European Research Studies Journal
Volume XXVII, Issue 4, 2024

pp. 837-865

Financial Benchmarking on the Example of Energy Sector Companies in Poland

Submitted 10/09/24, 1st revision 25/09/24, 2nd revision 01/10/24, accepted 30/10/24

Łukasz Szydełko[1], Sabina Rokita[2]

Abstract:

Purpose: *The aim of the article is to indicate the possibilities of the application of financial benchmarking in supporting management, on the example of companies from the energy sector in Poland, using descriptive statistics and the TOPSIS method.*
Design/Methodology/Approach: *Achieving the research goal defined in the article requires the use of a comprehensive research approach, carried out in several stages, and combining several research methods. At the beginning, a critical review of the literature on the subject is conducted and the method of reasoning by analogy is used. Then, a financial benchmarking proposal is presented (on the example of companies from the energy sector in Poland) including selecting the subject and object of comparison, collecting external data, calculating indicators and analyzing results using descriptive statistics, the TOPSIS method, and creating appropriate rankings. Research methods such as literature review, reasoning by analogy, Spearman's rank correlation descriptive statistics (mean, median, minimum, maximum, standard deviation, variation coefficient, kurtosis) and TOPSIS method are used in the study.*
Findings: *The analyses carried out indicate large application possibilities in the context of using financial benchmarking in companies from the energy sector. Properly selected areas and indicators in financial benchmarking can support management in additional financial dimensions. This, in turn, translates into more effective creation and implementation of strategies, and an increase in the efficiency of operational management (focused on business processes) in companies from the energy sector.*
Practical implications: *The implementation of financial benchmarking can lead to an improvement in the quality of the management process in companies from the energy sector. Properly selected areas, measures (indicators), methods and objects of comparison in financial benchmarking allow for drawing valuable conclusions (including in the scope of the strengths and weaknesses of the company compared to the competition, inefficient use of resources, inappropriate actions) and setting new directions or methods of development. This allows for improving the process of creating, implementing and monitoring strategies in companies, and increasing the efficiency of operational management (focused on business processes). As a result, these activities lead to an increase in the value of companies from the energy sector for shareholders (including an increase in the capitalization of companies from the energy sector on the stock exchange).*
Originality: *The article presents the possibilities of the application of financial benchmarking in supporting management, using descriptive statistics and the TOPSIS method. The financial benchmarking proposal is based on the example of companies from*

[1]*Rzeszow University of Technology, Poland, lukaszsz@prz.edu.pl;*
[2]*Rzeszow University of Technology, Poland, srokita@prz.edu.pl;*

the energy sector in Poland, but it contains general assumptions that can be implemented in any entity regardless of the sector in which it operates.

Keywords: *Financial benchmarking, financial indicators, management, strategy, energy industry.*

JEL codes: *G3, M20, M40.*

Paper type: *Research article.*

1. Introduction

The energy sector in Poland is undergoing constant transformation. This is mainly related to the introduction of appropriate energy policies in the European Union. The energy transformation concerns not only energy producers, but also entities that store and distribute it.

Currently, there is a very high variability of the environment and an increase in competitiveness in the energy sector in Poland. Enterprises are fighting for customers, capital for development, and resources on the local energy market. In particular, this concerns energy projects (i.a., documentation and location, energy technologies, qualified engineering staff).

By analyzing current trends in the energy sector in Poland, new directions of development and innovation can be indicated. Emphasis is placed particularly on (10 trendów w energetyce…, 2024; Energy Policy…, 2021):

1. Sustainable energy production.
2. Energy efficiency in enterprises.
3. Energy storage.
4. Electromobility.
5. Gas fuel as part of a transitional energy strategy.
6. Smart energy networks.
7. Microgrids and local energy systems.
8. Artificial intelligence in energy.
9. Energy security and reliability of supply.
10. Energy regulations and policy.

Diversification of energy production (sustainable energy production) is one of the most important trends on the energy market in Poland. The share of renewable energy sources is growing. Very large increases are noted in the area of solar and

wind energy production. There are also significant increases in the area of biomass and geothermal energy (Zagłębienie się w dynamikę…, 2023).

In many Polish companies, bills for electricity consumption have increased. Managers and owners of companies are taking actions to reduce them and to diversify energy sources. In this way, company renewable energy installations are often created, mainly photovoltaic ones (Perspektywy KPMG…, 2024). An additional impetus for investment in this area at the enterprise level is certainly the available subsidies and preferential interest-bearing loans.

The development of energy storage technology leads to an increasing interest from companies operating in the energy sector in Poland. Thanks to the energy storage, it is possible to stabilize power grids and integrate renewable energy sources with traditional sources of energy generation (Lis *et al.*, 2024; Pociovalisteanu *et al.*, 2010).

Another important trend in the energy sector in Poland is the increase in the level of electromobility. This is particularly visible in the area of vehicle charging stations, as the number of electric cars in Poland is growing. This leads to an increased demand for vehicle charging stations, so building the right infrastructure in this field is crucial.

Gas fuel also has a significant impact on the functioning of the energy market in Poland, as the country is moving away from a coal-based economy as part of its transitional energy strategy (Dzikuć *et al.*, 2021; Koczan and Alkan, 2022). The process of decarbonization is taking place, and gas often directly replaces coal. Moreover, in Poland, the consumption of liquefied natural gas (LNG) and synthetic gas is rising. Technologies using hydrogen and biogas are developing very dynamically.

Smart energy networks also play a significant role in the development of the energy market in Poland. The introduction of such solutions leads to more effective management of energy flows and enables the prediction of network failures. This is of great importance given the growing share of energy supplies from renewable sources (such supplies are characterized by irregularity, and the problem of network stabilization appears).

Micro-networks and local energy systems also play a key role in the development of the energy market in Poland. The design and expansion of such local energy systems relieves the main networks and increases the energy security of local communities. Errors and faults from the main networks do not transfer to local energy systems and vice versa, local energy systems do not pose a risk to the main networks.

In Poland, there is also a noticeable increase in the use of artificial intelligence solutions. This applies, in particular, to the management of energy networks,

optimizing energy consumption, and forecasting energy demand. Thanks to artificial intelligence, the efficiency of resource use and implemented processes is increased.

Entities operating on the energy market in Poland must also take into account the country's energy security and supply reliability in their activities. Securing the resources of companies operating in the energy sector in Poland is strategic in this respect (the infrastructure owned by companies is critical, and must be secured against external attacks, e.g. sabotage, cyberattacks). This means that for many companies in the energy sector such security measures result in additional costs and lower financial results.

An important factor that influences the functioning of the energy market in Poland is certainly the law. Each country, including Poland, has specific strategic goals to achieve in terms of energy policy. The introduction of specific legal regulations causes a shift in emphasis to desired areas (e.g., sustainable development, technological innovation, green transformation, ESG strategies) and has a direct impact on the structure of the energy market and energy prices.

If companies in the energy sector want to develop, they must constantly meet the ever-increasing expectations of their customers and adapt to the conditions and requirements of the changing and dynamic environment (Ward and Duray, 2000). Strengthening the position of a company in the energy market is only possible if appropriate strategies are created and implemented.

The development of a company operating in the energy sector depends on the broadly understood quality of strategic and operational management. Well-organized economic entities can effectively respond to changes occurring in the environment. Managers of energy companies must be aware that they should make rational decisions which will allow for very rapid adaptation to these changes.

Long-term thinking is primarily about adjusting and adapting a company operating in the energy sector to the future environment. Properly established and implemented missions, visions, and strategies are helpful in this respect. Choosing the right strategy and the forms of its subsequent implementation plays a fundamental role in achieving successes by a company in the energy sector, measured by the growth of its value.

Proper identification and formulation of strategy (the strategy creation stage), as well as the implementation and strategic control (the strategy implementation stage) are the most important elements of strategic management. This is confirmed by numerous scientific studies and advice from management practitioners (Wardhana, 2024).

Operational management of a company functioning in the energy sector also requires additional support. Despite the fact that companies use elements of modern

management concepts, there are still knowledge deficits in certain areas. In recent years, a key element in modern management in companies, including those in the energy sector, has become management focused on business processes (business process management).

The pursuit of continuous development and efficient use of resources leads to the search for various management support tools. Properly defined and modelled financial benchmarking can be helpful in creating and implementing strategies and operational management (focused on business processes) in companies from the energy sector.

Taking into account the importance of financial benchmarking in management and the challenges that the energy sector in Poland must face, the aim of the article is to indicate the possibilities of the application of financial benchmarking in supporting management, on the example of companies from the energy sector in Poland, using descriptive statistics and the TOPSIS method.

2. Research Design and Methodology

Achieving the research goal defined in the article requires the use of a comprehensive research approach, carried out in several stages, and combining several research methods.

At the beginning, a critical review of the literature on the subject is conducted and the method of reasoning by analogy is used. Then, a financial benchmarking proposal is presented (on the example of companies from the energy sector in Poland) including selecting the subject and object of comparison, collecting external data, calculating indicators and analyzing results using descriptive statistics, the TOPSIS method, and creating appropriate rankings.

Research methods such as literature review, reasoning by analogy, Spearman's rank correlation, descriptive statistics (mean, median, minimum, maximum, standard deviation, variation coefficient, kurtosis) and TOPSIS method are used in the study.

3. The Significance of Benchmarking in Management

Business management should be considered at the strategic and operational levels. In both cases, through management, managers direct businesses towards achieving specific goals (in the strategic dimension – strategic goals, while at the operational level – operational goals).

From a strategic perspective, key elements include (Aldhaheri *et al.*, 2020):

- mission,
- vision,
- strategic analysis,

- strategy creation (identification of strategic options and selection of an option for implementation),
- strategy execution (strategy implementation and control).

Orienting companies towards achieving operational goals is possible using process management. Within the operational processes management, the following are distinguished (Gupta, 2004; zur Muehlen and Rosemann, 2004):

- process identification,
- process measurement,
- process analysis,
- process improvement,
- process controls.

The search for the best solutions and models to follow led to the creation of benchmarking. The literature on the subject indicates that benchmarking is derived from the word 'benchmark' (reference point) and is most often defined as a set of procedures and techniques that allow for comparisons with leaders inside and outside the company, appropriately focused on learning and creative use of experience gained from best practices (Nita, 2008).

Best practices can concern both the strategic and operational dimensions. In particular, during benchmarking-based analyses, the following areas of comparison can be distinguished:

- products, services,
- method of selling (distributing) products, services,
- customer service,
- quality systems,
- work organization,
- processes executed in the enterprise.

Benchmarking is also a search for the most effective methods of action for a given company that allow it to achieve a competitive advantage (Camp, 1995). It is crucial in management aimed at reducing the role and share of competitors on the market. Benchmarking can be divided into (Weber, 2001):

- functional benchmarking,
- process benchmarking,
- internal benchmarking,
- external benchmarking.

Functional benchmarking is related to the situation in which companies, which are usually not the closest competitors, are compared. The subject of this type of benchmarking may include specific functions, e.g., warehousing or supply.

Process benchmarking most often means comparing processes and procedures in enterprises (from the point of view of selected criteria) (Kowalak, 2009a). The most common criteria include (Kowalak, 2009b; Sierpińska and Niedbała, 2003):

- purpose of application (support for the process of creating and implementing the strategy, support for improving process efficiency),
- orientation (competitors' processes, internal processes),
- data sources (competitors, enterprise),
- data nature (qualitative data, quantitative data),
- method of evaluation (compliance with assumptions in the form of a description, results at the process level),
- measures (no indicators - comparison based on description, indicators describing results).

Internal benchmarking refers to comparisons within a single enterprise. The subject of this type of benchmarking may be, for example, separate organizational units. This specifically applies to: responsibility centers, departments, plants, branches, divisions, and strategic business units. The greater the degree of decentralization in a given enterprise, the greater the possibilities of very detailed comparisons in this area.

Benchmarking in relation to competitors is also referred to as external benchmarking. It is most often used in a situation where the aim of a given company is to compare itself to a competitor (competitors) operating in the same industry. In these comparisons, the reference points are, in particular (Szydełko and Szydełko, 2013):

- processes,
- functions,
- methods of operation,
- operations,
- products.

One of the functions that can be compared to competitors is finance. This means that within external benchmarking there can be financial benchmarking.

4. Financial Benchmarking – Essence and Stages

Financial benchmarking is comparing oneself to direct competitors in the financial dimension. Most often, this is done in selected areas of financial achievements of enterprises using specific indicators (metrics).

Only on the basis of selected indicators it is possible to properly compare a given enterprise with other enterprises (competitors) in the industry.

The detailed financial benchmarking procedure will consist of many stages (phases). Using analogical reasoning within the benchmarking procedure, it is possible to distinguish (Bendel and Boulter, 2000):

- Selecting the subject of comparison.
- Conducting internal research to determine current practices and results achieved.
- Selecting the object or objects of comparison (e.g. competitors).
- Collecting external data.
- Analyzing the data and calculating indicators.
- Identifying the potential for the improvement program.
- Implementing the improvement program.
- Maintaining the improvement program.

The choice of the appropriate subject for comparison is determined by the information that the company intends to obtain. Of course, the industry and specifics of the company's activity should also be taken into account. In practice, the most common comparisons in the area of finance are (Financial Benchmarking …, 2024; Business Financial Benchmark Analysis, 2024; Trejo-Pech, 2024):

- liquidity,
- profitability,
- indebtedness,
- activity (efficiency).

In each of these areas, indicators (ratios) are selected and their sample summary is presented in Table 1.

Table 1. *Example of a list of financial areas and indicators*

Area	**Indicators**
Liquidity	Cash ratio, quick ratio, current ratio, immediately due liabilities ratio, receivables turnover ratio, net working capital ratio.
Profitability	Return on assets (ROA), Return on equity (ROE), Return on sales (ROS), operating profit margin, net profit margin, sales profit margin, gross profit margin, Return on invested capital (ROIC).
Indebtedness	Debt ratio, equity ratio, debt-to-equity ratio, long-term debt ratio, fixed assets to long-term debt ratio, long-term solvency ratio based on fixed capital coverage, ratio of financial leverage effect, interest coverage ratio, cash flow coverage ratio, net debt to EBITDA ratio, net financial debt to EBITDA ratio.
Activity (efficiency)	Accounts receivable cycle, inventory cycle, operating cycle, accounts payable cycle, cash conversion cycle, net working capital (NWC), total assets turnover ratio, fixed assets turnover ratio, current assets turnover ratio, receivable turnover ratio, inventory turnover ratio, working capital coverage ratio.

Source: *Own study based on Financial Ratios eBook,2024; Business Financial Benchmark Analysis, 2024; Financial analysis,2024.*

Based on internal data, the next step is to calculate selected indicators in defined (specified) financial areas.

Then, the objects to which the selected areas and indicators will be compared are determined. In financial benchmarking, which is an element of external benchmarking, the objects of comparison will be the main competitors.

The first three stages in the financial benchmarking procedure are not problematic. Certain inconveniences may occur when gathering external data. Most often, it turns out that in the case of many competitors, the data for calculating their indicators is not publicly disclosed or is disclosed with a delay. The situation is completely different in the case of companies listed on the stock exchange, because their financial data is generally reported after each completed quarter. This means that it is possible to compare the indicators of a given company with the indicators of competing companies more often than once a year. Obtaining data on competitors is key in benchmarking. The more of this data is collected, the greater the possibilities of conducting advanced analyses. Thanks to them, it is possible to determine the so-called gap at the level of a given indicator, and calculate its size (as the difference between the value of the indicator of a given company and, for example, the value of the same indicator of a competing company, the average industry value of the same indicator). At the same time, it is possible to position a given company in relation to the industry or selected objects from this industry (Krishnamoorthy and D'Lima, 2014). Based on this type of information, a model is determined and the path that needs to be followed, so everything that has been written in the strategic and operational plan can be fully implemented.

Achieving strategic and operational goals is possible mainly through the use of specific management methods and techniques, with the simultaneous assumption that financial benchmarking will be carried out continuously, with the full involvement of employees responsible for finance (their willingness to implement changes is crucial in this respect).

From a strategic and operational points of view, it is important to pay attention to whether the values of individual indicators achieved in a given company are a source of competitive advantage. Nowadays, only when a company focuses on key indicators (referred to as Key Performance Index (KPI)) can it effectively use its resources and effectively compete on the market.

It is worth emphasizing here that strategic KPIs should be disaggregated into operational KPIs (regarding processes). Thanks to these solutions, it will be possible to implement an improvement program and consolidate it in the future.

5. Possibilities of Using the TOPSIS Method in Financial Benchmarking

Determining the position of an enterprise in financial benchmarking in relation to the

object or objects of comparison (e.g., competitors) can be done on the basis of one or several indicators. Assessment based on one indicator is usually unambiguous and does not raise any doubts. However, the position of an enterprise is a complex phenomenon, shaped at the same time by many factors (variables), therefore, its assessment usually requires simultaneous consideration of multiple criteria and indicators (Nowak, 1997).

The analysis of the enterprise's position on the basis of several indicators can cause problems, because, for example, different indicators can give contradictory results. In the case of comparisons with competitors, the situation may be similar, i.e. a comparison based on one measure may provide different results than a comparison based on another measure (Nowak, 1997).

In order to avoid these problems, a synthetic (integrated) measure (taking into account many evaluation criteria or measures simultaneously) can be used to assess complex phenomena, which is the result of applying specific linear ordering methods (Bąk, 2016). One of them is the TOPSIS method (Technique for Order Preference by Similarity to Ideal Solution) proposed by Ching-Lai Hwang and Kwangsun Yoon (Hwang and Yoon, 1981).

The idea of the TOPSIS method is based on the evaluation of decision variants based on their distance from two reference points, i.e., Positive Ideal Solution and Negative Ideal Solution, expressed by a synthetic (integrated) measure. The best decision variant is the one that is the closest to Positive Ideal Solution while being the furthest from Negative Ideal Solution (Effatpanah *et al.*, 2022; Filipowicz-Chomko, 2021; Kacprzak, 2018).

TOPSIS method, the main stages (Effatpanah *et al.*, 2022; Pardede *et al., 2023;* Konuk, 2018; Acar and Sariyer 2021; Bąk, 2016; 2018):

1. Preparation of the initial decision matrix X, where *n* is the number of alternatives and *m* is the number of criteria:

$$X = [x_{ij}]_{nxm}; i = 1,2, \dots n; j = 1,2, \dots m \quad (1)$$

2. Normalization (quotient transformation) of the decision matrix R:

$$R = [r_{ij}]_{nxm} \quad (2)$$

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{n} x_{ij}^2}} \quad (3)$$

3. Calculation of the weighted normalized decision matrix V:

$$V = [v_{ij}]_{nxm} \quad (4)$$

$$v_{ij} = w_j * r_{ij} \tag{5}$$

w_j – weight of *j* criterion, $\sum_{j=1}^{m} w_j = 1$

4. Establishing the ideal positive solution (A^+) and the ideal negative solution (A^-):

$$A^+ = \{V_i^+, \dots, V_n^+\} = \left\{\left(MAX\ i_{v_{ij}}, j \in J\right)\left(MIN\ i_{v_{ij}}, j \in J\right)\right\} \tag{6}$$

$$A^- = \{V_i^-, \dots, V_n^-\} = \left\{\left(MIN\ i_{v_{ij}}, j \in J\right)\left(MAX\ i_{v_{ij}}, j \in J\right)\right\} \tag{7}$$

5. Calculating the distance (Euclidean distance) from the ideal positive solution (D^+) and the ideal negative solution (D^-):

$$D_i^+ = \sqrt{\sum_{j=1}^{m}(v_{ij} - v_j^+)^2} \tag{8}$$

$$D_i^- = \sqrt{\sum_{j=1}^{m}(v_{ij} - v_j^-)^2} \tag{9}$$

6. Calculate the relative closeness (C) of each alternative to the ideal solution:

$$C_i = \frac{D_i^-}{D_i^+ + D_i^-} \tag{10}$$

$$0 \leq D_i \leq 1$$

7. Ranking the alternatives by arranging them in descending order of relative closeness values. The most advantageous alternative has the highest C_i value.

6. Financial Benchmarking Proposal for Energy Sector Companies

With reference to the part "Financial benchmarking – essence and stages" of the article, this financial benchmarking proposal includes stages (phases) such as selecting the subject and object of comparison, collecting external data, calculating indicators and analyzing results, using descriptive statistics and the TOPSIS method.

However, it does not include conducting internal research to determine current practices, results achieved and parts related to identifying, implementing and maintaining the improvement program, because they are closely related to a specific company and it exceeds the aim of this article. The financial benchmarking proposal

is based on the example of companies from the energy sector in Poland, but it contains general assumptions that can be implemented in any entity regardless of the sector in which it operates.

6.1 Choosing the Subject of Comparison

At this stage, the company should select the subject of comparison for financial benchmarking. Four financial areas are selected for the study, and in each area two financial indicators. The selected areas and indicators are presented in Table 2.

Table 2. *Selected areas and financial indicators for financial benchmarking*

Area name	Indicator name	Calculation method	Interpretation
Profitability	ROE (X1)	Net profit/equity (average)	The indicator informs about the return on equity, i.e. how many units of net profit are generated by one unit of equity.
	Net profit margin ratio (X2)	Net profit/total revenue	The indicator informs about the profitability of revenue, i.e. how many units of net profit are generated by one unit of total revenue.
Liquidity	Current ratio (X3)	Current assets (average)/short-term liabilities (average)	The indicator shows how many units of current assets are generated by one unit of short-term liabilities.
	Net working capital ratio (X4)	(Current assets (average) – short-term liabilities (average))/total assets (average)	The indicator shows how many units of working capital are generated by one unit of assets.
Activity (efficiency)	Total liabilities turnover ratio (X5)	Total revenue/total liabilities (average)	The indicator shows how many units of revenue are generated by one unit of liabilities.
	Total assets turnover ratio (X6)	Total revenue/total assets (average)	The indicator shows how many units of revenue are generated by one unit of assets.
Indebtedness	Long-term solvency ratio based on fixed capital coverage (X7)	(Equity (average) + long-term liabilities (average))/fixed assets (average)	The indicator shows how many units of fixed capital are generated by one unit of fixed assets.
	Debt ratio (X8)	Total liabilities (average)/total assets (average)	The indicator shows how many units of total liabilities are generated by one unit of liabilities.

Source: *Own study.*

It is assumed that financial benchmarking of energy companies for 2023 will be carried out based on the indicators presented in Table 2 using descriptive statistics and the TOPSIS method.

6.2 Selection of Companies for Comparison, Collection of External Data, Data Analysis and Calculation of Indicators

Due to the availability and reliability of financial data, energy companies listed on the stock exchange are selected as objects of comparison. Initially, all Polish energy sector companies listed on the Warsaw Stock Exchange (GPW) Main Market and NewConnect were selected for the study, i.e. whose financial data were complete and allowed for the calculation of the financial indicators indicated in the table, there were 28 of them.

Then, based on the data from the individual financial statements for 2023, the financial indicators were recalculated. After calculating the financial indicators and their preliminary analysis, it turned out that 8 out of the group of 28 energy companies should be excluded, because their financial indicators showed extreme values. For this reason, the final research sample includes 20 companies, including:

- 10 companies from the GPW Main Market, the Energy sector and the Fuels and Gas sector,
- 10 companies from the GPW NewConnect, the Renewable Energy sector.

Then, for the group of 20 energy companies, an analysis of the variability of all 8 financial indicators is carried out (to eliminate those for which the coefficient of variation is lower than 10%) and a correlation analysis is performed using the Spearman's rank correlation (to eliminate indicators that are too correlated, i.e. those for which the correlation coefficient is higher than 70%) (Gierusz and Pobłocka, 2022). The results of the analyses are presented in tables 3 and 4, respectively.

Table 3. *Coefficients of variation of 8 financial indicators*

Specification	**X1**	**X2**	**X3**	**X4**	**X5**	**X6**	**X7**	**X8**
Coeff. of var.	245.79%	-1068.81%	92.46%	215.47%	76.14%	82.90%	383.66%	36.40%

Source: *Own study.*

The variability analysis shows that all indicators are characterized by high variability (above 10%).

Table 4. *Spearman's rank correlation analysis for 8 financial indicators**

Specification	**X1**	**X2**	**X3**	**X4**	**X5**	**X6**	**X7**	**X8**
X1	1.0000	0.8677	-0.4076	-0.4331	-0.1113	-0.0181	-0.4165	0.1594
X2	0.8677	1.0000	-0.4511	-0.5338	-0.3038	-0.3128	-0.5459	-0.0557
X3	-0.4075	-0.4511	1.0000	0.9293	0.3985	0.2887	0.8917	-0.4301
X4	-0.4331	-0.5338	0.9293	1.0000	0.5188	0.4361	0.9880	-0.3203

X5	-0.1113	-0.3038	0.3985	0.5188	1.0000	0.8887	0.5293	-0.0752
X6	-0.0181	-0.3128	0.2887	0.4361	0.8887	1.0000	0.4947	0.3173
X7	-0.4165	-0.5459	0.8917	0.9880	0.5293	0.4947	1.0000	-0.2301
X8	0.1594	-0.0556	-0.4301	-0.3203	-0.0752	0.3173	-0.2301	1.0000

Note: ** Financial indicators that are excluded from the study due to the correlation coefficient value exceeding 70% are marked in yellow.*
Source: *Own study.*

However, the Spearman's rank correlation analysis shows excessive correlation (over 70%) of some financial indicators, for this reason, 4 of them are eliminated, i.e.: Net profit margin ratio (X2), Net working capital ratio (X4), Total liabilities turnover ratio (X5), Long-term solvency ratio based on fixed capital coverage (X7). Ultimately, each of the 4 areas examined is described by only one indicator, which is presented in Table 5.

Table 5. *The final set of financial areas and ratios for financial benchmarking*

Area name	**Indicator name**
Profitability	ROE (X1)
Liquidity	Current ratio (X3)
Activity (efficiency)	Total assets turnover ratio (X6)
Indebtedness	Debt ratio (X8)

Source: *Own study.*

6.3 Description of the Group of 20 Surveyed Energy Companies Based on 4 Financial Indicators (in Table 5) Using Descriptive Statistics

Table 6 presents the group of 20 energy companies surveyed and the values of financial indicators for 2023.

Table 6. *Group of 20 energy companies listed on the GPW (Main Market and NewConnect) and the values of financial indicators for 2023*

No.	**GPW: market and sector***	**Company name**	**ROE (X1)**	**Current ratio (X3)**	**Total assets turnover ratio (X6)**	**Debt ratio (X8)**
1	MM, E	PGE S.A.	-0.1320	2.8075	1.1274	0.2905
2	MM, E	Onde S.A.	0.0884	1.6473	1.7122	0.4657
3	MM, E	ML System S.A.	-0.0052	1.0378	0.4019	0.6519
4	MM, E	Energa S.A.	0.0050	0.4313	0.0506	0.4528
5	MM, E	Novavis Group S.A.	0.1736	0.3704	0.3315	0.4933
6	MM, E	ENEA S.A.	-0.1214	1.2513	0.9404	0.4016
7	MM, E	KOGENERACJA S.A.	0.1159	0.8328	0.6087	0.4500
8	MM, FG	Orlen S.A.	0.1580	1.2843	1.2849	0.3789
9	MM, FG	Unimot S.A.	0.1128	1.0608	1.4879	0.4883
10	MM, FG	Termo-Rex S.A.	0.0681	1.2385	0.4119	0.2081
11	NC, RE	OZE Capital S.A.	0.1602	2.9983	0.1366	0.3242

12	NC, RE	Voolt S.A.	-0.2120	7.3034	0.0405	0.1367
13	NC, RE	Sun Dragon S.A.	0.3168	0.3573	0.2750	0.1642
14	NC, RE	BeeIN S.A.	-0.1167	1.9924	3.4804	0.4968
15	NC, RE	ELQ S.A.	0.4477	1.0886	1.4463	0.6366
16	NC, RE	Erato Energy S.A.	-0.1225	1.0484	1.1492	0.6281
17	NC, RE	Foto Volt Eko Energia S.A.	0.0120	1.5683	1.8080	0.4441
18	NC, RE	Termo2Power S.A.	0.1997	0.8656	0.8777	0.6974
19	NC, RE	Zeneris Projekty S.A.	0.0913	2.9095	1.3493	0.3595
20	NC, RE	G-ENERGY S.A.	0.0718	1.1864	0.6592	0.5707

Note: ** MM, E = the Main Market, the Energy sector; MM, FG = the Main Market, the Fuels and Gas sector; NC, RE = the NewConnect, the Renewable Energy sector.*
Source: *Own study based on financial statements.*

Descriptive statistics for the group of 20 energy companies surveyed are presented in Table 7.

Table 7. *Descriptive statistics of 20 energy companies listed on the GPW (Main Market and NewConnect)*

Specification	Mean	Median	Min	Max	Standard deviation	Coefficient of variation (%)	Kurtosis
ROE (X1)	0.0656	0.0801	-0.2120	0.4477	0.1612	245.7884	0.4249
Current ratio (X3)	1.6640	1.2124	0.3573	7.3034	1.5386	92.4634	9.7165
Total assets turnover ratio (X6)	0.9790	0.9090	0.0405	3.4804	0.8116	82.8980	3.5790
Debt ratio (X8)	0.4370	0.4514	0.1367	0.6974	0.1591	36.4038	-0.4825

Source: *Own study.*

The average return on equity in energy companies listed on the GPW is at the level of 0.0656. Half of them achieve ROE at a level lower, or equal to 0.0801, and another half, at a level higher, or equal to 0.0801, as evidenced by the median. The minimum ROE value is -0.2120, achieved by Voolt S.A. This means that Voolt S.A. generates a loss, which in 2023, converted per one unit of equity, is 0.2120. In turn, the maximum ROE value is 0.4477, and it is achieved by ELQ S.A. A positive ROE value indicates that ELQ S.A. generates a net profit of 0.4477 per one unit of equity in 2023. The kurtosis, at the level of 0.4249, informs that the distribution of ROE values in the sample is close to normal, slightly leptokurtic. On the other hand, the values of the standard deviation (0.1612) and the coefficient of variation (245.7884%) indicate a very high variability of ROE in the examined group of companies.

The current ratio informs about the company's ability to settle liabilities in a short period of time. In the group of analyzed companies, the average value of the current ratio is 1.6640. Half of the companies in the analyzed sample have a current ratio higher than, or equal to 1.2124 (median), and another half, at a level lower than, or

equal to 1.2124. The standard deviation of 1.5386 and the coefficient of variation of 92.4634% inform about the high variability of the current ratio in the analyzed group of companies. In turn, the kurtosis of 9.7165 indicates a very high concentration of the current ratio around the average. In 2023, the maximum value of the current ratio (7.3034) is recorded in Voolt S.A. The current assets of this company exceed short-term liabilities by seven times, which may indicate a very high ability to settle short-term liabilities in a timely manner. On the other hand, the minimum value of the current ratio (0.3573) in 2023 is recorded by Sun Dragon S.A., which may indicate problems with current payments, as current assets cover only approximately 35.73% of short-term liabilities.

The total assets turnover ratio indicates how much revenue a one unit of assets generates during the year. In the analyzed group of companies, the average value of the total assets turnover ratio is 0.9790, and the median is 0.9090. In 2023, the minimum value of the total assets turnover ratio is 0.0405 and is recorded in Voolt S.A., while the maximum value of 3.4804 is achieved by BeeIN S.A.

The values of the standard deviation (0.8116) and the coefficient of variation (82.8980%) indicate high variability of the total assets turnover ratio in the analyzed sample. The kurtosis of 3.5790 indicates a very high concentration of the total assets turnover ratio around the mean.

The debt ratio informs about the share of total liabilities in the value of total assets. In 2023, the average debt level of energy companies is 0.4370. Half of the companies are indebted at a level lower than or equal to 45.14% of the value of total assets, and another half, at a level greater than or equal to 45.14% (median). The lowest level of using liabilities in financing assets is 13.67% for Voolt S.A., while the highest is 69.74% for Termo2Power S.A. The values of the standard deviation (0.1591) and the coefficient of variation (36.4038%) indicate significant variability of the debt ratio value in the studied sample. On the other hand, the kurtosis at the level of -0.4825 informs that the distribution of the debt ratio value in the group of studied companies is close to normal, slightly platykurtic.

Descriptive statistics for the group of 10 companies from the GPW Main Market, Energy sector and Fuels and Gas sector are presented in Table 8.

Table 8. *Descriptive statistics for the group of 10 companies listed on the GPW (Main Market)*

Specification	Mean	Median	Min	Max	St. Dev.	Coe of vr. (%)	Kurtosis
ROE (X1)	0.0463	0.0783	-0.1320	0.1736	0.1077	232.6095	-0.6510
Current ratio (X3)	1.1962	1.1496	0.3704	2.8075	0.6876	57.4812	3.0900
Total assets turnover ratio (X6)	0.8357	0.7745	0.0506	1.7122	0.5559	66.5192	-1.2905
Debt ratio (X8)	0.4281	0.4514	0.2081	0.6519	0.1206	28.1726	1.0751

Source: *Own study.*

In the group of energy companies listed on the GPW Main Market, the average ROE value is 0.0463, while the median is 0.0783. The values of the standard deviation (0.1077) and the coefficient of variation (232.6095%) indicate a very high variability of ROE in the sample. The kurtosis of -0.6510 means that the distribution of ROE values in the sample is close to normal, slightly platykurtic. In 2023, the minimum ROE value, equals to -0.1320, is achieved by PGE S.A. This means that it generates a loss of 0.1320 per one unit of equity. On the other hand, the maximum ROE value of 0.1736 is achieved by Novavis Group S.A., which means that the net profit is 0.1736 per one unit of equity.

In 2023, the average value of the current ratio in the studied group is 1.1962, and the median is 1.1496. The standard deviation of 0.6876 and the coefficient of variation of 57.4812% indicate high variability of the current ratio in the studied group of companies. The kurtosis of 3.0900 indicates a very high concentration of the current ratio around the average. In 2023, the maximum value of the current ratio (2.8075) is recorded in PGE S.A., while the minimum value (0.3704) in Novavis Group S.A.

In energy companies listed on the GPW Main Market, the average value of the total assets turnover ratio is 0.8357 and the median is 0.7745. In 2023, the maximum value of the total assets turnover ratio (1.7122) is achieved by Onde S.A., and the minimum value (0.0506) is recorded by Energa S.A. The values of the standard deviation (0.5559) and the coefficient of variation (66.5192%) indicate high variability of the total assets turnover ratio in the sample studied.
A kurtosis of -1.2905 indicates a lower concentration of the total assets turnover ratio around the mean than in the normal distribution.

In 2023, the average debt of energy companies listed on the GPW Main Market is 42.81%, with half of them having debt of less than or equal to 45.14%, and another half having debt of more than or equal to 45.14% (median). The lowest debt level of 20.81% is recorded by Termo-Rex S.A., while the highest is 65.19% by ML System S.A. The values of the standard deviation (0.1206) and the coefficient of variation (28.1726%) indicate significant variability of the debt ratio in the sample. On the other hand, the Kurtosis of 1.0751 indicates that the distribution of the debt ratio in the group of companies examined is largely concentrated around the mean.

Descriptive statistics for the group of 10 companies from the GPW NewConnect market, the Renewable Energy sector are presented in Table 9.

Table 9. *Descriptive statistics for the group of 10 companies listed on the GPW (NewConnect)*

Specification	**Mean**	**Median**	**Min**	**Max**	**Standard deviation**	**Coefficient of variation (%)**	**Kurtosis**
ROE (X1)	0.0848	0.0815	-0.2120	0.4477	0.2059	242.7636	-0.4870
Current ratio (X3)	2.1318	1.3774	0.3573	7.3034	2.0096	94.2665	5.4592
Total asset turnover	1.1222	1.0134	0.0405	3.4804	1.0177	90.6889	2.5851

ratio (X6)							
Debt ratio (X8)	0.4458	0.4704	0.1367	0.6974	0.1967	44.1239	-1.0764

Source: *Own study.*

In 2023, in the group of energy companies listed on the GPW NewConnect market, the average ROE is 0.0848, the median is 0.0815, and, what is worth noting, these values are close to each other. The maximum ROE value of 0.4477 is achieved by ELQ S.A., which means that 0.4477 of net profit is generated per one unit of equity. On the other hand, the minimum ROE value of -0.2120 is achieved by Voolt S.A., which means that it achieves a net loss of 0.2120 per one unit of equity. The values of the standard deviation (0.2059) and the coefficient of variation (242.7636%) indicate a very high variability of ROE in the sample. Kurtosis at -0.4870 means that the distribution of ROE values in the sample is close to normal, slightly platykurtic.

The average value of the current ratio in the studied group is 2.1318, and the median is 1.3774. The standard deviation of 2.0096 and the coefficient of variation of 94.2665% indicate high variability of the current ratio in the group of energy companies listed on the GPW NewConnect market. The kurtosis of 5.4592 indicates a very high concentration of the current ratio around the average. In 2023, the maximum value of the current ratio (7.3034) is recorded in Voolt S.A., while the minimum value (0.3573) is recorded in Sun Dragon S.A.

In energy companies listed on the GPW NewConnect market, the average value of the total assets turnover ratio is 1.1222 and the median is 1.0134, which means that in half of the companies a one unit of assets generates 1.0134 or less units of revenue, and in another half of the companies a one unit of assets generates 1.0134 or more units of revenue. In 2023, the maximum value of the total assets turnover ratio (3.4804) is achieved by BeeIN S.A., and the minimum value (0.0405) is in Voolt S.A. The values of the standard deviation (1.0177) and the coefficient of variation (90.6889%) indicate high variability of the total assets turnover ratio in the sample studied. The kurtosis equal to 2.5851 indicates a very high concentration of the total assets turnover ratio around the mean.

In 2023, the average debt of energy companies listed on the GPW NewConnect market is 44.58%, with half of them having debt of less than or equal to 47.04%, another half of them having debt of more than or equal to 47.04% (median). The highest debt level of 69.74% is in Termo2Power S.A., and the lowest 13.67% in Voolt S.A. The values of the standard deviation (0.1967) and the coefficient of variation (44.1239%) indicate significant variability of the debt ratio in the analyzed sample. On the other hand, the Kurtosis of -1.0764 informs that the distribution of the debt ratio value in the group of analyzed companies is platykurtic and, therefore, is less concentrated around the mean than in the normal distribution.

Comparing the group of 10 companies listed on the GPW Main Market with the group of 10 companies listed on the GPW NewConnect market, it can be observed

that the latter achieves better results in 2023, especially taking into account the average and median values.
Companies from the GPW NewConnect market achieve, on average, a higher return on equity (ROE), better asset turnover and financial liquidity indicators than companies listed on the GPW Main Market.

On the other hand, the values of the debt ratio are at a similar level in both groups of companies.

In order to determine the company's position among its competitors, rankings of energy companies are prepared separately for each of the financial indicators analyzed, and the results are presented in Tables 10, 11 and 12, respectively.

Table 10. *Rankings of 20 energy companies listed on the GPW (Main Market and NewConnect) prepared separately for each of the analyzed financial indicators*

No.	GPW: market and sector*	Company name	ROE (X1)		Current ratio (X3)		Total assets turnover ratio (X6)		Debt ratio (X8)	
			Ratio value	Rank	Ratio value	Rank	Ratio value	Rank	Ratio value	Rank
1	MM, E	PGE S.A.	-0.1320	19	2.8075	4	1.1274	9	0.2905	4
2	MM, E	Onde S.A.	0.0884	10	1.6473	6	1.7122	3	0.4657	12
3	MM, E	ML System S.A.	-0.0052	15	1.0378	15	0.4019	15	0.6519	19
4	MM, E	Energa S.A.	0.0050	14	0.4313	18	0.0506	19	0.4528	11
5	MM, E	Novavis Group S.A.	0.1736	4	0.3704	19	0.3315	16	0.4933	14
6	MM, E	ENEA S.A.	-0.1214	17	1.2513	9	0.9404	10	0.4016	8
7	MM, E	KOGENERACJA S.A.	0.1159	7	0.8328	17	0.6087	13	0.4500	10
8	MM, FG	Orlen S.A.	0.1580	6	1.2843	8	1.2849	7	0.3789	7
9	MM, FG	Unimot S.A.	0.1128	8	1.0608	13	1.4879	4	0.4883	13
10	MM, FG	Termo-Rex S.A.	0.0681	12	1.2385	10	0.4119	14	0.2081	3
11	NC, RE	OZE Capital S.A.	0.1602	5	2.9983	2	0.1366	18	0.3242	5
12	NC, RE	Voolt S.A.	-0.2120	20	7.3034	1	0.0405	20	0.1367	1
13	NC, RE	Sun Dragon S.A.	0.3168	2	0.3573	20	0.2750	17	0.1642	2
14	NC, RE	BeeIN S.A.	-0.1167	16	1.9924	5	3.4804	1	0.4968	15
15	NC, RE	ELQ S.A.	0.4477	1	1.0886	12	1.4463	5	0.6366	18
16	NC, RE	Erato Energy S.A.	-0.1225	18	1.0484	14	1.1492	8	0.6281	17
17	NC, RE	Foto Volt Eko Energia S.A.	0.0120	13	1.5683	7	1.8080	2	0.4441	9
18	NC, RE	Termo2Power S.A.	0.1997	3	0.8656	16	0.8777	11	0.6974	20
19	NC, RE	Zeneris Projekty S.A.	0.0913	9	2.9095	3	1.3493	6	0.3595	6
20	NC, RE	G-ENERGY S.A.	0.0718	11	1.1864	11	0.6592	12	0.5707	16

Note: MM, E = the Main Market, the Energy sector; MM, FG = the Main Market, the Fuels and Gas sector; NC, RE = the NewConnect, the Renewable Energy sector.*
Source: *Own study based on financial statements.*

Table 11. *Rankings of 10 energy companies listed on the GPW (Main Market) prepared separately for each of the analyzed financial indicators*

No.	GPW: market and sector*	Company name	ROE (X1)		Current ratio (X3)		Total assets turnover ratio (X6)		Debt ratio (X8)	
			Ratio value	Rank	Ratio value	Rank	Ratio value	Rank	Ratio value	Rank
1	MM, E	PGE S.A.	-0.1320	10	2.8075	1	1.1274	4	0.2905	2
2	MM, E	Onde S.A.	0.0884	5	1.6473	2	1.7122	1	0.4657	7
3	MM, E	ML System S.A.	-0.0052	8	1.0378	7	0.4019	8	0.6519	10
4	MM, E	Energa S.A.	0.0050	7	0.4313	9	0.0506	10	0.4528	6
5	MM, E	Novavis Group S.A.	0.1736	1	0.3704	10	0.3315	9	0.4933	9
6	MM, E	ENEA S.A.	-0.1214	9	1.2513	4	0.9404	5	0.4016	4
7	MM, E	KOGENERACJA S.A.	0.1159	3	0.8328	8	0.6087	6	0.4500	5
8	MM, FG	Orlen S.A.	0.1580	2	1.2843	3	1.2849	3	0.3789	3
9	MM, FG	Unimot S.A.	0.1128	4	1.0608	6	1.4879	2	0.4883	8
10	MM, FG	Termo-Rex S.A.	0.0681	6	1.2385	5	0.4119	7	0.2081	1

Note: ** MM, E = the Main Market, the Energy sector; MM, FG = the Main Market, the Fuels and Gas sector; NC, RE = the NewConnect, the Renewable Energy sector.*
Source: *Own study based on financial statements.*

Table 12. *Rankings of 10 energy companies listed on the GPW (NewConnect) prepared separately for each of the analyzed financial indicators*

No.	GPW: market and sector*	Company name	ROE (X1)		Current ratio (X3)		Total assets turnover ratio (X6)		Debt ratio (X8)	
			Ratio value	Rank	Ratio value	Rank	Ratio value	Rank	Ratio value	Rank
1	NC, RE	OZE Capital S.A.	0.1602	4	2.9983	2	0.1366	9	0.3242	3
2	NC, RE	Voolt S.A.	-0.2120	10	7.3034	1	0.0405	10	0.1367	1
3	NC, RE	Sun Dragon S.A.	0.3168	2	0.3573	10	0.2750	8	0.1642	2
4	NC, RE	BeeIN S.A.	-0.1167	8	1.9924	4	3.4804	1	0.4968	6
5	NC, RE	ELQ S.A.	0.4477	1	1.0886	7	1.4463	3	0.6366	9
6	NC, RE	Erato Energy S.A.	-0.1225	9	1.0484	8	1.1492	5	0.6281	8
7	NC, RE	Foto Volt Eko Energia S.A.	0.0120	7	1.5683	5	1.8080	2	0.4441	5
8	NC, RE	Termo2Power S.A.	0.1997	3	0.8656	9	0.8777	6	0.6974	10
9	NC, RE	Zeneris Projekty S.A.	0.0913	5	2.9095	3	1.3493	4	0.3595	4
10	NC, RE	G-ENERGY S.A.	0.0718	6	1.1864	6	0.6592	7	0.5707	7

Note: ** MM, E = the Main Market, the Energy sector; MM, F&G = the Main Market, the Fuels and Gas sector; NC, RE = the NewConnect, the Renewable Energy sector.*
Source: *Own study based on financial statements.*

Although knowledge of the values of individual financial indicators and their descriptive statistics provide a great deal of information about the companies being studied, it is worth noting that they allow for a selective assessment, focused on a selected financial area of activity. It is also worth mentioning that it is problematic to determine the position of the company against the competition, if one wants to take into account all four financial areas at the same time, because energy companies occupy different places in rankings prepared separately for each of the analyzed areas and financial indicators.

Multi-criteria assessment methods, one of the representatives of which the TOPSIS method is, allow for a collective assessment, taking into account several aspects at the same time. The integrated measure allows for combining all 4 financial indicators at the same time, i.e. ROE, current ratio, total assets turnover ratio and debt ratio.

6.4 Ranking Preparation of Energy Companies Listed on the Warsaw Stock Exchange Using the TOPSIS Method

The initial decision matrix is built based on data presented in Table 6, where *n* is the number of companies from 1 to 20, and *m* is the number of indicators (X1, X3, X6, X8). In addition, to prepare a ranking of energy companies using the TOPSIS method, it is necessary to assign weights to individual measures (the sum of the weights is 1) and to determine which of them are treated as stimulants (for which the highest possible values are the most desirable) or destimulants (for which the lowest possible values are the most desirable).

The adopted assumptions regarding the importance of individual areas dimensioned with weights and the nature of financial indicators are presented in Table 13.

Table 13. *Financial areas and indicators - assumptions regarding weights and their nature*

Area name	**Indicator name**	**Weight**	**The nature of the indicator**
Profitability	ROE (X1)	0.30	Stimulant
Liquidity	Current ratio (X3)	0.20	Stimulant
Activity (efficiency)	Total asset turnover ratio (X6)	0.23	Stimulant
Indebtedness	Debt ratio(X8)	0.27	Destimulant
Total		1	-

Source: *Own study.*

When assigning weights, the importance of a given area and indicator from the perspective of strategic and operational management is taken into account.

ROE reflects the benefit that shareholders gain from the capital invested in the

company. In the long term, shareholders strive to maximize their benefits, which is why the company's ability to maintain ROE at a satisfactory level determines, among other things, the possibility of obtaining equity capital and the ability to develop. In this context, the most important area is considered to be profitability (measured by ROE), which is why, it is assigned the highest weight, i.e., 0.30.

The second most important area is debt, measured by the debt ratio. This ratio reflects the share of total liabilities (long-term and short-term) in total assets. Generally, the use of debt capital in financing assets is considered a positive phenomenon. However, too high level of debt can be dangerous, e.g., due to potential problems with insolvency, increasing costs of its servicing, which can even lead to an increase in the risk of bankruptcy of the company. Skillful debt management, especially in the long term, is extremely important, which is why the area of debt is given a weight of 0.27.

The third most important area is the efficiency of operations, which is measured by the total assets turnover ratio. This ratio reflects the ability of management to use the assets at the company's disposal. This area is given a weight of 0.23.

The last place in terms of importance is occupied by the area of financial liquidity measured by the current ratio, which is based on the most volatile assets of the company and sources of financing in a short period of time. Temporary payment problems do not pose a major threat, but long-term ones do, which is why this area is given a weight of 0.20.

Table 14 presents the ranking of 20 energy companies listed on the GPW (Main Market and NewConnect) using the TOPSIS method.

Table 14. *Ranking of 20 energy companies listed on the GPW (Main Market and NewConnect) using the TOPSIS method*

GPW: market and sector*	**Company name**	**Ci**	**Rank**
NC, RE	ELQ S.A.	0.6209	1
NC, RE	Sun Dragon S.A.	0.5267	2
MM, FG	Orlen S.A.	0.4573	3
NC, RE	OZE Capital S.A.	0.4512	4
NC, RE	Termo2Power S.A.	0.4456	5
NC, RE	Zeneris Projekty S.A.	0.4374	6
MM, E	Onde S.A.	0.4162	7
MM, FG	Unimot S.A.	0.4141	8
MM, E	Novavis Group S.A.	0.4101	9
MM, E	KOGENERACJA S.A. (KGN)	0.3792	10
NC, RE	BeeIN S.A.	0.3764	11
MM, FG	Termo-Rex S.A.	0.3604	12

NC, RE	Foto Volt Eko Energia S.A.	0.3541	13
NC, RE	Voolt S.A.	0.3465	14
NC, RE	G-ENERGY S.A.	0.3363	15
MM, E	Energa S.A.	0.2557	16
MM, E	PGE S.A.	0.2548	17
MM, E	ML System S.A.	0.2442	18
MM, E	ENEA S.A. (ENA)	0.1936	19
NC, RE	Erato Energy S.A.	0.1751	20

Note: ** MM, E = the Main Market, the Energy sector; MM, FG = the Main Market, the Fuels and Gas sector; NC, RE = the NewConnect, the Renewable Energy sector.*
Source: *Own study.*

The analysis of the table demonstrates that the companies no. 1, 2 and 4, 5, 6 from the GPW NewConnect market occupy the top ten of the ranking.

On the other hand, place 3 and those from 7 up to 10 are occupied by companies from the GPW Main Market. In the second ten of the ranking, companies from the NewConnect market are also significantly ahead of those from the GPW Main Market.

The leader is ELQ S.A. with an integrated indicator value of 0.6209. The worst company in the ranking is Erato Energy S.A. with an integrated indicator value of 0.1751. For all companies in the ranking, differences between their integrated indicator value and the leader can be determined.

The ranking of 10 energy companies listed on the GPW Main Market using the TOPSIS method is presented in Table 15.

Table 15. *Ranking of 10 energy companies listed on the GPW (Main Market) using the TOPSIS method*

GPW: market and sector*	**Company name**	**C_i**	**Rank**
MM, E	Orlen S.A.	0.7604	1
MM, E	Onde S.A.	0.6945	2
MM, E	Unimot S.A.	0.6801	3
MM, E	Novavis Group S.A.	0.6174	4
MM, E	KOGENERACJA S.A. (KGN)	0.6094	5
MM, E	Termo-Rex S.A.	0.5664	6
MM, E	PGE S.A.	0.3709	7
MM, E	Energa S.A.	0.3540	8
MM, E	ML System S.A.	0.3477	9
MM, E	ENEA S.A. (ENA)	0.2542	10

Note: ** MM, E = the Main Market, the Energy sector; MM, F&G = the Main Market, the Fuels and Gas sector; NC, RE = the NewConnect, the Renewable Energy sector.*
Source: *own study.*

The leader is Orlen S.A. with an integrated indicator value of 0.7604. The worst company in the ranking is ENEA S.A. with an integrated indicator value of 0.2542. For all companies in the ranking, differences between their integrated indicator value and the leader can be determined.

The values assigned to the leader, in the longer term, should be adopted as a reference point (target) to be achieved in all companies that are in the ranking in places from 2 up to 10. Achieving these goals will be possible in each company by implementing appropriate strategic and operational initiatives that will have an impact on selected indicators, areas, and the level of the integrated indicator.

The ranking of 10 energy companies listed on the GPW NewConnect market using the TOPSIS method is presented in Table 16.

Table 16. *Ranking of 10 energy companies listed on the GPW (NewConnect) using the TOPSIS method*

GPW: market and sector*	**Company name**	**Ci**	**Rank**
NC, RE	ELQ S.A.	0.6123	1
NC, RE	Sun Dragon S.A.	0.5274	2
NC, RE	OZE Capital S.A.	0.4480	3
NC, RE	Zeneris Projekty S.A.	0.4401	4
NC, RE	Termo2Power S.A.	0.4374	5
NC, RE	BeeIN S.A.	0.3893	6
NC, RE	Foto Volt Eko Energia S.A.	0.3608	7
NC, RE	Voolt S.A.	0.3503	8
NC, RE	G-ENERGY S.A.	0.3326	9
NC, RE	Erato Energy S.A.	0.1787	10

Note: ** MM, E = the Main Market, the Energy sector; MM, F&G = the Main Market, the Fuels and Gas sector; NC, RE = the NewConnect, the Renewable Energy sector.*
Source: *Own study.*

The leader is ELQ S.A. with an integrated indicator value of 0.6123. The worst company in the ranking is Erato Energy S.A. with an integrated indicator value of 0.1787. For all companies in the ranking, differences between their integrated indicator value and the leader can be determined.

The values assigned to the leaders, in the longer term, should be adopted as a reference point (target) to be achieved in all companies that are in the ranking in places from 2 up to 10. Achieving these goals will be possible in each company by implementing appropriate strategic and operational initiatives that will have an impact on selected indicators, areas, and the level of the integrated indicator.

7. Conclusions

Financial benchmarking can be used in the strategic and operational management of an energy company. It supports the identification and formulation of strategies, and the implementation of strategies and strategic control. It supports both the top management of an energy company and the process managers in coordinating activities at the level of business processes.

In financial benchmarking, it is worth using various statistical and econometric methods. Descriptive statistics and tools used in multi-dimensional comparative analysis, such as the TOPSIS method, may prove useful here.

As it results from the analysis conducted within the financial benchmarking on the example of companies from the energy sector, descriptive statistics allow for the general characteristics of the studied group.

The company can compare itself, among others, to the average, minimum, maximum, middle (median) values of financial indicators achieved by the group of competitors. In addition, measures such as standard deviation and coefficient of variation allow for the examination of the variability of the analyzed financial indicators in the group, while kurtosis informs about their concentration around the mean.

In financial benchmarking, it is also useful to create rankings according to different areas and indicators, thanks to which, the positioning of companies among themselves is possible. Based on the rankings, it is possible to determine the gap (distance) between the leader in a given category and a given company. Rankings can also be created based on integrated measures that simultaneously take into account several indicators. Linear ordering methods, including the TOPSIS method, may be used in this respect.

8. Limitations

The article presents the most important theoretical assumptions of financial benchmarking and a proposal for its implementation on the example of companies from the energy sector. The proposal for financial benchmarking includes the most frequently analyzed financial areas in practice (profitability, debt, operational efficiency, financial liquidity) and the indicators used to measure them. In addition, basic descriptive statistics (average, minimum, maximum, median, standard deviations, coefficient of variation, kurtosis) and the TOPSIS method are used to conduct the analyses.

However, the proposed way of conducting financial benchmarking on the example of companies from the energy sector definitely does not exhaust all possibilities. Examples of directions for improving financial benchmarking in an enterprise are as

follows:

- expansion with additional financial dimensions (areas) and measures (indicators) in these areas,
- taking into account measures (indicators) based on business process costs,
- using other linear ordering methods,
- automation of tools supporting financial benchmarking due to the electronic form of financial statements (xml format) and tax settlements of companies in Poland (e.g., JPK VAT, JPK CIT).

It is also worth pointing out the possibility of integrating financial benchmarking with tools such as:

- balanced scorecard,
- value chain analysis,
- business process controlling,
- activity-based costing,
- business process reengineering,
- responsibility accounting oriented towards business processes.

In this context, further interesting research may concern the possibilities of integrating financial benchmarking with other broadly understood instruments of controlling and management accounting.

References:

10 trendów w energetyce na 2024 które warto mieć na radarze. 2024. Available at: https://www.ewe.pl/10-trendow-w-energetyce-na-2024-r-ktore-warto-miec-na-radarze#.

Acar, E., Sariyer, G. 2021. Financial performance evaluation of Turkish basic metal industry: combining AHP and TOPSIS. International Journal of Economic and Administrative Studies, (31), 113-128. DOI: 10.18092/ulikidince.734976.

AlDhaheri, F., Ameen, A., Izaak, O. 2020. The Influence of Strategy Formulation Vision Mission and Goals on the Organizational Operations. Journal of Critical Reviews, 7(17), p.1933-1934. http://dx.doi.org/10.31838/jcr.07.17.240.

Bąk, A. 2016. Porządkowanie liniowe obiektów metodą Hellwiga i TOPSIS – analiza porównawcza (Linear ordering of objects using Hellwig and TOPSIS methods – a comparative analysis). Prace Naukowe Uniwersytetu Ekonomicznego We Wrocławiu, Research Papers of Wrocław University of Economics, 426, 22-31. https://doi.org/10.15611/pn.2016.426.02.

Bąk, A. 2018. Analiza porównawcza wybranych metod porządkowania liniowego, (Comparative analysis of selected linear ordering methods based on empirical and simulation data). Prace Naukowe Uniwersytetu Ekonomicznego We Wrocławiu, Research Papers of Wrocław University of Economics nr 508, 19-28. https://doi.org/10.15611/pn.2018.508.02.

Bendel, T., Boulter L. 2000. Benchmarking. Jak uzyskać przewagę nad konkurencją. Kraków: Wydawnictwo Profesjonalnej Szkoły Biznesu.

Business Financial Benchmark Analysis. 2024. Available at: https://financialbenchmarking.com/what-is-financial-performance-benchmarking-analysis-with-industry-comparison/#:~:text=By%20Kevin%20M.%20Burke,%20CTP.%20What%20is%20Financial.

Camp, R.C. 1995. Business Process Benchmarking. Finding and Implementing Best Practices. Milwaukee, Wisconsin: ASQC Quality Press.

Dzikuć, M., Gorączkowska, J., Piwowar, A., Dzikuć, M., Smoleński, R., Kułyk, P. 2021. The analysis of the innovative potencial of the energy sector and low – carbon development: A case study for Poland. Energy Strategy Reviews, 38 (2021), 1-8. https://doi.org/10.1016/j.esr.2021.100769.

Effatpanah, S.K., Ahmadi, M.H., Aungkulanon, P., Maleki, A., Sadeghzadeh, M., Sharifpur, M., Chen, L. 2022. Comparative Analysis of Five Widely-Used Multi-Criteria Decision-Making Methods to Evaluate Clean Energy Technologies: A Case Study. Sustainability 2022, 14, 1403. https://doi.org/10.3390/su14031403.

Energy Policy in Poland until 2040. 2021. Available at: https://www.gov.pl/web/climate/energy-policy-of-poland-until-2040-epp2040.

Filipowicz-Chomko, M. 2021. Wpływ doboru technik normalizacji kryteriów decyzyjnych na stabilność rankingów uzyskanych algorytmem TOPSIS. In: Oniśko, A. (red.) Wybrane zagadnienia informatyki technicznej. Modelowanie i przetwarzanie informacji w warunkach niepewności, Białystok: Oficyna Wydawnicza Politechniki Białostockiej. https://doi.org/10.24427/978-83-66391-85-7_1.

Financial analysis. 2024. Available at: https://eanaliza.pl/en/financial-analysis.

Financial Benchmarking. 2024. How to Compare Your Financial Performance with Industry Peers and Best. Available at: https://fastercapital.com/content/Financial-Benchmarking--How-to-Compare-Your-Financial-Performance-with-Industry-Peers-and-Best-Practices.html#:~:text=1.%20Understanding%20the%20Importance%20of%20Financial%20Benchmarking.%202.

Financial Ratios eBook. 2024. Available at: https://corporatefinanceinstitute.com/assets/CFI-Financial-Ratios-Cheat-Sheet-eBook.pdf.

Gierusz, A., Pobłocka, A. 2022. Porządkowanie liniowe z wykorzystaniem wskaźników finansowych zakładów ubezpieczeń w Polsce. In: M. Lemkowska, M. Wojtkowiak (red.), Sektor ubezpieczeń w obliczu wyzwań współczesności (s. 118-137). Poznań: Wydawnictwo Uniwersytetu Ekonomicznego w Poznaniu. https://doi.org/10.18559/978-83-8211-131-6/8.

Gupta, P. 2004. Six Sigma. Business Scorecard: Ensuring Performance for Profit. New York: McGraw-Hill.

Hwang, C.L., Yoon, K. 1981. Methods for Multiple Attribute Decision Making. In: Multiple Attribute Decision Making. Methods and Applications A State-of-the-Art Survey. Lecture Notes in Economics and Mathematical Systems, 186. Berlin, Heidelberg, New York: Springer-Verlag. https://doi.org/10.1007/978-3-642-48318-9_3.

Kacprzak, D. 2018. Przedziałowa metoda TOPSIS dla grupowego podejmowania decyzji. Optimum. Economic Studies, 4 (94). https://doi.org/10.15290/oes.2018.04.94.19.

Koczan, M., Alkan, A. 2022. Bezpieczeństwo energetyczne a transformacja sektora elektroenergetycznego w Polsce (na przykładzie wybranych podsektorów). Wschodnioznawstwo. 16, 432-433. https://doi.org/10.4467/20827695WSC.22.024.16773.

Konuk, F. 2018. Financial and performance analysis of food companies: application of TOPSIS and DEA. MANAS Journal of Social Studies, 7 (3).

Kowalak, R. 2009a. Benchmarking jako metoda zarządzania wspomagająca controlling przedsiębiorstwa. Wrocław: Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu.

Kowalak, R. 2009b. Benchmarking w rachunku kosztów cyklu życia produktu, [w:], Rachunek kosztów cyklu życia produktu w zarządzaniu przedsiębiorstwem. Wrocław: Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu.

Krishnamoorthy, B., D'Lima C. 2014. Benchmarking as a measure of competitiveness. International Journal of Process Management and Benchmarking, 4(3), 342-359. http://dx.doi.org/10.1504/IJPMB.2014.063240.

Lis, M., Antonov, V., Olczak, P. 2024. Hybrid photovoltaic and energy storage system in order to enhance self-consumption energy – Poland case study. Journal of Energy Storage, 91. https://doi.org/10.1016/j.est.2024.112096.

Nita, B. 2008. Rachunkowość w zarządzaniu strategicznym przedsiębiorstwem. Warszawa: Oficyna Wolters Kluwer business.

Nowak, E. 1997. Wielowymiarowa analiza porównawcza w modelowaniu kondycji finansowej przedsiębiorstw. Annales Universitatis Mariae Curie-Skłodowska. Sectio H, Oeconomia, 31, 111-123.

Pardede, E., Susanti, D., Sukono. 2023. Application of the AHP-TOPSIS Method to Support Stock Investment Decisions Based on Financial Ratio Analysis. International Journal of Global Operations Research, 4(4), 253-262. http://www.iorajournal.org/index.php/ijgor/index.

Perspektywy KPMG: Transformacja energetyczna w 2024 roku. 2024. Available at: https://kpmg.com/pl/pl/home/insights/2024/03/perspektywy-kpmg-transformacja-energetyczna-w-2024-roku.html#:~:text=Umowy%20PPA%20i%20CPPA,%20energia%20odnawialna%20i%20AI.

Pociovalisteanu, D.M., Thalassinos, E., Tirca, A., Filho, W.L. 2010. Trends and challenges in the energy sector of Romania in the post-accession to the European Union. International Journal of Environmental Technology and Management, 12(1), 3-15.

Sierpińska, M., Niedbała, B. 2003. Controlling operacyjny w przedsiębiorstwie. Warszawa: PWN.

Szydełko, M., Szydełko, Ł. 2013. Benchmarking w podejściu procesowym w przedsiębiorstwie – wybrane zagadnienia. Modern Management Review, XVIII, 20, 106. https://doi.prz.edu.pl/pl/pdf/zim/51.

Trejo-Pech, C. 2024. Financial Benchmarking: Financial Metrics Across U.S. Industries. Academy of Economics and Finance Journal, 14, 1-27. https://dx.doi.org/10.2139/ssrn.4596933.

Ward, P.T., Duray, R. 2000. Manufacturing strategy in context: environment, competitive strategy and manufacturing strategy Journal of Operations Management, 18, 124.

Wardhana, A. 2024. Business Strategy and Policy in the Digital Edge 4,0. Eureka Media Aksara, 1-142.

Weber, J. 2001. Wprowadzenie do controllingu. Katowice: Oficyna Controllingu Profit.

Zagłębienie się w dynamikę rynku energii elektrycznej w Polsce: aktualne trendy i przyszłość rynku energetycznego. 2023. Available at: https://energetykon.pl/zaglebienie-sie-w-dynamike-rynku-energii-elektrycznej-w-polsce-aktualne-trendy-i-przyszlosc-

rynkuenergetycznego/#:~:text=Rynek%20energii%20elektrycznej%20w%20Polsce%20wyruszy%C5%82%20na%20ekscytuj%C4%85c%C4%85.

zur Muehlen, M., Rosemann, M. 2004. Multi – Paradigm Process Management. In: Grundspekis, J., Kirikovej, M. (red.) Proceedings of CAiSE'04 Workshops – 5th Workshop on Business Process Modeling, Development and Support (BPMDS 2004). Ryga, Łotwa.