect of the profitability of investment in wind farms. He said that under the conditions prevailing in 2013 in Poland, to build wind farms do not meet the criteria for acceptance.

Concluding the theoretical aspect of the study, it should be mentioned that the problem of RES development as well as bioenergy has been enjoying recently an increasing interest of the Polish scientific environment. However, it does not mean that the research area has been fully analyzed. The further part of this paper may confirm the assumption made hereabove since the study will touch upon the analysis of one of these economic factors which has been omitted so far, at least in Polish publications. It concerns the risk of revenue volatility in a company whose production is based on solid biomass. In particular, it will be crucial to determine the influence of this risk on the shape of the revenues structure. It should be mentioned that the selected company obtains revenue from selling four, very different in many aspects, 'products' (Figure 1 and Tables 2-5).

2. Data and method

To identify the case, secondary information were investigated, including data from Polish Power Exchange and primary data from in-depth interviews. Descriptive analysis and sensitivity analysis were selected as the primary tool for answers to research questions.

The company generating its revenue from wood biomass has been analyzed here. Figure 1 presents the revenues structure. The data which constitute market and regulated prices of dry wood distillation products, i.e. charcoal and coal dust (which is used to produce briquette) as well as electrical energy were analyzed

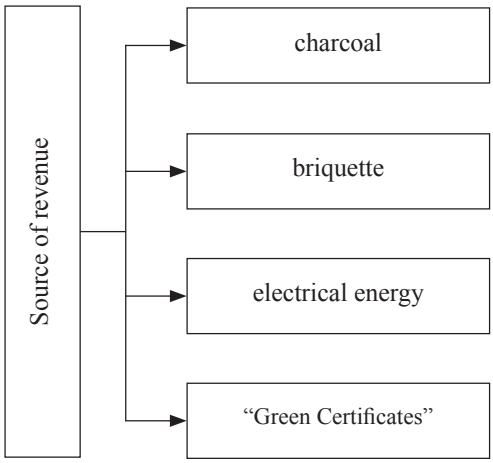

Figure 1. Revenue structure

Sources: own analysis.

Table 2. Adopted prices of effects of dry wood distillation (average prices within 2012/2013) and the prices of electrical energy and "Green Certificates" in one-year-period

Revenue source	Regulated prices	Contract prices (market)
Charcoal*	–	487 EUR/ton
Briquette	–	410 EUR/ton
Electrical energy	PLN 192.35 MWh	–
Property rights ("Green Certificates")	PLN 100-180 per MWh (minimal and maximum price on the energy market in 1H2013) adopted price – PLN 160**. Contract prices PLN 240 and 280 per MWh on the basis of long-term contracts.	

* The prices of coal dust in this model were not analyzed due to their little share. It is assumed that 90% of dust coal is used to produce briquette.

** It is an average price as of August 2013.

Glossary: Charcoal – the coal price is the market price and depends mainly on the market position of a company. Briquette – the briquette price is mainly a derivative of the coal price. Electrical energy – the price of so called 'black energy' is a regulated price. Green certificates – belong to the mechanisms supporting 'green energy' but also are influenced by a market mechanism.

Sources: own analysis based on Polish Power Exchange data.

as well. Also one supporting element was taken into account, namely the price of "Green Certificates" (Table 2).

We assumed that technological efficiency of the presented model equals 100% within the entire production process, i.e. 350 days (15 days in a year are devoted to a technological break). In practice, it is extremely difficult to maintain production continuously since there happen unplanned breaks resulting from e.g. imperfection of the raw material. The analysis was conducted in a one-year-period assuming continuous work of two technological lines used to produce dry wood distillation products. Electrical energy is produced by means of a Siemens tribune

Table 3. Sources and risk characteristics of revenue volatility

Revenue	Risk level	Risk description
Charcoal	high	Price volatility risk. The price depends on the market position of the producer and production possibilities.
Briquette	low	Price volatility risk. Saturated market and strongly competitive.
Electrical energy	low	Regulation risk – prices are regulated. The risk of price volatility is low.
Property rights ("Green Certificates")	high	Regulated risk, price volatility risk – market prices; the possibility to sign long-term contracts to protect oneself against price volatility.

Sources: own analysis.

of the declared power of 7.23 MW and is a derivative of supplied steam from two heat recovery steam generators from coal lines in the amount of 8.5 t/h each, and from a biomass boiler in the amount of 14 t/h. The daily production of dry wood distillation products is estimated at the level of 30 t from one technological line (the analysis was conducted on two technological lines L1, L2) which equals the annual production of 21 thousand tons of products out of which coal amounts to 14 thousand tons and dust coal equals 7 thousand tons. Table 3 shows the level and description of risk for products of dry wood distillation as well as for electrical energy and "Green Certificates".

3. Results

Sensitivity analysis of particular revenue elements was conducted. Technological efficiency is implied directly by the level of charcoal and dust coal produc-

Table 4. Annual production values obtained from wood biomass

Revenue sources	Daily production for L1, L2	Annual production for L1, L2	Type of dry wood distillation products	
Dry wood distillation products	30 t × 2 = 60 t	350 × 60 t = = 21 000 t	charcoal	14 000 t
			coal dust	7000 t = 6600 t briquette
Electrical energy	–	For sale × 49 453.7 MWh	–	–
Property rights ("Green Certificates")	–	60 373.7 MWh	–	–

* The amount of energy for sale is lower than the produced one. It is due to the fact that the company uses a part of this energy for its own purposes.

Sources: own analysis based on the data obtained from the company.

Table 5. The volume and structure of revenue for the base figures

Revenue	Unit price	Sale volume	Total (1 × 2)	PLN 3(WD,BR) × 4.2323	Share in %
Charcoal (WD)	487 EUR/t	14 000 t	6 818 000 EUR	28 855 821.4	48.5
Briquette (BR)	410 EUR/t	6 600 t	2 706 000 EUR	11 452 603.8	19.3
Electrical energy (EE)	192.35 PLN/MWh	49 456 MWh	PLN 9 512 865	9 512 865.0	15.9
Property rights "Green Certificates" (GC)	PLN 160 per MWh	60 373.7 MWh	PLN 9 659 789	9 659 789.0	16.2

Sources: author's own analysis based on Polish Power Exchange and company's data.

tion as well as dust coal, electrical energy and the number of green certificates. Table 4 presents annual values of obtained products. Below, Table 5 contains the volume and structure of revenues for the adopted model taking into consideration average market prices on the Polish market. Since part of the production is sold in a foreign currency, an average euro exchange rate was assumed, announced by the National Bank of Poland on the 23 day of August 2013.

The first analyzed element is charcoal which influences operational profitability most strongly. An average price on the Polish market amounts to 487 euros/t, however, higher prices are also possible as for example the prices on developed markets. For instance, companies with a solid position on the European market reach prices at the level of 800 euros/t.

The price of briquette is directly connected with wood price and its share in the revenues structure equals about 19.3% in the assumed model. The market is relatively competitive and there exists little space for price fluctuations.

The price of electrical energy is regulated by the law. The average weighted price of electrical energy equals almost PLN 193 per 1 MWh.

The price of "Green Certificates" is a market price and the volume of revenues from this source depends on the amount of produced electrical energy and market price. In the analyzed model the revenue from this source equals 16.2% in the company's revenues structure. Most European countries support renewable sources by the Feed-in-Tariff system, which means that renewable power station is guaranteed a price for which energy is sold to the network.

Additionally, the prices of "Green Certificates" are the element of a market game. For years they have been maintained within the cost of compensatory payment[2] but in 2012 they started decreasing. The market reality showed that the

[2] After receiving a certificate of origin, the entities are obliged to submit this certificate to the president of the Energy Regulatory Office for redemption otherwise they should transfer a compensatory payment to the bank account of the National Fund for Environmental Protection and Water Management (Pol. NFOŚiGW). The fee for green energy in 2007 was PLN 242.40 per MWh, for red

prices started to reflect a growing excessive supply. In February 2012 the market price of a green certificate fell to the record lowest level of PLN 100 per MWh. The price reached its maximum, i.e. PLN 180 per MWh after the Ministry of Economy announced the decrease of excessive supply and returned market balance. Currently, the excessive supply of green certificates is still huge. Its volume is estimated at about 7 TWh, which means more or less a half of the amount of green energy produced last year.

The revenues in the event of unit price changes were presented in Table 6. The analyzed example assumed: three price variants of charcoal sale, one variant for briquettes and electrical energy as well as five variants for "Green Certificates" (all of them refer to the price leap). It is due to the risk analysis for particular revenues presented in Table 6.

Table 6. The revenues in the event of unit price leap

Revenue		Unit price	Sale volume	Total (A-E, 1 × 2)	PLN 3(A, B, C, D) × 4.2323 PLN 1 × 3(E-M)
Charcoal (Ch)	A	800 EUR/t	14 000 t	11 200 000.0 EUR	47 401 760.0
	B	600 EUR/t	14 000 t	8 400 000.0 EUR	35 551 320.0
	C	487 EUR/t	14 000 t	6 818 000.0 EUR	28 855 821.4
Briquettes (BR)	D	410 EUR/t	6 600 t	2 706 000.0 EUR	11 452 603.8
Electrical energy (EE)	E	192.35 PLN/ MWh	49 456 MWh	9 512 865.0 PLN	9 512 865.0
Property rights "Green Certificates" (GC)	F	160 PLN MWh	60 373.7 MWh 1:1	60 373.7 MWh	9 659 792.0
	G	100 PLN MWh	60 373.7 MWh 1:1	60 373.7 MWh	6 037 370.0
	H	180 PLN MWh	60 373.7 MWh 1:1	60 373.7 MWh	10 867 266.0
	I	240 PLN MWh	60 373,7 MWh 1:1	60 373.7 MWh	14 489 688.0
	J	280 PLN MWh	60 373,1 MWh 1:1	60 373.7 MWh	16 904 636.0

Sources: author's own analysis.

All possible combinations were analyzed for the adopted parameters and the results were presented as the structure of revenues level for particular combinations (Table 7). The widest spectrum of changes takes place in the case of the revenues obtained from green certificates within <8.1%; 25.33%>. The second element of the revenues, also of high changeability level, is charcoal with <43.25%; 63.7%>. The prices of charcoal are market prices, whereas the prices of "Green Certificates" depend on market price.

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energy PLN 17.96 per MWh and for yellow energy PLN 117 per MWh. In the case of 'green' energy the value of the payment is indexed every year by the inflation rate, whereas the value of payment for 'red' and 'yellow' energies is settled by the president of the Energy Regulatory Office every year.

Table 7. The structure of revenues depending on the assumed scenario

Group	Ch	BR	EE	GC
A	A 60.8% A 63.7% A 59.8% A 57.2% A 55.6%	D 14.6% D 15.4% D 14.4% D 13.8% D 13.4%	E 12.2% E 12.8% E 12.0% E 11.5% E 11.2%	F 12.4% G 8.1% H 13.8% I 17.5% J 19.8%
B	B 53.7% B 56.9% B 52.8% B 50.03% B 48.42%	D 17.3% D 18.3% D 16.9% D 16.13% D 15.60%	E 14.4% E 15.2% E 14.1% E 13.40% E 12.96%	F 14.6% G 9.6% H 16.2% I 20.41% J 23.02%
C	C 48.5% C 51.6% C 47.5% C 44.87% C 43.25%	D 19.3% D 20.5% D 18.9% D 17.81% D 17.16%	E 15.9% E 17.0% E 15.7% E 14.79% E 14.26%	I 16.2% J 10.8% K 17.9% L 22.53% M 25.33%

Sources: author's own analysis.

Finally, Table 8 presents the volume of revenues within three selected groups distinguished on the basis of charcoal prices. Each group has adopted five scenarios depending on the level of market price of green certificates. The potential volume of revenues, depending on the adopted assumptions, is very high. It may fluctuate between PLN 55.9 and 85.2 million annually. The highest volume refers to group C and the lowest to group A.

The main lesson which may be learned from the analysis is as follows: "Green Certificates" are the key source of revenue volatility. Further analytical research

Table 8. The volume of revenues according to the adopted groups and scenarios

Group	The volume of revenue for the entire sample A-C in PLN million (in %)	The volume of revenue in particular groups: A, B, C in PLN million (in %)
A	55.9-85.2 (52.4%)	74.4-85.2 (14.5%)
B		62.5-73.4 (17.4%)
C		55.9-66.7 (19.3%)

Sources: the author's own analysis.

concerning this revenue component should be aimed at preparing a proper supporting model for energy obtained from biomass which will optimize the state's policy towards the production of this type.

Conclusions

The obligation to increase significantly the RES share in the total sale of energy is one of the priority challenges for the Polish public authorities until 2020. The so far development of this part of the country's energy sector is characterized by a relatively high growth dynamics. However, there are a lot of factors suggesting that the pace of growth may turn out to be insufficient to reach the level required by the European Union. In this case, some action should be taken which may facilitate and accelerate the transition into energy using renewable sources of energy to a much greater extend.

The preparation of an effective support model for RES should be based upon former identification of the key developmental factors. Such an identification should not discuss RES as a whole, but should be rather directed to particular RES segments. Unfortunately, Polish publications do not fulfill such needs sufficiently, which sets an interesting direction for future research.

One of the important economic factors, identified for the needs of this study in the company whose production is based on biomass, is the risk of revenue volatility. The conducted analysis clearly indicates that the implementation of this risk may have a crucial influence on the shape of the company's revenue structure, and "Green Certificates" seem to be the key factor for revenue volatility.

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Wpływ polityki rynkowej na przychody polskiego sektora energetycznego biomasy – doświadczenia MSP

Streszczenie. *Celem niniejszej pracy jest zbadanie czynników, które mają kluczowe znaczenie dla generowania dochodów w polskim przemyśle pozyskiwania energii odnawialnej z biomasy. Istotna dla sektora energetycznego biomasy jest odpowiednia polityka publiczna, zwłaszcza przepisy dotyczące aspektów finansowych. Równie ważne są mechanizmy rynkowe, które określają przychody spółki. Trudno jednak rozsądzić, które z czynników – porządek publiczny czy mechanizmy rynkowe – są ważniejsze. Badania pomogą zdefiniować zmienność przychodów wynikających z produkcji energii z biomasy, a lepsze zrozumienie warunków funkcjonowania polskiego sektora biomasy będzie przydatne w dostosowywaniu polityki do wspierania rozwoju odnawialnych źródeł energii. Badanie to jest jedną z pierwszych prób oceny kwestii dotyczących wyników finansowych sektora energii odnawialnej na polskim rynku.*

Słowa kluczowe: *odnawialne źródła energii, sektor energii z biomasy, innowacyjne technologie, mechanizm rynkowy, regulacje rynkowe, wyniki finansowe*