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Accounting for financial costs in electric power companies: the role of accounting in cost optimization

ABSTRACT: The purpose of this work was to study the features of organizing the accounting of electric power companies within the framework of sustainable development. Within the framework of the study, information from the financial statements of companies from the United Kingdom and the United States was analyzed in comparison to the situation in Ukraine. It was concluded that energy companies implemented the ideas of sustainable development by reducing the carbon emission intensity and investing in alternative energy sources. Depending on the capacity of the companies, medium-term investments in green energy could have reached USD 11 billion, as in the case of Duke Energy, or USD 17 billion, in the case of ExxonMobil. Some companies, however, tried to adapt to changes in the energy market by optimizing investments or changing the focus. A reduction

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in annual investments from USD 7 billion to USD 1.5–2 billion was recorded at Shell, which also increased oil and gas production in response to the instability of the energy market. The redirection of investments was documented at DTEK, which allocated USD 1 billion to the development of critical infrastructure that had been damaged by hostilities. During the study, it was concluded that regardless of the type of costs, the effective managerial and financial accounting involved taking into account economic, environmental, social, and organizational factors. Quantitative and qualitative metrics for such accounting were also proposed, in particular, employee and community engagement, compliance with social standards of the supply chain, carbon footprint intensity, waste management, and so on.

KEYWORDS: accounting, financial costs, environmental responsibility, financial management, strategic management, optimization of resource use

Introduction

Sustainable development is an important component of the development of any country, as it contributes to the preservation of natural resources, the improvement of the quality of life of the population, and the creation of conditions for long-term economic growth. One of the key roles of sustainable development is economic stability, which contributes to the creation of a strong and resilient economy capable of withstanding various economic shocks, supporting small and medium-sized businesses, developing innovative technologies, and creating new jobs. Another important aspect is environmental protection, which includes reducing greenhouse gas emissions, decreasing pollution, preserving biodiversity, and the efficient use of natural resources. In this context, the role of both the introduction of high-quality state policy by countries and the actions of energy companies in the context of achieving sustainable development strategies is significant. In this regard, finding ways to improve the efficiency of these companies in the field of sustainable development is effective (Maka and Alabid 2022).

From a theoretical perspective, sustainable development in the energy sector is based on the integration of economic, environmental, and social dimensions. It reflects the balance between profitability, ecological responsibility, and social welfare, ensuring the long-term stability of enterprises. This approach also relies on the principles of transition management and stakeholder participation, which emphasize the need for innovation, transparency, and the active involvement of all participants in achieving sustainability goals.

The state of the energy sector in Ukraine was studied by numerous scientists, including Ostapenko et al. (2022), who examined approaches to assessing the effectiveness of the use of renewable energy technologies in Ukraine's energy sector. The scientists proposed a comprehensive methodology for improving the efficiency of such assessments, as well as demonstrated the possibilities of using geographic information systems for these purposes. Skrypnyk et al. (2023), within the work, also studied global and regional external effects observed

in the energy sector, created a methodology for assessing the external impact of traditional electricity production on other sectors, in particular agriculture, and proposed a tariff strategy that takes these external effects into account.

Proposals for the long-term development of the Ukrainian energy sector were presented in the work of Bobrov (2021), which emphasized the importance of diversifying the power grid, improving energy efficiency, developing renewable energy, implementing changes in the coal industry (since it was subsidized), and ensuring the sustainable functioning of the energy sector. The features of accounting, taxation, and reporting during martial law were studied by Kuzub et al. (2022a). The importance of timely and full payment of taxes for the state's ability to fulfill its obligations, especially during wartime, as well as adapting accounting and reporting to martial law conditions to accurately reflect the state of an enterprise in these circumstances, was emphasized. The scientists also made some of their proposals for improving taxation, accounting, and reporting based on legislative requirements. A comparison of Ukrainian and European accounting standards within the study was carried out by Kuzub et al. (2022b). The authors noted that the Ukrainian statement of financial position and approaches to updating its components comply with International Accounting Standards rather than Generally Accepted Accounting Principles due to differences in economic development and geopolitical conditions. The study showed that the integration of EU practices into Ukraine's financial reporting is beneficial in view of strengthening European integration.

The importance of accounting for the activities of energy companies is determined, in particular, by the economic benefits of implementing sustainable development strategies. Jakubelskas and Skvarciany (2023) conducted a comparative analysis of a number of European countries and concluded that enterprises in Sweden, Luxembourg, Ireland, Latvia, Estonia, Malta, and Bulgaria demonstrate the highest efficiency in the use of alternative energy sources, while Austria has the lowest. According to the cited experts, the uneven use of solar and wind energy in different EU countries is an obstacle to sustainable development and the growth of economic potential. The study by Atstaja (2024) found that the rational use of the energy potential of certain Baltic countries could significantly reduce the volume of imported electricity, increase energy independence, and become a factor in sustainable economic growth. According to the cited researcher, an illustration of this statement is Latvia, which uses twice as much alternative energy as other EU countries – 42.1% compared to 21.8%. Atstaja emphasized that the complete transition to alternative energy sources would allow Latvia to reduce imports from Finland, Sweden, and Poland, which as of 2024 amounted to 130,053 GWh.

Gyimah et al. (2023), in the longitudinal study of Ghana's economy, emphasized the absence of a direct correlation between economic growth and carbon emissions. The cited study pointed out the advisability of adhering to the principles of sustainable development to support economic growth. Similar results were obtained by Neverauskiene et al. (2025), who analyzed the economic development of 27 EU countries in the context of the transition to alternative energy sources. Based on data obtained in 2001–2022, the cited experts concluded that adherence to sustainable development standards acts as a driving force of economic development, manifested through job creation, reduced energy prices, increased energy independence, and readiness for sustainable

growth. Based on the cited sources, it can be stated that the implementation of sustainable development principles in the energy segment is a guarantee of economic growth, provided that such a transition is effectively accounted for.

While existing research in Ukraine has examined the state of the energy market and the impact of renewable energy, there is a lack of empirical analysis on how energy companies account for and optimize costs within the framework of sustainable development, especially during wartime. This study addresses this gap by comparing cost accounting practices in Ukraine, the UK, and the US, and proposing actionable recommendations for Ukrainian energy companies. In view of this, the purpose of the work was to assess approaches to reducing the costs of companies in the USA, the United Kingdom, and Ukraine.

1. Materials and methods

The study of sustainable cost reduction strategies in electricity companies during the period from 2020 to 2024 was carried out using a comprehensive approach that included quantitative and qualitative analysis. Comparative analysis methods were applied to identify the features and effectiveness of different approaches to cost optimization, which included measures to improve energy efficiency and the introduction of renewable energy sources, as well as initiatives to reduce emissions and manage waste. In the course of the study, both traditional approaches to cost reduction, including consumption optimization, and innovative methods that envisaged a transition to the use of alternative energy sources were considered.

Within the framework of the study, approaches to company operations in the context of cost reduction while maintaining sustainable development goals were assessed. The data were collected using a mixed-methods approach, combining qualitative analysis of secondary sources with quantitative data from financial statements from 2020 to 2024 and sustainable development disclosures. The main sources were corporate reports, government publications, and industry sustainability standards such as the Global Reporting Initiative (GRI) standards. Among the companies whose reporting data were used were Nextera Energy (2025), National Grid Group (2025), Duke Energy (2025), General Electric (2024), Royal Dutch Shell (2025), and British Petroleum (2025). British Petroleum and Royal Dutch Shell were selected for analysis because both companies, despite the historical affiliation with the oil and gas sector, actively transformed towards electricity generation in 2020–2024. Regarding the analysis of Ukrainian companies, one of the largest local energy companies – DTEK (2025) – was selected as a case study, and information about it was taken from the company’s official website and its financial statements. The information obtained from the companies’ financial statements was used to form a unified vision of such enterprises’ strategies in the context of the long-term development strategies, taking into account sustainable development goals and the need to reduce costs.

Qualitative data were analyzed using content analysis methods to identify key sustainable development themes, trends in cost management, and the implementation of renewable energy strategies. The cost-benefit analysis evaluated variables such as initial investment, expected energy savings, and carbon reduction to calculate the financial payback period and return on investment. For cost reduction strategies, data on energy consumption models, investments in renewable energy technologies, and the introduction of circular economy practices, such as recycling and waste reduction, were evaluated. To further examine the financial implications, the study used cost-benefit analysis to assess the long-term economic benefits of sustainable practices such as reducing energy consumption, lowering operating costs through the introduction of renewable energy technologies, and reducing costs associated with carbon emissions.

Within the project, the most commonly used financial and managerial accounting strategies in the enterprise sustainability system were also analyzed. The features of financial and managerial cost accounting in the sustainable development strategy were considered, and recommendations for the implementation in the functioning of Ukrainian enterprises were proposed. In the development of the recommendations, special attention was paid to financial and managerial cost accounting strategies in Ukraine's energy sector.

2. Results

Sustainable development is of key importance for energy companies. Primarily, this is due to the fact that environmental responsibility lies with these companies, as these companies are among the largest polluters of the environment through greenhouse gas emissions and other pollutants. In turn, ensuring sustainable development helps to reduce the negative impact on the environment, promoting the use of clean and renewable energy sources. In addition, sustainable development contributes to increasing the economic stability of companies through the efficient use of resources and reducing dependence on fossil fuels. This allows energy companies to better adapt to market changes and reduces risks associated with fluctuations in energy resource prices (Gunnarsdottir et al. 2021). International companies have implemented various sustainable development strategies, the key ones of which are presented in Table 1.

Based on Table 1, it can be concluded that what international companies and DTEK have in common is the activity in the field of renewable energy and the use of low-carbon solutions. All the companies listed in the table invest significant funds in renewable energy sources such as wind, solar, biofuel, hydrogen, and electric vehicle charging infrastructure. The above-mentioned efforts are consistent with the broader goals of achieving net-zero emissions by 2050: similarly, DTEK is taking significant steps in "green" energy, focusing on climate-neutral technologies and aiming to become climate-neutral by 2040. Also, DTEK has invested USD 1 billion in renewable energy and infrastructure development, targeting a 10% reduction in carbon emissions by 2026. The difference between the Ukrainian enterprise and the other companies analyzed lies in the

TABLE 1. Sustainable development strategies of international companies

TABELA 1. Strategie zrównoważonego rozwoju przedsiębiorstw międzynarodowych

No.	Company name	Sustainable development strategies
1	British Petroleum	The company's annual investments in green energy development amount to USD 1.5–2 billion. British Petroleum's Reimagining Energy strategy, with annual investments of USD 5 billion, focuses on transitioning from fossil fuels to renewable energy sources, aiming for net-zero emissions by 2050.
2	Duke Energy	By 2030, the company plans to reduce carbon emissions by 50%, and by 2050, it aims to achieve carbon neutrality. By 2026, the company will invest USD 11 billion in clean energy sources while closing coal-fired power plants. The company has already invested USD 25 billion in creating a smart energy network and continues to implement initiatives aimed at ensuring the flexibility and sustainability of the energy network, most of whose components are connected to renewable energy sources
3	General Electric	Adhering to the principles of sustainable development, the company has installed 57,000 wind turbines and 7,000 gas turbines. Given that the company produces more than 25% of the world's energy, its role in the transition to alternative sources is significant
4	National Grid Group	Between 2025 and 2029, the company will invest GBP 60 billion in modernizing and expanding the electricity grid in the United Kingdom and the United States. The company issued shares worth GBP 6.8 billion and plans to sell assets worth GBP 3.6 billion for further investment in the development of high-voltage transmission lines and the integration of renewable energy sources
5	Nextera Energy	The company plans to double its energy capacity from 64 GW to 128 GW by 2027, supporting this with investments of USD 120 billion
6	Royal Dutch Shell	Between 2023 and 2025, the company plans to invest USD 10–15 billion in strategies to reduce carbon emissions. The company's strategic goals are to achieve zero emissions by 2050, improve the efficiency of key production processes, and reduce emissions from oil and gas production through advanced technologies and processes
7	DTEK	The company's primary goal is to align its activities with the European Green Deal, which provides for the reduction of greenhouse gas emissions and the implementation of circular economy principles, particularly in coal and gas production. DTEK has been implementing climate-neutral technologies for several years and aims to become carbon-neutral by 2040. Even during the full-scale invasion by the Russian Federation, the company invested more than USD 1 billion in Ukraine's energy infrastructure, demonstrating its commitment to sustainable development

Source: developed by the authors based on DTEK (2025); British Petroleum (2025); Duke Energy (2025); General Electric (2024); National Grid Group (2025); Nextera Energy (2025); Royal Dutch Shell (2025).

fact that DTEK's strategy is largely focused at the regional level, taking into account the specific needs of Ukraine, particularly in light of the ongoing conflict and the need for energy security. DTEK's focus on infrastructure modernization and energy storage distinguishes it, for example, from Shell or British Petroleum. Although Royal Dutch Shell, British Petroleum, and DTEK share a common goal – to achieve sustainable development and reduce the carbon footprint – the shared approaches are adapted to the specific conditions and challenges. A comparative analysis of sustainable development strategies and cost accounting approaches in selected energy companies was also carried out. The results of the comparison are presented in Table 2.

TABLE 2. Comparison of sustainable development strategies and cost accounting approaches in energy companies

TABELA 2. Porównanie strategii zrównoważonego rozwoju i metod rachunku kosztów w przedsiębiorstwach energetycznych

No.	Company name	Country	Main energy activity	Sustainable development strategies	Investments in renewable energy	Features of cost accounting (by sources or in reports)
1	British Petroleum	Great Britain	Oil and gas company focused on transition to renewable energy sources	Reimagining Energy strategy, goal – to achieve zero emissions by 2050	USD 5 billion annually until 2030	ESG reports in accordance with TCFD, GRI; public annual reports; separate decarbonization costs into separate blocks
2	Duke Energy	USA	Electricity generation and distribution; development of renewable energy sources	Goal: achieving zero emissions by 2050, investments in solar and wind energy	USD 145 billion by 2030	Annual reports with a focus on clean energy investment; consideration of environmental costs in capital investments
3	General Electric	USA	Energy equipment manufacturing; development of renewable energy sources	Electrifying the World strategy, focus on wind and hydro energy	USD 10 billion by 2025	ESG reports in accordance with GRI; detailed accounting of expenses for renewable energy sources and digital technologies in financial reports
4	National Grid Group	Great Britain	Electricity and gas distribution; transmission infrastructure	Net Zero by 2050, smart grids, green transformation, ESG reporting	GBP 60 billion by 2029 (including infrastructure development for renewable energy sources).	ESG reports in accordance with TCFD, GRI; public annual reports; separate expenses for decarbonization into individual blocks
5	Nextera Energy	USA	Production of electricity from solar and wind power; energy distribution (through Florida Power & Light)	Zero Carbon Target, investments in hydrogen, batteries, green generation	USD 120 billion by 2027	Annual reports with a focus on clean energy investment; consideration of environmental costs in capital investments
6	Royal Dutch Shell	Great Britain/ Netherlands	Oil and gas company focused on transitioning to renewable energy sources	Powering Progress strategy, goal – to achieve zero emissions by 2050	USD 2-3 billion annually until 2025	ESG reports in accordance with TCFD, GRI; public annual reports; separate blocks for decarbonization costs
7	DTEK	Ukraine	Electricity production and distribution; development of renewable energy sources	Energy 2030 strategy, goal – to achieve zero emissions by 2040	USD 1 billion by 2030	ESG reports in accordance with GRI; detailed accounting of expenses for renewable energy sources and digital technologies in financial reports

Note: TCFD – Task Force on Climate-related Financial Disclosures; ESG – Environmental, Social, and Governance.

Source: developed by the authors based on DTEK (2025); British Petroleum (2025); Duke Energy (2025); General Electric (2024); National Grid Group (2025); Nextera Energy (2025); Royal Dutch Shell (2025).

Taking into account the information from the table, it should be noted that the key sustainable development strategy for most companies in the sample is achieving net-zero emissions, including through investment in alternative energy sources. Depending on the size, financial potential of the company and other factors, the amount of investment varies from USD 1 to 145 billion. Cost accounting is carried out using various tools, but most often through ESG reports in accordance with TCFD standards.

The implementation of initiatives for the transition to alternative energy sources and the support of sustainable development involves the introduction of an effective system of financial and management cost accounting (Teymurova et al. 2024; Bulatov et al. 2020). In order to improve the cost accounting strategy in the economic management of energy enterprises, it is necessary to consider several key areas. It is extremely important to adhere to the basic principles of cost accounting, ensuring that all data is accurate and reliable, directly affecting the management of production costs. All costs must comply with applicable laws and regulations. In addition, cost accounting must be timely in order to adapt to market changes, especially for large-scale projects with long construction periods; timely updating is crucial, particularly for changes in the design and cost of new materials (Schaltegger et al. 2022). The main purpose of cost accounting is to provide accurate data to support cost management and decision-making; therefore, it should serve both cost control and management decisions (Anguelov and Kavaldzhieva 2021; Abbasova et al. 2022).

Based on the content analysis of previously conducted studies, in particular, Panchenko and Hryniavskiy (2024) and Zgalat-Lozynska and Lych (2022), it can be argued that conducting financial and management cost accounting in the sustainable development strategy is complicated by the existence of various external factors that affect this process. Such factors, in particular, include economic, environmental, social, and organizational ones, which are presented in Table 3.

TABLE 3. Factors determining the implementation of financial and management cost accounting in the sustainable development strategy of Ukraine's energy sector

TABELA 3. Czynniki determinujące wdrożenie rachunkowości finansowej i zarządczej w strategii zrównoważonego rozwoju sektora energetycznego Ukrainy

No.	Factor	Description
1	Economical	Spending on sustainable development initiatives; financial efficiency; financial feasibility
2	Environmental	Regulatory and climate change; waste management
3	Social	Social responsibility; working conditions
4	Organisational	Strategic management; functional authority

Source: developed by the authors based on Kostash et al. (2024), Sementsiv (2024), Panchenko and Hryniavskiy (2024).

From Table 3, it can be seen that the process of financial and management accounting of costs in the sustainable development strategy takes place under the influence of various factors, which,

depending on the context, may either accelerate or hinder the transition to effective accounting. The group of economic factors is one of the most numerous and includes, in particular, costs for initiatives related to sustainable development. At this level, accounting may be complicated by the fact that the accounting of the transition to green energy involves the allocation of specific sub-accounts, which may cause confusion at the initial stage of financial and management evaluation. In the long term, the allocation of such sub-accounts will make it possible to track the profitability of investments in sustainable development. An illustration of this conclusion can be provided by DTEK, which, at the time of the full-scale invasion and the legal regime of martial law, reprofiled its investments, placing greater emphasis on the sustainable development of the country's energy network. The economic factor also includes financial efficiency, which, according to Nguyen et al. (2024), consists of the ratio of benefits to costs associated with the implementation of sustainable practices.

At this stage of accounting, the complexity lies in choosing analytical tools to accurately and impartially reflect this ratio. The difficulty also lies in carrying out accounting in conditions of uncertainty, when forecasted values may differ significantly from actual ones. The validity of this statement can be illustrated by the example of British Petroleum, which significantly reduced its annual spending on green energy – from the planned USD 7 billion to USD 1.5–2 billion – while increasing oil and gas production. According to the company's Chief Executive Officer, Murray Auchincloss, the sharp change in the company's policy is related to the war in Ukraine, the consequences of the coronavirus pandemic, and the general instability of the global energy market (Kumar 2025). From the perspective of financial and management accounting, such instability means difficulties in obtaining reliable data and the further implementation of the strategic planning of the energy company's activities. In addition to the above, economic factors also include the financial capabilities of the enterprise, in particular, the accounting of loans and grants for the implementation of sustainable practices. A large volume of information on loans, grants, and other financial opportunities requires a systematic approach to its collection, analysis, and accounting. To effectively perform this task, some energy companies may need to involve additional specialists, including through outsourcing.

When conducting financial and management accounting, it is also important to take into account environmental changes occurring at various levels, including the regulatory level (Karlilar Pata et al. 2025; Kavaldzhieva 2022). Changes at this level mean the emergence of new environmental regulations and standards and, accordingly, the accounting of the implementation of these standards in the practice of energy companies. The introduction of new regulations and standards requires the constant retraining of specialists responsible for conducting financial and management accounting in energy companies. The change in regulations and standards also requires the preparation of new emission reports, often under time constraints and with the involvement of specialists from other enterprises or industries. Among the environmental factors that affect accounting processes, waste management should also be included.

Based on the above, the specialists of energy companies are responsible for accounting for waste disposal and recycling costs, which involves collecting and analyzing the information provided and preparing reports in compliance with existing regulations and standards, as well as

developing strategies to improve the efficiency of waste recycling and disposal. It is important, when planning and implementing financial and management accounting, to take into account climate change, which affects production processes, for example, by increasing the demand for electricity. According to Panchenko and Hryniavskyi (2024), changes in production processes also involve adapting accounting processes, in particular, in calculating the cost of risks or assessing material stocks. Based on the analysis carried out, it can be argued that the financial and management accounting of sustainable development costs involves taking into account numerous quantitative and qualitative indicators, some of which are quite unpredictable.

The organization of effective financial and management accounting also involves taking into account social factors, such as the steady growth of social responsibility. In the energy sector, such responsibility means reducing consumption, increasing demand for energy-saving technologies, and the gradual transition to alternative energy sources. Changes in social responsibility among consumers also entail changes in financial and management accounting, including the assessment of the impact of new consumer practices on the functioning of energy companies. Maintaining such accounting requires energy companies to gain access to a variety of information sources, including focus groups, for a better understanding of changes in consumer attitudes.

Financial and management accounting of costs in the context of social factors also requires the selection of relevant metrics for analyzing information; for example, assessing consumer costs and the impact on the operation of an energy company can be carried out using such tools as spend under management, cost reduction, and cost avoidance. When conducting financial and management accounting in a social context, it is worth considering not only changes related to consumers but also those related to employees of energy companies. During the period of martial law, DTEK employees work in extremely difficult conditions and require additional incentives in the form of salary increases, bonuses, and other social guarantees (Al-Ababneh et al. 2025; Desai et al. 2025). The purpose of financial and management accounting is to analyze the impact of the above and other initiatives on certain sustainable development indicators of the company; for example, it is worth considering the relationship between additional financial incentives for employees and the productivity or staff turnover.

In addition to those already mentioned, financial and management accounting of costs is carried out under the influence of organizational factors, in particular, strategic management. The implementation of sustainable development strategies by energy enterprises means that the accounting of the activities involves the inclusion of new indicators for objectively measuring not only financial but also environmental and social indicators (Miethlich and Oldenburg 2019; Bulatov 2025). Energy companies can be offered several metrics for measuring environmental and social indicators within the framework of financial and management accounting of sustainable development costs. The most commonly used metrics are presented in Table 4.

Based on Table 3, it should be noted that there are various quantitative and qualitative metrics for accounting for financial costs and optimization in energy companies. Effective financial and management accounting involves combining several metrics, which makes it possible to analyze a particular sustainable development initiative from different perspectives.

TABLE 4. Metrics for measuring environmental and social indicators of financial and management accounting of sustainable development costs of energy enterprises

TABELA 4. Wskaźniki pomiaru wskaźników środowiskowych i społecznych rachunkowości finansowej i zarządczej kosztów zrównoważonego rozwoju przedsiębiorstw energetycznych

Social indicators		
No.	Metrics	Features of use
1	Employee engagement	It can be measured through surveys, individual interviews, focus groups, observations, analysis of the number of days missed, etc. Allows exploring the relationship between sustainability initiatives, employee performance, and the financial well-being of the company.
2	Opportunities for professional training and career growth	It can be measured by counting the number of training sessions conducted over a period of time. Allows exploring the economic impact of the company's socially oriented initiatives.
3	Community involvement	This social indicator is assessed using surveys, focus groups, observations, and other quantitative and qualitative indicators. The goal is to explore the impact of sustainable development initiatives on the target audience's attitudes and the financial performance of the energy company.
4	Compliance with social standards in the supply chain	It can be assessed by observing and then comparing the data with approved industry standards. Using this metric allows assessing the economic impact of the company's existing supply strategies; identifying the economic risks of specific supply strategies; and developing recommendations to reduce the impact of the identified risks.
5	Compliance with labor rights and standards	It can be assessed through surveys, interviews, focus groups, and audits involving third-party experts. The above metric can be used to assess the economic benefits and costs associated with the implementation of specific sustainable development strategies of an energy company.
Environmental indicators		
No.	Metrics	Features of use
1	Power consumption	This metric involves analyzing the total amount of energy consumed and the amounts of non-renewable and renewable energy consumed. This metric can be used to investigate the feasibility of an energy company's transition to renewable energy and sustainable development.
2	Carbon footprint	The metric helps determine the total amount of carbon dioxide produced by a company over a certain period of time. The data obtained can be used to analyze the financial benefits and risks associated with the transition to sustainable development strategies.
3	Carbon footprint intensity	The metric allows calculating the amount of carbon emissions per unit of organizational activity or result. The data obtained through this metric can be used to assess the financial feasibility of strategic initiatives aimed at reducing pollution.
4	Waste management	This metric is used to calculate the volume of waste over a certain period of time. The metric can be used to assess the effectiveness of individual sustainable development strategies implemented by an energy company.

Source: developed by the authors based on Deb et al. (2023), Metelytsa and Gagalyuk (2024), Soto (2024).

Thus, several approaches can be recommended to improve the efficiency of companies' energy resource costs. One of the approaches is maintaining separate accounting of energy resource costs and monitoring the efficient use: such an implementation will make it possible to track where energy is used inefficiently and to introduce energy-saving technologies, reducing costs by optimizing energy consumption. Costs for waste disposal and recycling, as well as for reducing emissions, which are included in the company's financial statements, can be formed as separate items in order to ensure more effective management of such costs, minimizing resource recycling costs. The same positive effect will result from additional accounting of costs for the purchase and installation of energy-efficient equipment (solar panels, wind turbines) and for the maintenance and servicing of energy equipment throughout its life cycle, as well as conducting regular assessments of the costs of implementing new environmental solutions that can reduce operating costs in the long term.

The logic of all approaches to reducing company costs has a common principle: it requires initial investments to improve a particular process, followed by a reduction in production costs. This can be illustrated in the form of a graph, as shown in Figure 1.

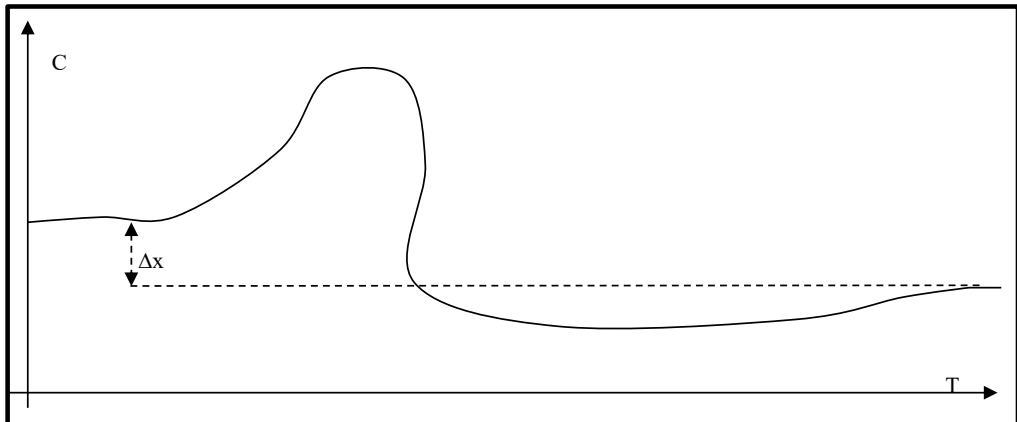


Fig. 1. Schematic representation of the cost graph when introducing new approaches to the reduction
Note: Δx – difference in the company's cost level; C – Cost; T – Time.

Source: compiled by the authors

Rys. 1. Schematyczna reprezentacja wykresu kosztów przy wprowadzaniu nowych podejść do redukcji

As can be seen from Figure 1, at first, costs for introducing such approaches increase due to the expenses for implementing new technologies. Nevertheless, the costs subsequently begin to decrease, which is associated with obtaining a positive effect from cost reduction. With a well-developed project, it will have a positive Net Present Value and allow the company to save funds in the long term.

It is also advisable to propose certain strategies for improving the efficiency of financial and management accounting of sustainable development costs. The first recommendation

is to systematize the types of costs to choose appropriate analytical tools. According to the classification by Zgalat-Lozynska and Lych (2022), enterprise development costs can be attributed to one of the following categories: costs for implementing internal and external sustainable development initiatives, costs for updating technologies and working assets, costs for the formation and development of tangible and intangible capital, costs for sales and promotion of goods or services, and costs for obtaining certain rights, including intellectual property rights. Understanding the type of costs makes it possible to choose a relevant accounting strategy and reduce the risk of calculation errors (Sinchuk et al. 2025).

When planning financial and management accounting of costs, it is also recommended to take into account regulatory acts governing sustainable development in the energy sector. Such acts include the Law of Ukraine No. 1818-IX “On Energy Efficiency” (2021), the Law of Ukraine No. 3764-IX “On Amendments to Certain Laws of Ukraine Regarding the Powers of Central Executive Authorities in the Field of Energy Efficiency” (2024), and the “Energy Strategy” of the Ministry of Energy of Ukraine (2022). The above-mentioned regulatory documents provide a definition of sustainable development of the energy sector, present its goals and objectives, and propose criteria for its evaluation. These criteria are important when maintaining financial and management accounting of sustainable development costs of enterprises in the sector.

In addition to the above recommendations, it is proposed to provide training for specialists who are to perform the professional duties related to maintaining financial and management accounting of sustainable development costs of an energy enterprise. Rapid changes in the field of sustainable development require an understanding of systemic processes and the ability to apply these processes in practice, as the lack of theoretical and practical skills can lead to system imbalance and the emergence of critical situations. Preparing specialists for accounting in compliance with sectoral requirements can take various forms, including formal training through the organization of specialized courses and training sessions (Razak et al. 2025; Horskyi 2025). Internships can also be proposed, enabling specialists from companies that have just begun to implement sustainable development strategies to learn from the more experienced colleagues about the specifics of introducing and maintaining such accounting. Depending on the context, objectives, and other factors, internships may take place at regional, national, or international levels with the aim of using accounting practices that have proven effective in other countries. Based on the above analysis, it can be recommended to arrange internships for Ukrainian financial and management accounting specialists in energy companies in the USA and the UK, whose large-scale sustainable development initiatives have become known far beyond the borders of these countries.

A recommended strategy can also be to increase the transparency of financial and management accounting by introducing a system of periodic reporting to stakeholders: company board members, employees, product or service consumers, and the community in which the enterprise operates. Periodic reports can take various forms, including formal, analytical, and project reports. To improve communication between the parties, technical and analytical notes can also be recommended for use. The proposed reporting tools for maintaining financial and management accounting help energy companies to achieve several strategic objectives at once.

Firstly, the tools provide an informed understanding of the effectiveness of implementing sustainable development strategies in energy enterprises in Ukraine. Secondly, periodic reports to stakeholders make it possible to understand the factors that influence the effectiveness of implementing sustainable development strategies in the energy sector. Understanding the factors that hinder the implementation of such strategies helps to develop response policies and support the sustainable development of enterprises.

Thus, sustainable development is of critical importance for energy companies due to the significant negative impact on the environment, particularly as a result of the greenhouse gas emissions these companies produce. By applying various approaches, such as the use of renewable energy sources and increasing energy efficiency, the above-mentioned companies can reduce the environmental impact while simultaneously enhancing economic stability. In particular, applying cost accounting and waste management, combined with investments in energy-efficient technologies, makes it possible to optimize resource use, reduce operating costs, and align such practices with global sustainable development goals.

4. Discussion

In the presented study, it was emphasized that accounting played a crucial role in the processes of sustainable cost reduction in energy companies, primarily in terms of providing important financial information that made it possible to make more effective decisions on cost control and strategic planning. Confirmation of this idea was found in the work of Petricica Vintila and Danaila (2024), according to which one of the main tasks of accounting in the context of sustainable development was the collection of necessary data and the preparation of reports. Martincevic et al. (2024) stressed that, thanks to the accurate tracking of investments in renewable energy sources, energy efficiency measures, and other sustainable development projects, accounting systems allowed companies to control the costs and benefits associated with these initiatives. Kaur et al. (2025) explained that regular financial reports made it possible to understand the current state of the company, assess its costs and savings obtained from environmental practices, and draw conclusions regarding the company's impact on the external environment. Another key aspect of accounting was cost analysis and allocation, which involved the analysis and classification of costs, in particular those related to activities in the context of achieving sustainable development goals.

Chimwanja and Shumba (2025) emphasized that the correct allocation helped companies understand the use of resources and identify areas for further cost optimization. Budgeting and forecasting were also integral parts of the role of accounting in sustainable development. By forecasting future costs and savings from sustainable investments, accounting allowed companies to plan and allocate resources effectively. According to Bhennaty et al. (2024), financial planning was particularly important for managing cash flows in capital-intensive projects, such

as infrastructure modernization or the implementation of energy storage technologies. Accurate budgeting helped establish realistic expectations and timeframes for these initiatives, ensuring the successful implementation. Another important component remained the measurement of the efficiency of the company's entrepreneurial activity and the calculation of relevant financial indicators. In addition to internal performance indicators, accounting also ensured compliance with regulatory requirements and standards related to achieving sustainable development goals: companies had to comply with environmental regulations approved in current legislation, such as greenhouse gas emissions reporting or adherence to carbon pricing mechanisms. For example, by segmenting carbon-related costs into distinct accounting blocks, companies like Duke Energy can more effectively allocate resources to their sustainability initiatives while tracking the financial impact of each strategy.

Within the framework of the current study, considerable attention was paid to the opportunities available to energy companies regarding the achievement of sustainable development goals. Renewable energy in sustainable development was examined by Strielkowski et al. (2021). The authors indicated that, under modern conditions, renewable energy sources played a crucial role in the sustainable development of the electricity sector, allowing the protection of the state of the external environment, improving the quality of consumed energy, and creating new opportunities for business development. In connection with the above, the scholars stressed the importance of further development and deeper implementation of renewable energy sources within developing countries. The aforementioned study also noted that "green" energy played an increasingly significant role in the world. This was primarily due to the characteristics of this type of energy, namely its low negative impact on the environment and the ability to recover quickly. Therefore, it was natural that energy sector companies, as shown in the current study, began to incorporate components related to the development of renewable energy into the strategies. It should be noted, however, that these companies also considered this as an opportunity to reduce the costs in the long term, given the characteristics of this technology.

In turn, the factors motivating energy companies to adhere to the principles of sustainable development were examined by Agudelo (2020). The scholar showed that many enterprises had begun to apply the principles of corporate social responsibility and acted in such a way as to achieve sustainable development goals as efficiently as possible. However, it should be noted that this was most often due to pressure from government authorities and society. In other words, at present, the main motivation for energy companies to achieve sustainable development goals was more external factors than an actual desire to improve the state of the environment or the quality of people's lives. Nevertheless, considering the main goal of the company as profit-making, such behavior (as a response to external factors) was more than logical, as companies believed that such a policy would allow them to achieve better relations with the state and society.

The principles of sustainable management of energy companies in the context of Poland were examined by Jedrych et al. (2021). The authors wrote that the introduction of management goals in energy companies aimed to improve efficiency by rewarding board members and making the company's activities more transparent for stakeholders. The research showed that focusing exclusively on economic indicators as goals led to wasted resources and inefficiency. The new

approach proposed sustainable capital management, where profit-making in the accounting system was mainly used for taxation purposes. The model separated the goal and the effect, assuming that economic results should be regarded as outcomes rather than objectives. The study successfully developed a theoretical model for the balance, created formulas for calculating the efficiency, established evaluation principles, measured levels of social capital and conducted pilot studies, and examined issues related to building mathematical models aimed at achieving the main goal of such activities. Within the framework of the current study, strategies for the transition to sustainable development goals of American energy companies and the Ukrainian company DTEK were also mentioned. Overall, the approaches used by Polish entrepreneurs were similar to those employed by the companies mentioned in the study, indicating the overall effectiveness. Creating a model of this kind, as shown in the study in the context of Poland, fitted into the approach formed in the scheme: in other words, building such models to calculate more efficient opportunities for resource expenditure should become part of the long-term strategies of companies seeking to achieve lower costs and more efficient attainment of sustainable development goals.

The implementation of strategic cost management in manufacturing companies was studied by Rounaghi et al. (2021). The scholars proposed a model for integrating data on economic, social, and environmental performance in manufacturing industries, addressing the problem of resource constraints by promoting innovative technologies and cost-reduction strategies aimed at increasing market share and sustainability. The authors noted that, for small businesses, it was extremely important to balance customer service with long-term goals and to control costs. Adopting a strategic approach to cost management, which focused on adding value and effective cost control, in such a context helped to make informed financial decisions, especially in areas such as procurement, pricing, and inventory management. The scholars noted that modern management accounting systems were vital for effective cost management: these tools facilitated the accurate assessment of costs, profit creation, profitability, and added value. Strategic cost management provided valuable data for decision-making, supporting both short-term and long-term strategic goals (Ongan et al. 2025; Ismanzhanov and Tashiev 2016). Within the framework of the current study, it was also noted that the formation of a unified high-quality approach to cost management was an important component of enterprise development. This was particularly important in wartime conditions, when ensuring the highest level of financial stability was the main focus of the company's activities. The approaches used in Ukraine and by American companies were long-term and aimed at investing in technologies that made it possible to reduce costs through more efficient use of resources. This approach was generally effective; however, in wartime conditions, it was also important to use shorter-term cost-reduction strategies.

Conclusions

Thus, sustainable development was of crucial importance for energy companies, as these companies bore significant responsibility for environmental pollution, primarily due to greenhouse gas emissions and other pollutants. The implementation of environmental practices helped these companies reduce the negative impact on the environment, contributing to the use of clean and renewable energy sources. For Ukrainian energy companies, reducing costs during wartime was critically important, as the war exerted enormous pressure on the country's economy – it led to a decrease in the revenues of energy companies and an increase in expenditure on infrastructure repairs, security, and logistics. By reducing costs, companies could maintain financial stability under conditions of uncertainty. The formation of a sound financial policy during such a period was an important component in maintaining a stable energy supply, which was a priority for the operation of hospitals, military facilities, and other critical institutions during the war. In addition, effective cost management could prevent mass layoffs, preserve jobs, and contribute to social stability and local economic support.

The study examined certain areas of cost management of companies: ExxonMobil, Occidental Petroleum, Duke Energy, General Electric, Royal Dutch Shell, British Petroleum, and DTEK. It was established that energy companies focused on sustainable development envisaged medium- and long-term intentions to reduce carbon emission intensity by 40–80%. The strategies of certain energy companies, in particular ExxonMobil and Duke Energy, envisaged a constant increase in investment in the development of green energy, which as of 2024 amounted to USD 17 billion and USD 11 billion, respectively. Some companies, on the contrary, were forced to reduce investment in green energy and increase the intensity of oil and gas production in response to the global economic crisis. An example of such a company was Shell, which reduced the volume of annual investment in the development of alternative energy to USD 1.5–2 billion, while increasing oil and gas production in response to the uncertainty caused by the Russian-Ukrainian war. While American and British companies focused on the global transition to sustainable energy, DTEK addressed the unique challenges of Ukraine's energy landscape in light of ongoing conflicts and the need for energy security, investing USD 1 billion in the country's critical infrastructure. As these companies continued to implement innovations and adapt to changing market conditions, the strategies significantly influenced the future of the global energy sector, demonstrating that sustainable development was not only a corporate responsibility but also a critical component of economic resilience and growth. It is recommended that Ukrainian energy companies, particularly during wartime, adopt cost-efficient accounting strategies similar to DTEK's focus on infrastructure resilience while ensuring alignment with long-term sustainability goals.

The present study has several limitations that should be acknowledged. Firstly, the empirical analysis is limited to a small number of case studies of large-scale energy companies, which constrains the generalizability of the findings to smaller enterprises and other sectors of the economy. Secondly, the study primarily relies on publicly available reports and secondary data,

which may not fully reflect the internal cost-accounting mechanisms or the real-time dynamics of financial decision-making in the companies analyzed. Thirdly, the war in Ukraine represents an exceptional contextual factor that substantially affects both the availability of statistical data and the operational stability of domestic enterprises. Under wartime conditions, energy infrastructure, market demand, and fiscal policy are subject to rapid change, which makes it difficult to ensure longitudinal consistency and reliability of the data. Consequently, while the findings provide an important comparative insight into sustainable cost-management practices, further research using larger datasets and longitudinal field studies is required to validate and extend the results, particularly after the stabilization of Ukraine's energy system in the post-war period.

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Rachunkowość kosztów finansowych w przedsiębiorstwach energetycznych: rola rachunkowości w optymalizacji kosztów

Streszczenie

Celem niniejszej pracy było zbadanie cech organizacji rachunkowości przedsiębiorstw energetycznych w kontekście zrównoważonego rozwoju. W ramach badania przeanalizowano informacje ze sprawozdań finansowych przedsiębiorstw z Wielkiej Brytanii i Stanów Zjednoczonych w porównaniu z sytuacją w Ukrainie. Stwierdzono, że przedsiębiorstwa energetyczne wdrażają idee zrównoważonego rozwoju poprzez redukcję intensywności emisji dwutlenku węgla i inwestowanie w alternatywne źródła energii. W zależności od potencjału przedsiębiorstw średnioterminowe inwestycje w zieloną energię mogłyby osiągnąć 11 mld USD, jak w przypadku Duke Energy, lub 17 mld USD – w przypadku ExxonMobil. Niektóre przedsiębiorstwa starały się jednak dostosować do zmian na rynku energii, optymalizując inwestycje lub zmieniając ich ukierunkowanie. Zmniejszenie rocznych inwestycji z 7 mld USD do 1,5–2 mld USD odnotowano w firmie Shell, która również zwiększyła wydobycie ropy naftowej i gazu w odpowiedzi na niestabilność rynku energii. Przekierowanie inwestycji udokumentowano w firmie DTEK, która przeznaczyła 1 mld USD na rozwój infrastruktury krytycznej zniszczonej w wyniku działań wojennych. W trakcie badania stwierdzono, że niezależnie od rodzaju kosztów skuteczna rachunkowość zarządcza i finansowa wymaga uwzględnienia czynników ekonomicznych, środowiskowych, społecznych i organizacyjnych. Zaproponowano również ilościowe i jakościowe wskaźniki takiej rachunkowości, w szczególności dotyczące zaangażowania pracowników i społeczności, przestrzegania standardów społecznych w łańcuchu dostaw, intensywności śladu węglowego, gospodarki odpadami itp.

SŁOWA KLUCZOWE: rachunkowość, koszty finansowe, odpowiedzialność środowiskowa, zarządzanie finansowe, zarządzanie strategiczne, optymalizacja wykorzystania zasobów