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Determinants of Return-on-Equity (ROE) of Biogas Plants Operating in Poland

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Abstract: Poland has a large potential for biogas production from agricultural sources and food waste. This potential is still poorly used. There are many reasons for this state of affairs. We can indicate both the policy of the state towards renewable energy sources (RES) with a small amount of energy from biogas contracted at auctions, investment risk, and especially low return on investment in the absence of investment support. An important reason is also the limited state budget. The purpose of this work was to determine the endogenous factors that determine ROE, the direction of the impact of these factors, as well as the strategy of biogas plants in shaping the ROE level. The DuPont model was used in the analysis of ROE changes. We used the deviation method to determine the impact of the various factors on ROE. Against the background of the energy sector in Poland, the value of ROE in the examined biogas plants should be considered satisfactory, and in 2020 it was, on average, 13.9%. The decrease from 17.2% in 2019 occurred despite the increase in energy prices and the increase in the net profit margin (NPM). It resulted from the reduction of ROE's financial leverage through external capital. A high level of debt characterized the examined biogas plants, and the pursuit of risk reduction and debt reduction negatively impacts on ROE. This may indicate the need for state investment support at the plant construction stage or low-interest investment loans to develop biogas plants. In addition, using only price guarantees under the feed-in tariffs, with dynamic changes in costs, may bring the industry a relatively high investment risk compared to other RES, where the operational costs during the lifetime are low, as it is in PV or wind systems.

Keywords: biogas plants; DuPont; return on equity (ROE); net profit margin (NPM); total assets turnover (TAT); equity multiplier (EQM); deviation method

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1. Introduction

Energy security is currently one of the main challenges of economic policy. Important factors of energy security are efficiently functioning economic entities responsible for the production and distribution of electricity. The efficiency of functioning is expressed, inter alia, by the economic efficiency of economic entities. This efficiency is the result of the impact of exogenous factors (e.g., energy prices, green certificate prices, energy policy, environmental fees, etc.) and endogenous factors (e.g., production techniques used, organizational structure, sources of financing activities, investment level, etc.) related to the functioning of enterprises. This paper focuses on the endogenous factors. Exogenous factors affect the businesses from the outside, they are largely independent of the company, and it is the managers who have to adapt the organization to them. With relatively constant exogenous conditions, endogenous factors determine the maximization of the company's goals [1].

The category of economic efficiency is the basic standard of evaluation in economics. It is one of the central terms used in assessing and measuring the performance of organizations. The category of economic efficiency is based on the strong market compulsion of rational management and allocation of limited resources to solutions that ensure the maximalization of obtained results, with existing market constraints [2]. From the company's point of view, the term of effectiveness is explained as a relation of the obtained effects to the inputs involved. To assess the economic efficiency in the enterprise, a wide set of indicators can be used. It mainly depends on the purpose, size, and scope of the carried-out analysis or the legal form of the enterprise. The measurement of the economic efficiency of enterprises is an important aspect that allows the analysis and evaluation of their activities. Many methods and techniques are developed to ensure effective measurement and adequate results that can be used in the formulation of enterprise development policy.

In this article, the return-on-equity (ROE) ratio was used to assess the economic efficiency of a biogas plant. The analysis was carried out based on the DuPont model. The purpose of the work was to determine the endogenous factors that determine ROE, the direction of the impact of these factors, as well as the strategy of biogas plants in shaping the ROE level. According to the DuPont model, sales profitability, total assets management, and use of financial leverage were adopted as endogenous factors [3]. The results of this research may be helpful for managers managing the finances of such enterprises and for investors interested in investing in such projects.

In Poland, as in other countries of the European Union, there is a situation of unstable sources of renewable energy being dominant, which requires maintaining the reserves of power in more expensive, but stable sources. The costs of this should be borne by the unstable sources [4]. The increase in the number of biogases strongly and directly depends on the applied energy and investment subsidies to the initial costs; therefore, it is important to assess whether companies running biogas plants can maintain profitability at a safe level and what the main factors determining the profitability of companies are. Such knowledge is important both for governments that create support programs and for investors. The contribution of this work to the development of knowledge is that, so far, mainly the average cost of producing a unit of energy in biogas plants has been determined, and we have determined the profitability of companies operating biogas plants and the impact and importance of selected factors on the achieved profitability, including capital turnover and debt level. There are no current studies with such results. Most of the research concerns the estimation of the leveled costs of electricity and the ex-ante profitability of energy production, based on technical and economic assumptions. In our study, we verify assumptions about the profitability of enterprises based on real data.

In addition, the added value of the article is the systematization of knowledge about the theoretical and practical aspects of the DuPont model for in-depth financial analysis of enterprises. It should also contribute to the development of skills: quantitative assessment, economic interpretation, and seeking ways to improve the efficiency of business entities, which is crucial from the point of view of managers.

2. Conditions for the Development of Biogas in Poland

2.1. The Current State of Development of Biogas Plants in Poland

The overarching purpose of European climate policy is to achieve a climate-neutral economy by 2050. The sectors that must be particularly transformed include energy, transport, and agriculture. The energy sector is a priority due to its high emissivity, which accounts for over 75% of direct and indirect greenhouse gas emissions in the EU. The European Green Deal (EGD) clearly points to the energy that is based on energy efficiency and renewable sources, at the same time strongly departing from coal and reducing the emissions of the gas sector. The energy transition requires a significant investment effort, especially in the countries that are mostly dependent on fossil fuels. As part of The Just

Transition Mechanism (JTM), the European Commission predicts a large financial support from the European Union in order to achieve climate neutrality (Poland is to receive EUR 3.5 billion from the Just Transition Fund (JTF)) [5,6]. One of the important activities aimed at the energy transformation of the economies of the European Union Member States is to provide targeted support to accelerate and promote the development of the renewable energy market, including agricultural biogas. When analyzing the data on the share of renewable energy in the energy generated in Poland and the EU-27 (27 countries of the European Union, excluding the UK) for the years 2004–2020, an increase in their importance is observed. The share of renewable energy in Poland is much lower than the EU-27 average (Figure 1). An even greater difference is in the share of renewable energy in gross electricity consumption (Figure 2). This indicates the possibilities and the need to increase energy production from renewable sources in Poland.

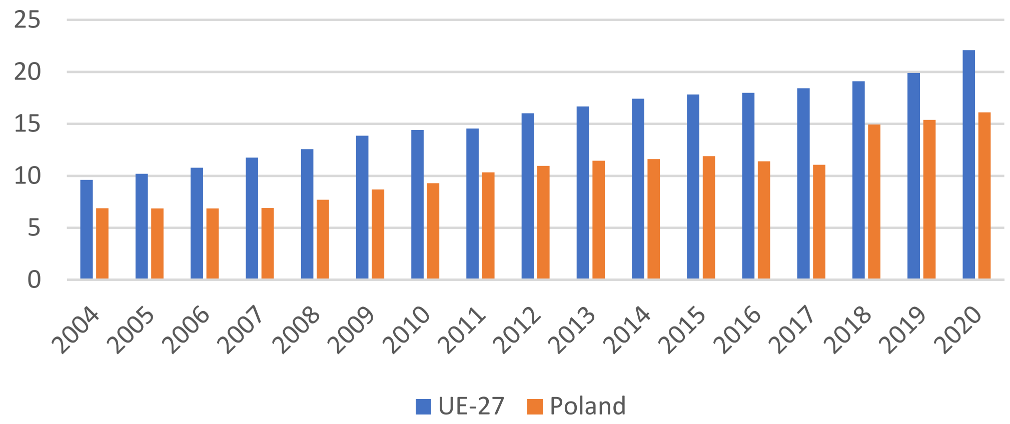

Figure 1. Overall share of energy from renewable sources in Poland and UE-27 [%]. Source: [7].

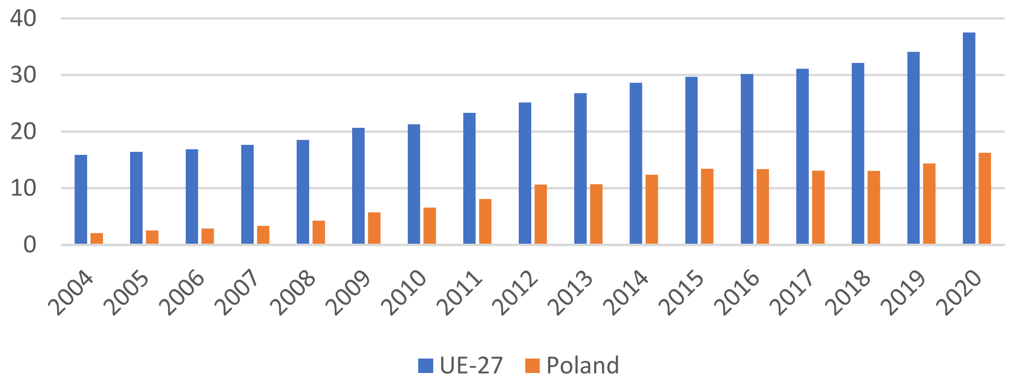

Figure 2. Share of energy from renewable sources in gross electricity consumption in Poland and UE-27 [%]. Source: [7].

Poland is one of the countries with high potential for biogas production. However, despite the large resource facility, the production of biogas is small. It is emphasized that the possibilities of biogas production in Poland are comparable to those of the European leader in biogas production—Germany [8,9]. Factors favoring the development of agricultural biogas production include the possibility of using agricultural waste, the storage of which may pose a threat to the environment [10]. The development of biogas plants creates the possibility of obtaining high-quality organic fertilizers, as well as the possibility of obtaining electricity, which, under the current conditions, may become an important supplement to conventional sources of electricity. The research of Bąk et al. [11] indicates the increasing importance of renewable energy in the economies of the European Union countries, but also significant disproportions among the Member States were noted. This indicates the diversified strategies for changing the energy systems of the European Union countries towards rational energy management. In recent years, the governments of many European countries have increased interest in biogas production, because biogas is an environmentally friendly energy that has a great potential to reduce greenhouse gas emissions [12]. As a result, several laws on the priority treatment of renewable energy sources took effect, and various government programs granted subsidies for the development of biogas plants [13]. It is also predicted that in the future, bioenergy may provide a greater share of renewable energy [14]. From the analysis conducted by Piwowar [15], the potential of the agricultural biogas market in Poland is currently being used to a small extent. It is necessary not only to provide institutional support, but also to increase the awareness of farmers and managers in agri-food companies of the possibility of using production waste for energy purposes. Piwowar [15] also points to the significant role of biogas plants in the economic and social areas for positively influencing the sustainable development of rural areas.

As of 31 December 2021, there were 128 biogas plants owned by 109 economic entities in Poland. The total installed electric power of these biogas plants amounted to 125,323 MW of electricity in 2021. The first biogas plant in Poland was launched in 2004. When analyzing the development of biogas plants in Poland since 2010 (Figure 3), their dynamic growth can be noticed. At the same time, in recent years, there has been a certain slowdown in the upward trend.

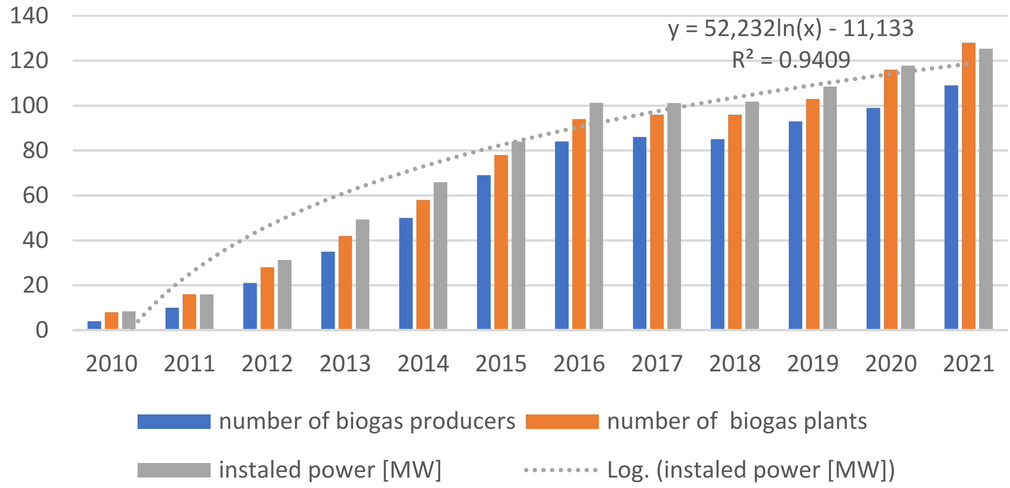

Figure 3. Number of agricultural biogas producers, biogas plants, and installed power. Source: [16].

The reasons for the decline in interest in investing in biogas plants may be various, due to both institutional and legal barriers, but also of an economic nature affecting the economic efficiency of such investments [17]. It may also result from the low profitability of functioning biogas plants. For this reason, the analysis of the factors influencing the profitability of biogas plants is important from the point of view of the managers of such facilities, and it may also indicate the need to create appropriate policy tools to support the development of the biogas plant sector.

2.2. Sources of Energy Sales Prices from Biogas Plants in Poland

The revenue of companies operating biogas plants depends mainly on the selling price of electricity. In Poland, until 2015, biogas plants sold energy at wholesale prices and obtained feed-in premiums or a green certificate. Green certificates could be sold at auctions. The Act on renewable energy sources from 2015 [18] established the auction system. Under this solution, the owners of RES installations sell the generated electricity at auctions announced by a government agency, or they may decide to sell it on the wholesale market and obtain green certificates, the revenue from which is complementary to the income from the sale of energy on the wholesale market. Fixed feed-in tariffs are applied to biogas plants that win auctions and are valid for 15 years.

In the framework of the auction system, owners of the RES installations sell manufactured electric energy at auctions, which are attended by energy companies and other entities obliged to keep the required level of green energy in the total sale of electric energy. Currently, there are nearly 20 instruments of various types in Poland, addressed to various stakeholder groups. Biogas plant owners can use one of several support instruments, e.g., FIT (feed in tariff), FIP (feed in premium), and green certificates [19].

A significant obstacle for biogas producers in Poland is the small number of bidders at auctions. By 2021, auctions required bidders to submit at least three valid bids for the auction for the energy supply from RES to be held. In 2016–2020, auctions for electricity from biogas plants were often not resolved because fewer than three bids were submitted [20]. Therefore, some owners of biogas plants sold energy on the wholesale market, in addition to selling the received green certificates on the commodity exchange.

Auction sale prices are set at a level not lower than those provided in government regulations [21]. In 2016, that was PLN 590/MWh, and in 2017, the maximum price increased to PLN 640/MWh (approx. EUR 140/MWh).

Figure 4 shows the wholesale electricity prices in Poland in 2016–2020 and the FIT obtained at auctions for energy supplies from biogas and PV power plants. The price of electricity from biogas plants was as much as 43% higher than from PV sources. Supporting biogas production through FIT tariffs for biogas energy producers is costly, but financing stable energy sources is considered necessary. In contrast, the amount of energy contracted from PV is many times higher than from biogas because it is cheaper. Similar trends in RES preferences were observed in other countries. Governments prefer sources from which energy is cheaper [22].

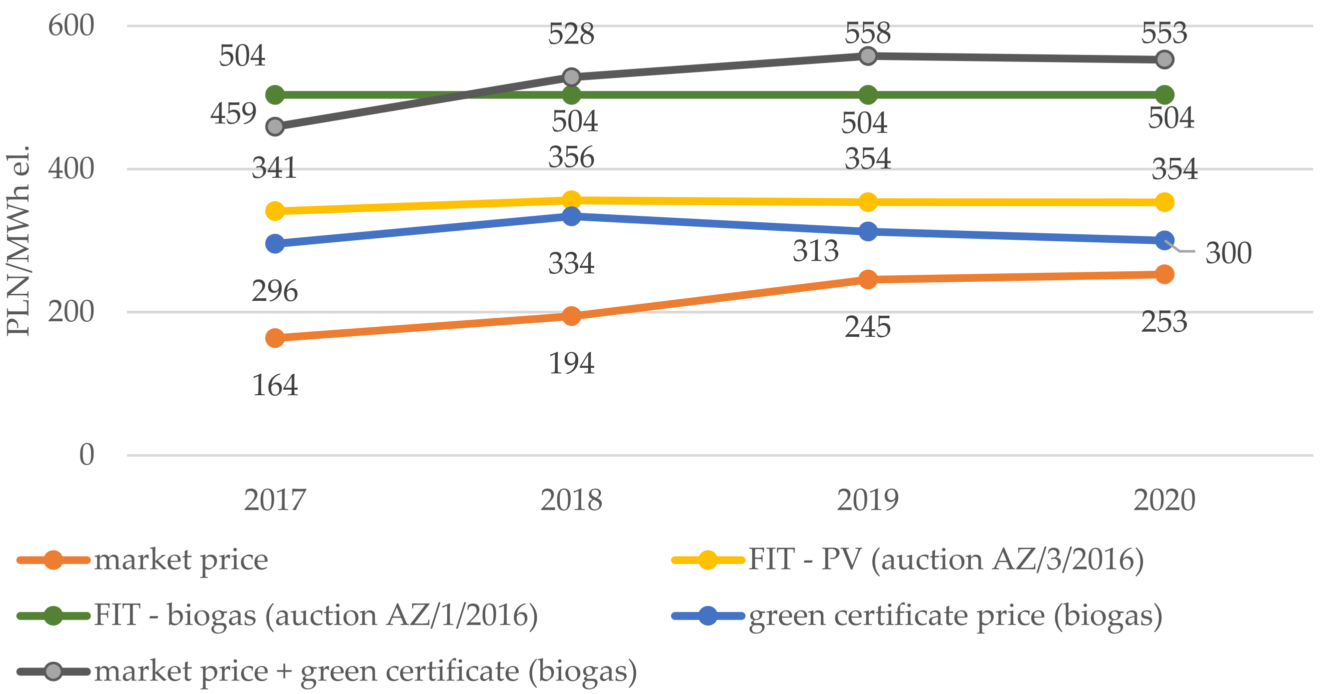

Figure 4. Electricity prices on the wholesale market and FIT for biogas and PV electricity in Poland [PLN/MWh]. Note: our elaboration based on data from [23]. 1 euro = ca. 4.7 PLN.

Revenues from selling 1 MWh of electricity from biogas in 2016–2020 increased in line with the prices for producers selling energy on the wholesale market. Together, for electricity and green certificates, they could receive PLN 459/MWh in 2016 and PLN 558/MWh in 2019. In the following year, prices slightly decreased to PLN 553/MWh.

Suppliers using the FIT received a fixed amount; for the 2016 auction (for 15 years), it was PLN 504/MWh. The presented changes in market prices show that the profitability of electricity production in biogas plants should increase, provided that other factors, such as raw material costs or capital costs, do not change significantly.

The level of support for energy production from biogas in Poland was relatively high, ca. PLN 140 for 1 MWh. In other EU countries, the amount of support ranged from 60 to even 200 Euro/MWh, depending on the source of the raw material and the biogas plant size [24]. The price of electricity from biogas plants under the FIT tariff in EU countries with strongly developed biogas production for contracts for 15–20 years was usually 80–100 EUR/MWh [25]. Therefore, long-term policy instruments are considered necessary to create favorable conditions for the biogas sector, providing a stable and predictable framework for producers and customers. However, there is a risk of a lock-in effect if the policy targets specific technical solutions or raw materials.

The level of revenue from the sale of energy from biogas plants is essential in our study, as it affects the profitability of sales and, indirectly, net profit and net profit margins, determining the level of return-on-equity. A relatively stable and guaranteed level of energy prices for biogas, which was observed in 2017–2020 (Figure 4), means that the source of improving the profitability of biogas plants that owners should seek is in the areas of production costs or production scale efficiency. In our opinion, favorable and guaranteed prices for energy from biogas under the FIT create good operating conditions for biogas plants.

2.3. Factors Determining the Profitability of Biogas Plants

One of the most important factors that impacts the profitability of biogas plants is the level of energy prices and the level of energy production costs incurred. Based on the trends in the costs of renewable energy systems production, it can be said that LCOE from PV installation has decreased in the last 10 years by almost 80%, and from onshore wind systems by 30%. LCOE from biogas did not change in the last decade [26,27]. The biogas energy offer is, thus, becoming less competitive, and supporting it is getting more and more expensive for governments. A better solution is to use biogas as a fuel for the combustion engine; however, this requires additional installations and fuel distribution [28,29], and often additional subsidies [30]. In the countries with relatively low electricity prices, biogas production for fuel for vehicles is the main option considered [31]. The profitability of the biogas plant increases when there is a possibility of selling the heat generated in the electric energy production process, or when it is possible to participate in the energy community where higher prices can be obtained or own energy replaces energy purchased from the grid [32–34]. Higher revenue can be obtained by enabling control of energy production within the grid in such a way as to sell the energy in the periods when other RES (PV, wind) do not produce it [35], and in some countries, even by planning flexible seasonal energy production [36]. In the future, biogas energy production, other than from the waste, can be permanently dependent on support policy—for example, justifying it to preserve the environment or to test the technology [37], or other externalities [38–40]—because the progress in reducing the technology costs is relatively small, but the competition for the resources used in food production is also small [41,42]. It is worth mentioning that the economic efficiency of biogas production is similar to that of bioethanol, but the energetic efficiency is higher [43]. It is mainly expected from the development of the technology to increase the efficiency of biogas from substrates, lower investment costs per unit of installed capacity [44], and commercialization of new CO_2 methanation methods [37]. We are convinced that supporting and developing different biogas utilisation pathways better supports this sector than investing in a single way of biogas use.

On the side of revenues from biogas plants, the price for energy obtained in the FIT contract is known; therefore, it becomes crucial to use the installed capacity well, which depends on the amount of available raw material and its price. The profitability of biogas production in biogas plants decreases quickly if raw materials from outside the enterprise are more difficult to obtain; their price and logistical costs increase [45]. A similar relationship can be observed for other biofuels obtained from agricultural raw materials [46]. In biogas production, one can strive to reduce the cost of the raw material and increase the efficiency of biogas from the raw material by using organic waste where available [47,48]. However, it is only profitable on the local scale, where there is no competition over the raw material and with low logistic costs [49,50]. For this reason, biogas plants located near food processing plants have a cost advantage [51] or other sources of waste [52], as well as biogas plants built on a farm, where livestock production occurs [53].

Investing in biogas plants is characterized by high sensitivity to the price changes obtained from selling the energy, as well as the changes of the raw material costs [54,55]. This means that even an increase in the production costs of substrates and wages costs may severely limit the profitability of biogas production, even when a fixed selling price is guaranteed under the FIT tariff. The logistic costs of transporting and storing waste and producing and transporting maize silage depend on the economic situation, and they may increase during the period covered by the FIT fixed tariff. Investments in which the share of the loan in financing the investment is small are also burdened with lower risk. Furthermore, the risk of being burdened with costs is much lower when country-specific subsidies for investments are used as a tool to support the RES.

Another factor determining the profitability of biogas plants is the scale of energy production. The size of the installation must be adjusted to the planned amount of processed raw material. If the proportion of the size of the installation is not adjusted to the possibility of obtaining the raw material, the capital costs are too high, which reduces the profitability of the investment and extends the payback period [54,56]. The rate of return determined in some studies for commercial biogas plants varied from 10 to 60% under the same external conditions [57], and for very small household biogas plants in Bangladesh, it was on average around 40% [58]. The results that present the profitability of biogas plants operated by enterprises are not clear. Zabolotnyy and Melnyk [59] found that ROE in the studied biogas plants in Poland ranged from −10 to 120%. Worse results were associated with over-investment and high cost of inventories and raw materials. In studies of the profitability of biogas plants using waste from fruit production in Italy, it was found that a ROE of 19.5% and a ROS of 30.4% are achieved [60], and in other studies on a group of 22 companies, it was found that the average ROE value was approximately 32% [61]. ROE in biogas plants at cattle farms in the USA was higher for larger installations by about 12%. Financial analysis indicates that the ROE was 12.54% for large farms, but only 0.73% for small and medium dairy farms [62]. This means that the profitability of an individual biogas plant depends on the country, including the obtained support in the form of feed-in tariffs and subsidies for investments, the use of waste from their own production as a raw material, and also factors within the enterprise, including energy use for internal needs of the company, investment outlays related to installed capacity, capital structure, and inventory management.

3. Theoretical Background of DuPont System

The DuPont system is a popular and often used method of analyzing a firm's return-on-equity ROE [63,64]. This indicator is calculated as the relation according to Formula (1):

$$ROE = {}^{Net\ profit}/_{Common\ equity} \tag{1}$$

For analytical purposes, in the DuPont system, ROE (net profit/common equity) is the product of three ratios (2): net profit margin (NPM) (net profit/sales), total assets turnover (TAT) (sales/total assets), and equity multiplier (EQM) (total assets/common equity):

$$ROE = NPM \times TAT \times EQM \tag{2}$$

The DuPont system was first used to analyze ROE in 1919. In the original version, profit margin and assets turnover were included as ROE determinants. It was not until 1970 that the EQM was added to the analysis [3,65,66].

The popularity of the DuPont system is due to its ease of use. It is based on indicators that can be easily derived from financial statements. It can also be used as a planning and control tool [67–70]. Moreover, the attractiveness of investments depends on the return on equity. Therefore, an extremely important element of making investment decisions is information about the possible profitability of invested equity. Equity plays an extremely important role, both purely economic and of guaranteeing the interests of shareholders [71]. The ROE tells common shareholders how effectively their money is being employed. With it, one can determine whether a firm is a profit-creator or a profit-burner, as well as management's profit-earnings efficiency [72]. Investors analyze changes in the ROE level in historical terms, comparing it to other companies in a given industry or to industry benchmarks. The basic formula of ROE (1) shows that an increase in ROE requires either an increase in net profit or a decrease in common equity (i.e., an increase in debt). However, such a narrow look at the determinants of ROE does not provide detailed guidance on how to increase ROE. The solution to this problem is the original DuPont model (2), also known as the Three-Step DuPont Model, which allows the ROE to be broken down into three factors—indicators. Net profit margin (NPM) reflects the pricing strategies used in the enterprise, total assets turnover (TAT) measures how much sales a company generates from each monetary unit of assets, and the last factor, equity multiplier (EQM), measures to what extent the enterprise uses this financial leverage. In the financial strategy of the enterprise, the most important thing is to maximize ROE in the long run. In order to achieve this, various methods are possible, based on Formula (2). For example, the value of one of the indicators can be increased without significantly decreasing the others. A characteristic feature of the DuPont model is the fact that the deterioration of one of the factors does not automatically have a negative impact on the ROE level. By observing the changes in the values of indicators that determine ROE from Formula (2), it is possible to determine what strategies the enterprise chose. It might be a "volume strategy", a "margin strategy", or a "leverage strategy". Companies rarely perform only one strategy; usually, it is a combination of two or three strategies [73].

In the literature on the subject, there are more extensive models of the ROE analysis that derive from the Three-Step DuPont Model. Hawawini and Viallet [74] have proposed a five-step model of DuPont analysis, which breaks down the net profit margin even further to assess the impact of higher borrowing costs associated with increased financial leverage. The most common method of analyzing financial results is the Three-Step DuPont Model [75–79].

Below, a few examples of the empirical applications of the DuPont model in enterprises of various sizes and types of business are introduced. They confirm the universality and common application of the model.

Oriskóová and Pakšiová [80] used the DuPont model to assess the financial situation of engineering industry enterprises in the Slovak Republic. The impact of ROE components was examined by regression and correlation analysis on a sample of 58 enterprises employing at least 200 employees. Their research shows that the asset turnover ratio has the greatest impact on ROA, and the equity multiplier has the smallest impact.

The subjects of the study by Filatov and Bunkovsky [81] using the DuPont model were construction companies in the Baikal region of the Russian Federation. On the basis of the obtained results, the strengths and weaknesses of economic entities were determined. The authors pointed out the possibility of subjecting poor financial indicators to a deeper decomposition in order to assess which area of the company's activity needs improvement more accurately. Botika [82] has reached similar conclusions by examining the factors of the DuPont model in the enterprises listed on the Bucharest Stock Exchange, as well as Padake and Soni [83], who studied the 12 largest banks in India.

Shabani et al. [84] illustrated the benefits of the DuPont model when they used it to determine the main causes and relationships of the changes in the profitability of 40 small and medium-sized enterprises that were operating in 2016–2018 in Kosovo. For the analysis, they used an econometric model to estimate the relationship between the dependent variable ROE and the independent variables asset utilization, capital multiplier, and profit margin. They emphasized that the DuPont model can be successfully used in companies operating in unstable markets with extremely strong competition. Furthermore, Açikgöz and Kiliç [85] used elements of the DuPont analysis for econometric modelling. In this way, they identified financial indicators affecting the market value of companies in the technology sector in Turkey.

Demmer [86], based on the results of research on 72,581 American companies in the years 1990–2012, concluded that an analysis using the DuPont model is the preferred method of estimating the market value of the company, showing the company's strength to improve future profitability through more efficient use of its assets.

Little et al. [87] used a modified DuPont model to identify financial success factors within alternative business strategies. The results of this study suggest that retail companies pursuing a differentiation strategy are more likely to achieve a higher return on net operating assets than companies pursuing a cost leadership strategy.

Research using the DuPont model was also conducted in enterprises from the energy sector. Buena et al. [76] conducted research on a sample of 1253 companies in the Romanian energy industry. The analysis was carried out on three groups of companies, divided according to their size, in order to see the differences in the impact of factors on ROE depending on the company's affiliation to a specific group and to determine how useful the information obtained from the application of the extended DuPont model is in this industry. According to their results, asset turnover and return on sales had the strongest impact on ROE.

Baran et al. [69] investigated whether the environmental, social, and corporate governance (ESG) score of companies operating in the energy sector is associated with their corporate financial performance (CFP). The research covered eight companies with a dominant position in the Polish energy sector. To assess their activities, a comparative analysis of ESG results with accounting measures of profitability was used: return on equity (ROE), return on assets (ROA), and return on sales (ROS). The analysis was deepened using the DuPont model. The obtained results do not reveal repeated relationships that would facilitate the discovery of the pattern of the impact of ESG factors on the financial results of enterprises.

Xu and Liu [88] used the DuPont model to divide renewable energy companies into groups according to the level of profitability. This was the starting point for further research assessing the impact of intellectual capital on the creation of enterprise value depending on the phase of the life cycle.

It can also be noted that the DuPont analysis has a broader use than just assessing the financial situation of an enterprise. Garcia et al. [79] introduced intangible assets to the DuPont analysis, and Pastusiak et al. [68] connected analysis of the financial situation of farms using the DuPont model with the Sustainable Growth Challenge (SGC) model, while Qing et al. [89] created a new DuPont analysis system based on Economic Value Added of Equity. Kasik and Snapka [90] used the DuPont model to signal possible crisis in a company. Beyer and Hinke [91] used the DuPont model to evaluate the strengths and weaknesses of agribusiness in selected European Union countries. Jałowiecki [92] used the DuPont model to assess the efficiency of logistic systems in agri-food enterprises. However, the DuPont model is commonly and widely used to assess the efficiency of business management by managers [75,93].

In the literature on the subject, the limitations of the ratio analysis using the DuPont model are indicated. It is one-dimensional, does not show a comprehensive picture of a company's financial condition, and does not relate to the past. However, such analysis remains one of the easiest, most popular, and simplest methods of assessing the financial condition of enterprises [94]. In addition, it reflects to some extent the macroeconomic situation in the environment of enterprises, and it may also pay attention to the situation in a given industry, indicating from a dynamic perspective ongoing trends.

4. Materials and Methods

Various statistical methods are used to analyse the factors determining the level of ROE based on the DuPont-a model, such as regression models [66,76,77,95–98], Generalised Method of Moments (short timelines) [99,100], a logarithmic and functional method within the multiplicative linkage [93], the Ordinary Least-Squares (OLS) method [79,95], and the deterministic (differentiation) method [66].

In this work, the sample covered all biogas plants operated as independent entities. Biogas plants operating within the organizational structures of other enterprises were not included in the research. These entities were excluded due to the fact that there were no separate financial statements for these entities, which made the analysis impossible. In order to guarantee the correctness of the analysis, companies with errors in their financial statements were removed from the research.

Originally, 99 entities—biogas producers entered in the register of biogas plants—were qualified for the research. These were all biogas plants operating in 2020 in Poland. The choice of this year was dictated by the full availability of financial statements for 2020. The financial statements for 2021 were not fully available. The financial data were obtained from the financial statements published by enterprises in the public domain of The National Court Register of the Ministry of Justice in Poland.

In the article, all biogas plants operated as independent entities (53 entities) were accepted for the study. Biogas plants operating within the organisational structures of other companies were not included in the study. The exclusion of these entities was due to the lack of separate financial statements for these entities, which made the analysis impossible. In order to guarantee the correctness of the analysis, enterprises with errors in their financial statements were removed from the study. In the next stage, biogas plants that showed both negative net profit and negative equity in their financial statements were also excluded from the analyses. In addition, due to the comparability of the study sample, those that had complete data for 2017–2020 were qualified for further study. In this case, the results of causal analysis using the DuPont model were obtained for 2018–2020 (due to the comparison with the previous year). Eventually, 28 entities were qualified for the research.

In the presented model, the return of equity depends on the profitability of sales, asset turnover, and the structure of capital engaged in the company. The comparison method (deviation method) was used to determine the impact of the various factors on the indicator under study. In this method, two categories of figures are compared. One of them expresses the actual state of affairs, and the other is the basis for comparison (in the study, these are the previous year's figures). By subtracting from the number being compared the quantity forming the basis of comparison, one obtains the differences commonly referred to as deviation. The calculation of deviations leads to simple comparisons, in which the influence of individual factors on the established deviations is not shown [101]. Therefore, when the evaluated quantity (ROE) is a function of various factors, it is necessary to conduct a dependency analysis (causal analysis), which assumes a detailed and measurable determination of the impact of individual factors on the resulting deviation [102]. When comparing two periods, the overall deviation of ROE (i.e., $O = ROE_{n1} - ROE_{n0}$) is broken down into several partial deviations. The overall deviation then becomes the algebraic sum of the corresponding partial deviations:

$$\pm O = \pm O_{NPM} \pm O_{TAT} \pm O_{EQM} \tag{3}$$

where

ROE_{n1}—the return on equity of the following year,

ROE_{n0}—the return on equity of the previous year,

$O_{NPM}, O_{TAT}, O_{EQM}$—partial deviations, which determine to what extent the increase or decrease in ROE is related to a change in individual factors.

Various mathematical methods are used to quantify the influence of individual factors on the size of the phenomenon under study. In the study, the logarithm method was generally used. The choice of this method was driven by the possibility of applying it to three factors and achieving accurate results because there are no restrictions on the order of estimating the influence of individual factors on the deviation of the studied phenomenon from the base figure. The algorithm of this method consists of the following steps [65,103]:

1. calculation of dynamics indicators for both independent variables (factors) and a dependent variable (ROE),
2. logarithmization of the dynamics indicators obtained in the first step,
3. calculation of the dynamic indices reflecting the impact of changes in the values of factors (independent variables) on the value of the phenomenon under study (dependent variable) as a quotient of the logarithmized quantities (obtained in the second stage); the calculated indicators reflect the strength with which changes in the values of independent variables affect changes in the dependent variable.

The calculation of partial deviations based on the logarithm method is not possible in the case of companies that made a profit in one of the years under study but a loss in the other, and the ROE growth rate had a negative value. Therefore, in such situations, out of necessity, another method was used—partial differences (since there is no logarithm of a negative number). For these, partial deviations were determined as follows:

$$O_{NPM} = (NPM_1 - NPM_0) \times TAT_0 \times EQM_0 \quad (4)$$

$$O_{TAT} = NPM_1 \times (TAT_1 - TAT_0) \times EQM_0 \quad (5)$$

$$O_{EQM} = NPM_1 \times TAT_1 \times (EQM_1 - EQM_0) \quad (6)$$

Although the partial difference method gives slightly less accurate results, its simplicity can be a useful tool.

5. Results

The DuPont analysis guides the equity owners, as well as the managerial team of a company, to find out the composition of ROE, which is contributed by three distinct variables (NPM, TAT, EQM). Figure 5 shows the value of the median ROE for the researched biogas plants for 2017–2020. The presented data show that the value of ROE improved significantly in the analyzed period. In 2019 and 2020, it was much larger than in 2017 and 2018. Compared to the energy sector in Poland, the value of ROE indicators in biogas plants should be considered as satisfactory [69]. Similarly, in Iotti and Bonazzi [61], it was discovered that ROE for biogas plants in Italy was characterized by high values, significantly higher than the average yield on Italian government bonds. Similarly, in Poland, ROE indicators for 2017–2020 were much higher than the average yield on Polish government bonds (approximately 0.5–2.0%). The downward trend in the value of the NPM index is disturbing (Figure 6), and this index increased in 2020. The lower the NPM ratio, the greater the value of sales must be accomplished in order to achieve a certain amount of profit. In the analyzed period, the efficiency of using the possessed property also decreased (Figure 7). The EQM indicator in the analyzed period ranged from approximately 5.0 to 6.0, which indicates a high level of indebtedness of the researched biogas plants (Figure 8). This situation may be disturbing in terms of maintaining financial liquidity, but it also confirms the relevance of financial debt in biogas plant firms' capital management. A similarly high level of indebtedness of agricultural biogas plants was found in Italy [61]. This may indicate the fact that the development of biogas plants requires instruments of state intervention to facilitate access to bank loans or preferential lending for investments in this sector. This also indicates the need to conduct research on the assessment of the financial situation of biogas plants and their debt service capacity.

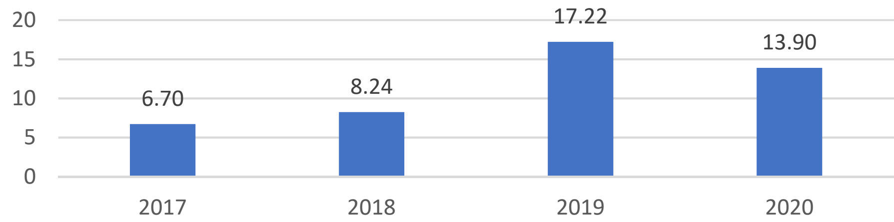

Figure 5. ROE (median) of biogas plants in 2017–2020 (%). Note: our calculations based on the biogas plant's financial statements.

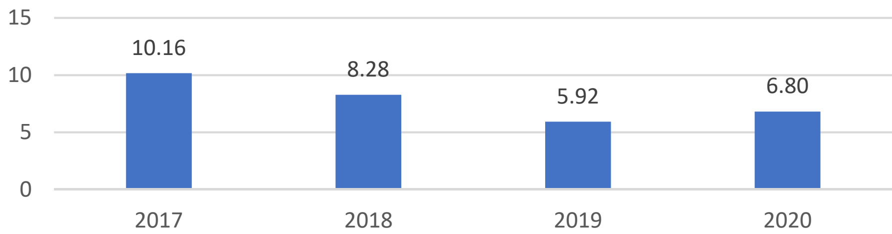

Figure 6. NPM (median) of biogas plants in 2017–2020 (%). Note: our calculations based on the biogas plant's financial statements.

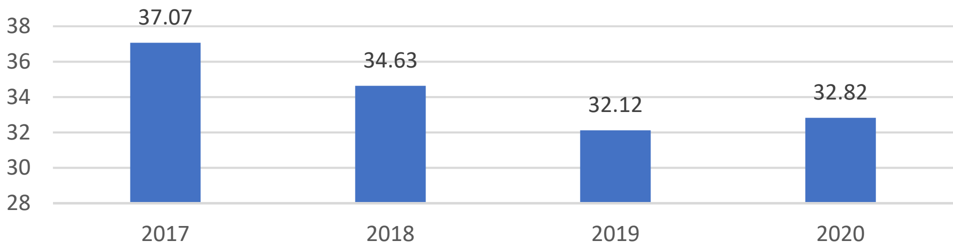

Figure 7. TAT (median) of biogas plants in 2017–2020 (%). Note: our calculations based on the biogas plant's financial statements.

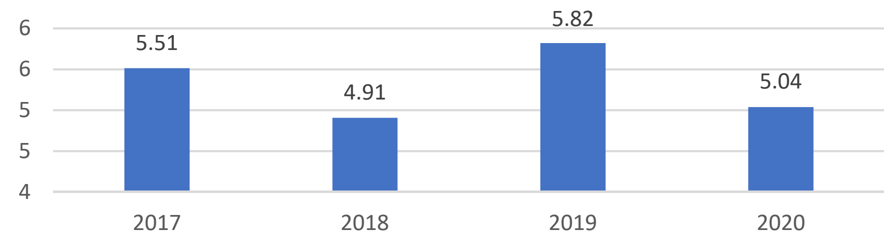

Figure 8. EQM (median) of biogas plants in 2017–2020 (times). Note: our calculations based on the biogas plant's financial statements.

The application of causal analysis of return on equity using the DuPont model makes it possible to determine the dependence of the deviation of the studied indicator on the degree of use of three endogenous factors: sales profitability, total assets management, and use of financial leverage. The results for 2020 are listed in Table 1. The analysis included 28 biogas plants operated as limited liability companies, except Biosas Malewski and Partners (No. company 7), a limited partnership. The companies were divided into three groups depending on the size of the development of the ROE deviation, i.e., the difference between the next year's value and the previous year's value. The first group includes companies that show an increase in ROE in 2020 compared to the previous year, the second group is a reduction in ROE from 0 to 0.2, while the third group is a negative deviation of ROE by a value greater than 0.2.

Table 1. Results of causal analysis using the Du Pont model for 2020.

No.	Company	Installed Electric Capacity (MWe)	Overall Deviation of ROE	Partial Deviations		
				NPM	TAT	EQM
			Group I			
1	Elektrociepłownia Bartos Sp. z o.o.	0.8	15.625	−1.590	−0.357	17.572
2	Bioelektrownia Przykona Sp. z o.o.	1.897	2.949	3.101	0.017	−0.169
3	Bioenergy Project Sp. z o.o.	1.996	1.213	0.919	0.014	0.280
4	Gamawind Sp. z o.o.	2	0.634	5.38	0.241	−4.987
5	Polskie Biogazownie "Energy-Zalesie" Sp. z o.o.	2	0.344	0.325	0.046	−0.027
6	Biogazownia Brzeżno Sp. z o.o.	0.8	0.331	0.302	0.043	−0.015
7	Biosas Malewski i Wspólnicy Sp. k.	0.999	0.258	0.359	−0.052	−0.049
8	Ekowood Sp. z o.o.	1.2	0.225	0.235	0.039	−0.049
9	P.P.-H.-U. "Serafin" Sp. z o.o.	0.99	0.134	0.150	−0.020	0.004
10	Elektrownia Biogazowa Cychry Sp. z o.o.	2.134	0.013	0.009	0.006	−0.003
			Group II			
11	"Ekogaz" Sp. z o.o.	0.999	−0.003	0.036	−0.028	−0.011
12	Nadmorskie Elektrownie Wiatrowe Darżyno Sp. z o.o.	2.4	−0.007	0.052	0.019	−0.078
13	Biogazownia Skarżyn Sp. z o.o.	1.56	−0.009	−0.006	−0.001	−0.002
14	Zielona Energia Michałowo Sp. z o.o.	0.6	−0.047	−0.036	0.021	−0.032
15	Allter Power Sp. z o.o.	1.6	−0.065	0.080	−0.081	−0.064
16	Biogal Sp. z o.o.	3.6	−0.067	−0.048	0.004	−0.023
17	Biogazownia Rypin Sp. z o.o.	1.875	−0.116	−0.005	0.048	−0.159
18	Biogazownie Małopolskie Sp. z o.o.	0.998	−0.121	−0.117	0.010	−0.013
19	Enerbio Eco Sp. z o.o.	0.999	−0.137	−0.104	−0.020	−0.013
20	DMG Sp. z o.o.	2.4	−0.157	−0.103	0.002	−0.057
21	P.P.-H. "Kontrakt" Sp. z o.o.	0.999	−0.158	−0.040	0.006	−0.123
22	Bioelektrownia Sp. z o.o.	1.2	−0.167	0.415	0.020	−0.602
			Group III			
23	Eko-Energia Grzmiąca Sp. z o.o.	1.6	−0.270	−0.247	−0.002	−0.020
24	Eko-Farmenergia Sp. z o.o.	0.999	−0.329	−0.294	−0.029	−0.007
25	Agro Bio Sp. z o.o.	0.4	−0.332	−0.314	0.010	−0.028
26	Enerbio Sp. z o.o.	0.999	−0.461	−0.277	−0.052	−0.132
27	Minex Kogeneracja Sp. z o.o.	1.2	−1.266	−0.914	−0.291	−0.062
28	Lorega Bio Sp. z o.o.	0.999	−1.335	−1.457	0.010	0.112

Note: our elaboration based on company financial statements.

Less than 36% of the analyzed companies recorded a positive ROE deviation. The distribution of ROE deviation in this group was characterised by high variation (210%) and very strong right-hand asymmetry (2.99), which means that, for most companies, the ROE deviation was below the average value. This situation is mainly influenced by the Elektrociepłownia Bartos CHP (No. company 1) company, for which the ROE in 2020 increased by 15.625. It was caused by a strong improvement in the EQM index, which improved the ROE by 17.572. Other indicators (NPM and TAT) had a negative impact on the change in ROE. The company Bioenergy Project (No. company 3) also deserves positive attention where the increase in the ROE ratio was dependent on the improvement of all the indicators adopted for the analysis. In six companies of this group, the improvement of ROE was positively influenced by the NPM and TAT ratios; in P.P.-H.-U. "Serafin" (No. company 9), by the NPM and EQM ratios; while in Biosas Malewski i Wspólnicy Sp. k. (No. company 7), by only one ratio—NPM.

The second group included 12 companies (43%), for which the average deviation of ROE was −0.088, with a variation of 68.0% and weak right-hand asymmetry (0.16). In all the surveyed entities, the deviation of ROE was negatively affected by the use of the financial leverage indicator, which lowered ROE by an average of 0.098. In the case of two companies (Biogazownia Skarżyn (No. company 13) and Enerbio Eco (No. company 19)), ROE was negatively affected by all endogenous factors. Eight companies recorded deterioration in two ratios; the most common (for six companies) were NPM and EQM.

The last group included 6 companies whose ROE decreased by at least 0.27 in 2020 compared to the previous year. The companies in this group are characterised by high diversification (68%) and strong left-sided asymmetry (−0.911), which means that for most of them, the deviation of ROE was above the average of −0.666. The deterioration of ROE for the four companies was negatively affected by all three factors, for Agro Bio (No. company 25) by two ratios (NPM and EQM), and for Lorega Bio (No. company 28) only by the NPM ratio.

The obtained results of the causal analysis for 2020 were compared with the results of previous years (Tables A1 and A2 in the Appendix A). It can be noted that the situation of the analysed companies was very diverse, and for most entities, it is difficult to find regularities related to the development of ROE. Two companies (Gamawind (No. company 4—Table 1) and Elektrociepłownia Bartos (No. company 1—Table 1)) deserve a positive assessment, as they recorded an improvement in ROE both in 2020 and in previous years. It implies rational decision making by managers regarding product sales prices, the efficiency of assets used, and capital structure. However, this cannot be said of the other 2 companies (Lorega Bio (No. company 28—Table 1) and Eko-Energia Grzmiąca (No. company 23—Table 1)), in which there was a successive deterioration of the ROE ratio (by more than 0.2) between 2017 and 2020.

6. Discussion

The statistical analysis indicated that in group I, the majority of the biogas plants have improved their ROE indicator, thanks to the improvement of two elements—NPM and TAT. In the Dehning and Stratopoulos [104] research, it was found that the increase of NPM and TAT indicators comes from the improvement of the effectiveness of management, connected with introducing new technological solutions. More functional technologies of production should influence reducing the costs of unit production, but also improve the quality of offered products, which will allow achieving higher prices. That should be seen in the improvement of the NPM factor. However, increased efficiency should improve the effectiveness of used resources, which improves the TAT indicator. This will result in profitability increase [75,76,104]. Wang et al. [62] research about the financial-economic situation of biogas plants that use anaerobic digester systems indicated the necessity of implementing new technological and operational solutions. Our research also indicates the necessity to pay attention to the actions that stimulate development and implement new technological and organizational solutions. It is also worth mentioning that biogas plants in group II and group III noted the decrease in ROE, which in the majority of these biogas plants was associated with the decrease of NPM and TAT indicators, which also ensures the necessity of paying more attention to the used production technologies and used raw material, as well as the maintenance of the technological regime that enables high biogas yield.

In numerous studies, the great relevance of NPM in the improvement of ROE is emphasized [105,106]. However, it should also be noted that the studied biogas plants used reference prices for the energy sold. For this reason, the price level obtained for energy has a significantly limited impact on the NPM level. As shown in Figure 4, the referential prices in the analyzed period were constant. In such a situation, the way to improve the NPM ratio is to increase the value of the net profit by optimizing the level of incurred costs. In addition, attention should also be paid to the efficiency of the use of assets. The improvement of the TAT index will also depend on the efficiency of the technologies used and the scale of production. Increasing the scale of production may improve economic efficiency, but the possibilities in this case are limited by the installed electric capacity. This conclusion is also important at the investment planning stage, as it requires a thorough assessment of the economic efficiency of the planned investment. Our research focused on the production scale of biogas plants (Table 1), and biogas plants from group III were the smallest. In further research, the relationship between profitability and the scale of production should be sought. Wang et al. [62] focused on that in their research, indicating that anaerobic digester systems technologies developed in the USA favor large farms.

Another issue that arises from our research is the assessment of the subsidizing policy of energy from renewable sources. The support of energy prices for biogas plants seems to be an important factor ensuring the profitability of such an activity. Research results indicate that government subsidies are not always used to promote improvements in corporate financial performance, and renewable energy companies are less profitable than other companies. The negative effect of government subsidies on corporate financial performance can be explained mostly by the rent-seeking behavior of firms [107,108]. However, our research indicates a higher level of profitability of biogas plants than other companies from the energy sector [69]. This may indicate a privileged position of biogas plants. However, the environmental effect value should also be considered in the economic calculation of the benefits of operating biogas plants [109], which may justify a support policy for this sector. This requires further research.

The capital structure is crucial for any business organization. The decision is important because of the need to maximize returns to various organizational constituencies, and also because of the impact such a decision has on a firm's ability to deal with its competitive environment [110]. In the vast majority of the examined biogas plants, the debt decrease negatively influenced the ROE level. We observed that biogas plants limited financial leverage. However, some of them still have high indebtedness (Figure 8), which may generate financial risk in the future, especially in the conditions of rising inflation and operating costs.

7. Conclusions

Bioenergy production, as part of a bio-based economy, has the potential to contribute significantly to the development of a green, low-carbon economy. Biogas production can significantly contribute to the development of rural areas and improve farm income. To achieve this goal, it is important to increase the number of entities producing energy from renewable sources, including biogas plants. Poland has significant potential for the development of biogas production. However, despite the large resource base, the production of biogas is small. In recent years, there has been some slowdown in the upward trend in the number of biogas plants. There are many reasons for this, both institutional and economic, but especially due to the low profitability of such investments.

The research found that:

1. In the analyzed period, biogas plants achieved an increase in ROE in 2019 and 2020 compared to that achieved in 2017–2018. Compared to the energy sector in Poland, the value of ROE indicators in the researched biogas plants should be considered satisfactory.
2. Attention should be paid to the effectiveness of the production technologies used in biogas plants. The improvement or decrease in the value of the ROE indicator in the majority of biogas plants was associated with changes in the level of TAT and NPM, and these in turn depend, inter alia, on the improvement of management efficiency resulting from the implementation of new technologies and compliance with the technological regime.
3. A high level of debt characterized the biogas plants covered by our research, and its reduction had a negative impact on ROE due to the decrease in financial leverage. However, the financial risk was limited. It seems that the development of energy production from biogas still requires instruments of state intervention: not only feed-in tariffs, but also access to low-interest investment loans.
4. The level of profitability observed for the group of biogas plants in Poland (about 14%) was lower than what was established in similar research for biogas plants in Italy, where it was 20% [61], but higher than what was obtained in countries where the level

of subsidisation is lower. In the USA, biogas plants achieved a level of profitability up to 12% [62].

8. Recommendations for Stakeholders

The obtained results allow the formulation of the following recommendations for stakeholders:

1. From the point of view of diversification of energy sources, the price policy mechanisms applied to the biogas plant sector should be positively assessed. Supporting the production of biogas by applying FIT tariffs for producers of energy from biogas is expensive, but it provides a permanent basis for their operation and maintaining stable energy sources in the created renewable energy mix.
2. The development policy of the biogas plant sector should consider the increase in both the public expenditure on research into optimal technological solutions and the scope of organizing the supply of raw materials for various types of biogas plants. The availability and costs of raw material for biogas plants must be the basic element of the cost-effectiveness calculation, which indicates the need to consider local and regional conditions for access to raw materials.
3. The high level of debt recorded in the examined biogas plants generates a high level of financial risk, but it is also conducive to high ROE. Investors must consider the risk of the cost of capital to a greater extent, taking into account the stability of funding. For this reason, the development of energy production from biogas still requires instruments of state intervention: not only feed-in tariffs, but also access to low-interest investment loans.

9. Research Limitations

The limitation of our research is the lack of detailed information on the production technologies used and the structure of the raw material in the analyzed biogas plants. Therefore, it is not possible to clearly indicate the required directions of changes beyond the postulation of local availability of raw materials. In further research, attention should be paid to the relationship between economic results and the technologies used, the efficiency of energy production from various raw materials, and logistics and transaction costs. Such information is particularly important for managerial investment decision making, and it will allow for a more precise assessment of the profitability of investments in new biogas plants.

Further research should also concern the impact of changes in economic conditions related to the increase in prices of raw materials, mainly specially grown energetic plants, as well as the impact of energy prices on the economic efficiency of biogas plants. The time frame of our research did not concern the period in which the energy market crisis occurred, and such an approach requires an analysis after the end of the next years of operation of enterprises.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Results of causal analysis using the Du Pont model for 2019.

No.	Company	Overall Deviation of ROE	Partial Deviations		
			NPM	TAT	EQM
1	Bioelektrownia Sp. z o.o.	7.146	3.169	−0.148	4.125
2	Gamawind Sp. z o.o.	3.822	2.874	0.046	0.902
3	Agro Bio Sp. z o.o.	3.221	1.881	0.229	1.111
4	Bioelektrownia Przykona Sp. z o.o.	0.996	−0.633	−0.177	1.806
5	Elektrociepłownia Bartos Sp. z o.o.	0.695	0.867	0.001	−0.173
6	Allter Power Sp. z o.o.	0.276	0.302	0.058	−0.085
7	DMG Sp. z o.o.	0.238	0.279	0.001	−0.043
8	Nadmorskie Elektrownie Wiatrowe Darżyno Sp. z o.o.	0.046	0.091	0.025	−0.070
9	Biogazownia Brzeżno Sp. z o.o.	0.016	0.054	−0.028	−0.010
10	Biogazownia Skarżyn Sp. z o.o.	0.009	0.018	−0.006	−0.003
11	Biogal Sp. z o.o.	−0.003	−0.011	0.020	−0.012
12	Biogazownie Małopolskie Sp. z o.o.	−0.040	−0.050	0.049	−0.039
13	Minex Kogeneracja Sp. z o.o.	−0.041	−0.187	0.136	0.009
14	Polskie Biogazownie "Energy-Zalesie" Sp. z o.o.	−0.051	−0.042	−0.008	−0.001
15	Elektrownia Biogazowa Cychry Sp. z o.o.	−0.066	−0.047	−0.013	−0.006
16	P.P.-H. "Kontrakt" Sp. z o.o.	−0.071	0.182	0.004	−0.257
17	"Ekogaz" Sp. z o.o.	−0.120	−0.140	0.025	−0.004
18	Eko-Farmenergia Sp. z o.o.	−0.131	−0.109	−0.011	−0.011
19	Zielona Energia Michałowo Sp. z o.o.	−0.152	−0.086	0.008	−0.074
20	Enerbio Sp. z o.o.	−0.161	0.363	0.076	−0.600
21	Biosas Malewski i Wspólnicy Sp. k.	−0.193	0.090	−0.285	0.002
22	Enerbio Eco Sp. z o.o.	−0.207	−0.041	−0.065	−0.102
23	Lorega Bio Sp. z o.o.	−0.246	−4.007	−0.729	4.489
24	Eko-Energia Grzmiąca Sp. z o.o.	−0.260	−0.165	0.094	−0.190
25	P.P.-H.-U. "Serafin" Sp. z o.o.	−0.437	−0.406	−0.037	0.006
26	Ekowood Sp. z o.o.	−0.625	−0.434	−0.077	−0.114
27	Biogazownia Rypin Sp. z o.o.	−0.774	0.174	−0.301	−0.647
28	Bioenergy Project Sp. z o.o.	−0.844	−0.365	0.032	−0.511

Note: our elaboration based on company financial statements.

Table A2. Results of causal analysis using the Du Pont model for 2018.

No.	Company	Overall Deviation of ROE	Partial Deviations		
			NPM	TAT	EQM
1	Gamawind Sp. z o.o.	11.723	14.838	−0.783	−2.332
2	Elektrociepłownia Bartos Sp. z o.o.	5.880	3.458	−0.255	2.676
3	Polskie Biogazownie "Energy-Zalesie" Sp. z o.o.	2.613	2.686	0.012	−0.086
4	Biogazownia Rypin Sp. z o.o.	2.267	−0.100	−0.299	2.666
5	Enerbio Eco Sp. z o.o.	1.248	−0.810	0.699	1.360
6	Enerbio Sp. z o.o.	0.691	0.914	0.041	−0.264
7	Eko-Farmenergia Sp. z o.o.	0.150	0.154	0.010	−0.013
8	Biogal Sp. z o.o.	0.078	0.024	0.031	0.024
9	Bioenergy Project Sp. z o.o.	0.029	0.056	−0.010	−0.017
10	Elektrownia Biogazowa Cychry Sp. z o.o.	−0.002	−0.040	0.048	−0.010
11	Biogazownie Małopolskie Sp. z o.o.	−0.043	−0.034	0.044	−0.054
12	Biosas Malewski i Wspólnicy Sp. k.	−0.055	−0.049	−0.003	−0.003
13	"Ekogaz" Sp. z o.o.	−0.062	−0.065	−0.001	0.005
14	Nadmorskie Elektrownie Wiatrowe Darżyno Sp. z o.o.	−0.093	−0.023	0.006	−0.075
15	Minex Kogeneracja Sp. z o.o.	−0.106	−0.100	−0.009	0.003
16	DMG Sp. z o.o.	−0.134	−0.136	0.026	−0.024

Table A2. *Cont.*

No.	Company	Overall Deviation of ROE	Partial Deviations		
			NPM	TAT	EQM
17	Biogazownia Brzeżno Sp. z o.o.	−0.154	−0.367	0.213	0.000
18	Biogazownia Skarżyn Sp. z o.o.	−0.307	−0.281	−0.002	−0.025
19	P.P.-H.-U. "Serafin" Sp. z o.o.	−0.382	−0.117	−0.009	−0.256
20	Zielona Energia Michałowo Sp. z o.o.	−0.534	−0.277	0.067	−0.324
21	Ekowood Sp. z o.o.	−0.536	0.164	0.279	−0.978
22	Eko-Energia Grzmiąca Sp. z o.o.	−0.744	0.044	0.009	−0.796
23	Lorega Bio Sp. z o.o.	−1.001	−1.578	0.011	0.566
24	P.P.-H. "Kontrakt" Sp. z o.o.	−1.063	−0.211	−0.625	−0.227
25	Bioelektrownia Przykona Sp. z o.o.	−2.251	−0.839	−0.158	−1.255
26	Agro Bio Sp. z o.o.	−2.330	0.177	−0.257	−2.250
27	Bioelektrownia Sp. z o.o.	−5.556	1.049	−0.699	−5.906
28	Allter Power Sp. z o.o.	−7.333	−7.442	0.002	0.108

Note: our elaboration based on company financial statements.

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