

THE CURRENT STATE OF SCIENTIFIC RESEARCH OF THE PROCESS OF RISK MANAGEMENT OF UKRAINIAN ENERGY SECTOR ENTERPRISES

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Abstract:

The research dedicated to risk management issues in the energy sector addresses current problems associated with risk management that arise in the energy sector. The aim of the study was to identify factors that affect risks, analyze scientific risk management methods, and consider innovative approaches to risk management in the energy sector. The study used a critical analysis of the literature on the subject as well as an analysis of risk management standards and methods. The innovation of the research lies in its consideration of modern trends in risk management in the energy sector, taking into account changing economic and political conditions, technical possibilities, as well as social attitudes and demands. The study showed that the most effective approach to risk management in the energy sector is the use of an integrated risk management system that takes into account all aspects of enterprise activity. The results of the study can be useful for energy companies that deal with risk management. They can be used to improve risk management strategies and reduce the possibility of negative consequences. In addition, this research can be used for educational purposes for students and professors who study risk management and the energy sector. The next steps of the research may include expanding the scope of the study to other areas and developing more detailed risk management models.

Key words: *risk management, energy sector, sustainable development, risk management methods, risk analysis*

INTRODUCTION

The energy sector is one of the most complex and risky sectors of the economy. Risk management is an integral part of the effective management of enterprises in any sector, including the energy sector. Given the volatility of the global economy, constant changes in legislation, growing competition in the energy services market, rising energy costs, the need to reduce the environmental burden, ensure uninterrupted energy supply and preserve the company's reputation, risk management is becoming particularly important.

Risk management allows energy companies to reduce the impact of risks on their financial performance, ensure the sustainability of investment projects, protect against energy-related hazards, and improve the reliability of the energy system as a whole. In addition, risk management in the energy sector helps to ensure the safety of employees, protect the environment, and reduce the number of energy-related accidents and incidents.

Thus, the study of the risk management process of energy sector enterprises is of great importance for increasing the efficiency of enterprise management, reducing losses,

improving reputation, ensuring uninterrupted energy supply and preserving the natural environment.

LITERATURE REVIEW

There are relatively many scientific articles devoted to the issues of risk management in energy sector enterprises in Poland. Risk management is approached from different perspectives. Is analyzed: – the impact of weather risk on the economic activity of energy sector enterprises [1]; – risk related to the delays in the implementation of investment programs in the Polish power industry [2, 3]; – the price risk related to trading in electricity markets has increased [4]; – market risk from the perspective of implementing ERM systems in the fuel and energy industry [5]; – the risk management processes in electric energy trade [6]; – non-financial reports of energy companies from the perspective of risk disclosure [7], risks related to the selection of alternative energy sources [8].

Similarly, Ukrainian scientists study risk management is approached from different perspectives and using different methods. They analyze risks for Ukrainian energy sector enterprises based on the hierarchy analysis (HA) method using the basic system of expert risk assessment (BSER) [9] as SWOT analysis, risk matrix, sensitivity analysis and impact analysis [10, 11], examined the role of risk management as a tool for managing an energy sector enterprise [12, 13].

Analysing the scientific sources on the issue of risk management of energy sector enterprises, it can be noted that this problem has recently become increasingly relevant. The authors examines: – the application of risk management methods at the construction stage of energy facilities, note that risk management in the energy sector is one of the key components of project management for the construction of energy facilities. The article analyses risk management methods that can be applied at different stages of construction of energy facilities [14, 15]; issues of risk management at the enterprises of the energy complex. The author notes that risk management in the energy sector is aimed at ensuring the sustainability of the energy sector and reducing the possible negative consequences of the enterprises' activities. The article discusses the basic principles of risk management at an enterprise [16]; the issue of implementing an effective risk management system at energy enterprises in Ukraine. The authors identified the main factors influencing the choice of an approach to risk management and proposed an algorithm for their consideration. In particular, it was noted that when implementing a risk management system at an energy company, it is necessary to take into account the specifics of the activity, existing risks and ways to reduce them, as well as the available resources and opportunities for implementing a risk management system [17].

Other scientific experience indicates that risks in the energy sector are unevenly distributed, which may affect the implementation of an effective risk management system. The authors showed that among the main risks that threaten the activities of energy companies, an important place is occupied by such risks as losses from necessary

investments, inadequate economic policy of the state, reduced consumer demand, violation of electricity trading rules, increased competition, changes in the country's financial policy, instability of the national currency, changes in the energy market, technological risks, reduced production quality and default on obligations to creditors [18].

Continuing the analysis of scientific papers, it is worth noting the studies scholars that have already become a certain classic of risk management in the energy sector.

One of the most well-known studies is "Risk management for power generation companies in liberalised electricity markets" by M. Liu, and F. F. Wu, published in the *Int. Journal of Elect. Power and Energy Sys.* in 2007. The authors studied the risks associated with the liberalisation of the electricity market and proposed methods for their management [19].

In 2017 Y. Li, Z. Sun, L. Han and N. Mei [20] proposed a risk management framework for energy companies. L. Yu, Y.P. Li, G.H. Huang (2018) explored risks in the energy chain and proposed a conceptual framework for their management [21]. Hessam Golmohamadi and Amin Asadi (2020) analysing risk management in oil and gas companies and offering recommendations for future research in this area [22].

Recent publications in the field of risk analysis in the energy sector and the development of new methods of risk management at energy companies reflect some common trends. In particular, researchers are actively studying risk analysis methods and developing risk management strategies in the energy sector using information and analytical systems. Research is also focused on the use of new technologies, such as artificial intelligence, machine learning, and other algorithms to predict risks and improve risk management.

A study was conducted on the risks associated with the introduction of renewable energy sources. One of the study's findings was that the risks associated with renewable energy sources may be lower than those associated with traditional energy sources. Moreover studies also focus on the introduction of green technologies in the energy sector.

The articles analyze issues related to energy technologies in terms of their risk profile and environmental impact. Attention is drawn to the need for a balanced approach to the assessment of technological risks and taking into account their impact on the environment when making decisions on the choice of energy technologies. It also analyzes the risks associated with climate change and the development of renewable energy, and how these risks can be mitigated through the development of new technologies and policies to support renewable energy. Other articles are devoted to it risks related to the financing of energy infrastructure projects. Attention is drawn to the need for careful analysis and risk management, in particular in the context of obtaining funds for energy projects. Risks related to the use of smart technologies in energy distribution networks are analyzed and new methods of managing these risks are proposed. A systematic review of the literature on risk management in the energy sector

was prepared, various methodologies and approaches were analyzed and compared, and a new method for assessing risk in the energy sector was proposed. A fuzzy analytical hierarchy of processes and a fuzzy technique of ordering preferences according to similarity to the ideal solution for assessing operational risk in energy systems are used. The articles also contain an overview of risk management methods in the oil and gas industry, analyze the main risks and challenges related to functioning in this industry and propose new methods of risk management [23, 24, 25, 26].

Recent publications on risk analysis and management in the energy sector are quite diverse and wide-ranging. Some of them focus on specific aspects of risk management, such as technical risks, financial risks, social risks, etc. Other articles describe general approaches to risk management and methods that can be used in the energy sector.

The literature on risks and risk management in other types of organizations is more extensive, but the applied solutions can also be helpful in the energy sector [27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38].

RESEARCH METHODOLOGY AND ASSUMPTIONS

The study used a critical analysis of the literature on the subject as well as an analysis of risk management standards and methods.

Analysis of scientific papers on the research problem

According to the Google Academy data (shown in Fig. 1), scientific publications by Ukrainian authors on risk analysis and management in the energy sector tend to increase steadily, but are rather limited in number. Nevertheless, some of them are worth mentioning.

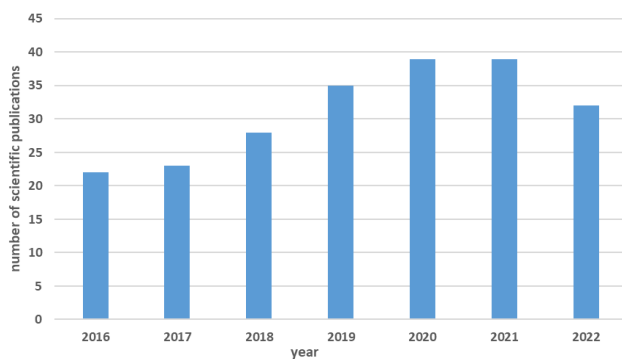


Fig. 1 "Number of scientific papers by Ukrainian scientists on the topic: "Risk Management in the Energy Sector" in recent years

The research of selected Ukrainian authors is presented in Table 1.

Table 1

The research of selected Ukrainian authors

O. Golubeva, O. Solodovnikova [1]	Authors analysed risks for Ukrainian energy sector enterprises based on the hierarchy analysis (HA) method using the basic system of expert risk assessment (BSER).
M. Kononova, I. Karpenko, O. Kurylenko [10]	Authors analysed the risks for Ukrainian energy sector enterprises based on methods such as SWOT analysis, risk matrix, sensitivity analysis and impact analysis.
V. Sapega, M. Berezhnyi [11]	Authors examined the role of risk management as a tool for managing an energy sector enterprise.
T.A. Balanchuk, O.V. Gubska, I.V. Grabovetska, Y.I. Kovalchuk [12]	Authors examined the application of risk management methods at the construction stage of energy facilities. The authors note that risk management in the energy sector is one of the key components of project management for the construction of energy facilities. The article analyses risk management methods that can be applied at different stages of construction of energy facilities.
I. Melnyk [13]	Author examines the issues of risk management at the enterprises of the energy complex. The author notes that risk management in the energy sector is aimed at ensuring the sustainability of the energy sector and reducing the possible negative consequences of the enterprises' activities. The article discusses the basic principles of risk management at an enterprise.
I. Polyakova, T. Shevchenko [14]	examines the issue of implementing an effective risk management system at energy enterprises in Ukraine. The authors identified the main factors influencing the choice of an approach to risk management and proposed an algorithm for their consideration. In particular, it was noted that when implementing a risk management system at an energy company, it is necessary to take into account the specifics of the activity, existing risks and ways to reduce them, as well as the available resources and opportunities for implementing a risk management system.
V. Pylypenko, M. Karpenko [15]	Authors indicate that among the main risks that threaten the activities of energy companies, an important place is occupied by such risks as losses from necessary investments, inadequate economic policy of the state, reduced consumer demand, violation of electricity trading rules, increased competition, changes in the country's financial policy, instability of the national currency, changes in the energy market, technological risks, reduced production quality and default on obligations to creditors.

Problem statement

Studies show that risk-based management is a key factor for the success of an enterprise, especially in the energy sector. It helps to ensure efficient use of resources and reduce the possibility of unexpected costs and losses.

However, despite the fact that risk management has become an integral part of most businesses, there are some challenges associated with its application. The first problem is that some enterprises may approach risk management in a formal way, without realising its essence and importance for achieving the enterprise's goals. The second problem is that risk management may not be performed effectively enough due to insufficient analysis, planning and implementation of risk mitigation measures. The third problem is that in some cases, risk management may be aimed only at controlling and managing already known risks, without paying attention to new ones that may arise in the future.

Thus, the problem is that not all energy companies are aware of the importance of risk-based management and do not perform it effectively, which can lead to unexpected costs and losses.

Summary of the main material

Despite the fact that the importance of risk management in the energy sector is well known, not all businesses pay sufficient attention to this issue. Risks are often assessed superficially or even ignored, which can lead to serious consequences. Therefore, to be successful in risk management, it is necessary to recognise its importance and pay sufficient attention to it.

It is also important to note that risk management is an ongoing process. Risks change over time, so it is important to regularly review and assess risks and make changes to risk management strategies in line with current conditions.

Thanks to advances in research and technology, today's energy companies can use a variety of tools and techniques to manage risks. For example, risk modelling, various analytical methods, risk assessment methods and risk minimisation techniques. However, it should be noted that each organisation has its own peculiarities and specifics, so before using any risk management method, it is necessary to study it in detail and determine whether it is suitable for the enterprise in question.

In addition, it is important to note that risk management is not a task that can be performed by a single department or individual within an organisation. Risk management must be integrated into all aspects of the enterprise and be the responsibility of all departments and employees.

Therefore, risk management is an important element of energy company management that helps to reduce the possible consequences of accidental events and ensures the sustainability and reliability of the company's operations. A properly organised risk management process reduces financial losses, improves the company's image, ensures employee safety and preserves the environment.

In order to effectively manage risks, it is necessary to constantly improve the risk management system and use new

methods and technologies. This requires allocating appropriate resources and investing in research. An important step is the training of qualified specialists who can implement new methods and develop effective risk management strategies. Thanks to ongoing scientific research, there are many different standards and methods of risk analysis, assessment and management that can be used in the energy sector. Let us consider some of them (first of all, the most relevant and modern ones).

ISO 31000 risk management methodology (ISO 31000:2018). The International Organisation for Standardisation (ISO) has developed the ISO 31000 risk management methodology, which is the global standard for risk management. This methodology is generally accepted and very popular all over the world. It is based on principles that ensure proper risk management and are interrelated. These principles include: organisational context, leadership, risk management process, risk assessment, risk decisions and performance measurement.

The ISO 31000 methodology includes the following stages of risk management:

- Establishing the context of the organisation;
- Risk assessment;
- Risk handling;
- Monitoring and review;
- COSO ERM risk management methodology.

The Committee of Organisational Social Accountability (COSO) has developed the Enterprise Risk Management (ERM) framework, which allows an organisation to manage risk on a more comprehensive level. COSO ERM is used in many countries around the world and is one of the most popular.

ISO 50001:2018 standard, which sets requirements for energy efficiency management systems and helps reduce the environmental impact of an enterprise.

One of the key elements of risk management is risk identification and assessment. In the energy sector, risks can arise from many sources, including natural disasters, unpredictable economic and social events, technical problems, and others. Therefore, effective risk identification and assessment is an important element of risk management in the energy sector.

Among the current methods of risk identification and assessment in the energy sector are the following:

- Failure Analysis and Uncertainty Assessment (FAUNA) methodology – used to assess the risk of power system disruption and to predict the occurrence of emergencies. Montecarlo method – used to assess risks associated with random processes, such as fluctuations in fuel prices or equipment maintenance costs.
- The expert assessment method is based on the collection and analysis of opinions of experts from various energy sectors and allows for several different scenarios.
- Residual Risk Analysis – used to assess the effectiveness of risk management measures that have already been implemented.
- Critical Incident Technique – used to identify critical events that could lead to emergencies.

- Functional Analysis – allows you to identify and describe the functions of the system and determine which failures or errors can lead to disruption of its operation.

Each of these methods has its own advantages and disadvantages, so depending on the purpose and object of the study, you can choose the most appropriate method. Table 2 provides a comparative analysis of some methods of risk identification and assessment.

Table 2
Comparative analysis of risk identification and assessment methods

Method	Advantages	Disadvantages
Analysis of expert information	This method allows to use the experience and knowledge of experts, which allows to obtain realistic results	subjectivity of experts' answers and lack of accuracy
Analysis of statistical data	allows using historical data and forecasting risks based on probability does	not take into account new and unforeseen risks
Scenario analysis	allows to take into account various possible scenarios and their consequences	lack of accuracy and completeness of information about each scenario
Risk analysis with the use of information technology	makes it possible to use computer programmes to automate the process of risk identification and assessment	the user may not be able to use this technology and the results may not be accurate if the programme is not configured correctly
Methods of risk assessment using engineering tools	the method uses measuring instruments and other engineering tools to assess risks, i.e., the accuracy and objectivity of the results are available	complexity and high costs of the study

Modern methods of risk analysis in the energy sector can be classified according to various criteria, for example

Quantitative methods:

- methods of statistical analysis;
 - methods of risk analysis and modelling;
 - optimisation methods;
 - Scenario and simulation methods.
- Qualitative methods:
- Choice tree method;
 - method of analysing expert opinions;
 - method of impact analysis;
 - the method of relationship diagrams.

Each of these methods has its own advantages and disadvantages that may affect their use. For example, quantitative methods provide more precise results, but they can be more difficult to apply because they require a significant amount of input data and computation. Qualitative

methods, on the other hand, can be faster and easier to apply, but they do not always provide accurate results. Methods and tools for risk management in the energy sector.

Risk management in the energy sector involves the use of various methods and tools to reduce the level of risk and eliminate the possibility of negative consequences.

Modern risk management methods in the energy sector include:

Smart Contracts – this method automates risk management processes, reducing the cost of interacting with counterparties and ensuring the fulfilment of contractual obligations through the use of blockchain technology.

Differential Contracts methodology – this method is used to manage price risk, providing protection against the impact of price changes in the energy market.

Distributed Ledger Technology – this method ensures the storage and transfer of data in the energy sector through a decentralised platform that ensures the security and reliability of data storage.

Energy Project Risk Analysis – this method allows assessing and identifying risks associated with energy projects and developing strategies to manage these risks.

Energy Audit methods – this method helps to identify risks in energy consumption and energy supply, reducing energy costs and ensuring the sustainability of the energy balance.

Event Tree Analysis (ETA) is a risk analysis method that allows you to visualise the sequence of events leading to an accident and calculate the probability of this event occurring. The ETA method is used to assess risks from production processes, in particular in the energy sector.

Layer of Protection Analysis (LOPA) is a method used to assess the effectiveness of risk protection systems. The LOPA method allows to determine the required number of layers of protection to reduce the risk to an acceptable level.

Probabilistic Safety Assessment (PSA) is a risk analysis method used to assess the risks from hazardous events in systems used in the energy sector. The PSA method is based on the use of statistical data and models to estimate the probability of events and their consequences.

The Genetic Algorithm method is used to optimise risk management decision-making processes in the energy sector. It is based on evolutionary theory and is capable of finding optimal solutions in complex and uncertain systems.

Multi-agent modelling – used to model various interactions between different risk management entities, such as companies, government agencies, consumers, etc. The method allows analysing simulation models and forecasting risks in the energy sector.

Expert Judgement – involves the involvement of experts from various fields of energy to assess risks and develop risk management strategies. Expert judgement can help to avoid risks that cannot be identified using other methods.

Comparative analysis – used to compare risks in different segments of the energy sector or to compare the effectiveness of different risk management strategies (Table 3). The method allows you to choose the best risk management option that provides the best balance between cost and performance.

Simulation modelling – used to model the behaviour of the system under different conditions, which allows to predict risks and respond to them effectively.

The use of modern information systems in the risk management process is necessary due to the growing complexity of the energy sector and the emergence of new types of risks, such as cybersecurity and cyberattacks, climate change, risks associated with natural disasters, etc. Modern information systems can help energy companies manage risks effectively through:

- automated collection and processing of risk data, which allows for quick and accurate risk assessment and timely mitigation measures;

- using data analytics and artificial intelligence systems to predict risks and determine optimal risk management strategies;
- use of electronic reporting systems to ensure quick access to the necessary information and transparency of the risk management process;
- development of blockchain technologies that can ensure the security and reliability of risk management based on decentralised systems.

The latest information technologies, such as artificial intelligence, machine learning, the Internet of Things, and blockchain, are driving the development of software applications for risk management in the energy sector.

The general trend in recent years is that more and more energy companies are starting to use risk management software. This is due to the growing amount of data that needs to be analysed and the complexity of risk management processes.

Table 3
Comparative analysis of some risk management methods

Method	Advantages	Disadvantages
Consensus-based approach ensures	the involvement of all stakeholders in risk management; stimulates dialogue and mutual understanding between different groups; reduces the risk of negative consequences from making bad decisions.	the process of internal agreement may take a long time; the possibility that the consensus process may be difficult if there are no common goals; the possibility that some stakeholder groups may be dismissive of other groups.
The risk mapping method	allows you to visualise risks and draw attention to the most critical aspects; provides an opportunity to determine the priorities of risk management; allows to identify the interactivity of different risks.	the possibility of overloading the mapping with details that may complicate the decision-making process; the need for additional analysis after the risk map is created; the possibility that in some cases the risk map may not reflect the actual state of risk.
The risk management method based on risk indicators	provides the ability to monitor risks and assess the effectiveness of risk management measures; allows to respond quickly to changing conditions and reduce risks; allows to ensure the relationship between risks and financial results of the enterprise.	limited amount of information; limited accuracy; lack of flexibility; influence of external factors.
Standards-based risk management systems (e.g., ISO 31000)	provide a standardised approach to risk management; help to reduce the possibility of risks and increase the efficiency of risk management; increase public and stakeholder confidence in companies.	implementing a risk management system can be complex and costly; do not always allow for adaptability to changes in the risk environment; additional efforts and resources may be required to comply with standards.
Scenario analysis	allows you to predict possible consequences and identify risks in different scenarios; helps to develop emergency plans and risk management strategies.	assumes that future developments will follow the selected scenarios, which may not always be the case; may ignore risks that are not accounted for in the scenarios or occur in other areas.
Risk management based on Key Risk Indicators	effective risk identification; easy interpretation; effective monitoring; integration with risk management systems.	complexity of KRI definition; lack of standardisation; limited number of KRIs; lack of accuracy.

Software can automate many risk management processes, such as data analysis, risk assessment, risk strategy development and implementation.

One of the leading risk management software vendors is SAP, which offers a variety of software tools for different sectors of the economy, including the energy sector. Other leading risk management software vendors include IBM, Oracle and SAS.

There are also a number of open source software tools that can be used for risk management, such as R, Python, Apache Spark, etc. These tools allow you to collect, analyse and visualise data to make risk management decisions.

Here are some examples of software tools that are already used in the process of risk management in the energy sector:

SAP Risk Management: is a risk management software that provides tools for assessing, monitoring and mitigating risks at the enterprise level.

Enablon Risk Management: an integrated platform that allows energy companies to identify, analyse and manage risks.

Riskconnect is a cloud-based risk management application that enables energy companies to analyse risks and develop response plans.

RSA Archer: is a risk management software that enables energy companies to assess, monitor and mitigate risks.

Palisade @RISK: risk modelling and decision-making software that allows energy companies to assess the impact of various factors on risks and develop effective risk management strategies.

In addition, energy companies also use general risk management software such as Microsoft Excel and Power BI, as well as project management software such as Microsoft Project, Primavera P6, ProjectLibre.

The choice of a specific risk management software tool may depend on many factors, such as the needs of the enterprise, budget, complexity of activities, number of users, etc. However, we can compare some of the technical characteristics of several popular risk management software tools used in the energy sector:

SAP Risk Management: SAP Risk Management is an integrated module in SAP ERP that allows enterprises to identify, analyse and manage risks at different levels of the organisation. It has powerful analytical tools for assessing risks and opportunities, as well as for creating risk management plans. In terms of technical performance, SAP Risk Management is highly scalable, has a high level of security and data protection, and supports multiple languages and currencies. However, it can be quite complex to use and configure.

IBM OpenPages: IBM OpenPages is an integrated risk and liability management system that enables businesses to identify and analyse risks, develop risk management plans, and comply with various regulatory requirements. IBM OpenPages has powerful tools for data analysis, risk modelling and forecasting, and provides integration with various systems such as ERP and CRM. IBM OpenPages'

technical performance is also high, including scalability, security and support for various scenarios.

Another important characteristic of risk management software is its ability to collect and analyse data. The most effective software tools are those that have built-in tools for automatic data collection and analysis from various sources. Such tools may include integration with other systems, network monitoring, security breach detection, and other functions. They allow for the collection and analysis of a large amount of data in real time, which allows for a prompt response to changes in the situation.

Another important feature is the software's ability to visualise and present data. This may include displaying data in the form of graphs, tables, charts, and other data visualisation techniques. Such tools allow users to understand and analyse data quickly and efficiently.

In addition, an important feature is the ability of the software to perform simulations and model various risk scenarios. This allows users to explore different possible courses of action and assess their consequences.

Depending on the software tool, the technical indicators may vary. Here are some examples:

Palantir Foundry is a data analytics and risk management software product that allows you to integrate data from various sources and analyse it. Palantir Foundry's technical indicators include:

- data processing speed;
- scalability
- data security;
- user-friendly interface.

SAS Risk Management for Banking is a software for risk management in the banking sector. The technical indicators of SAS Risk Management include:

- high accuracy of risk forecasting;
- speed of processing large amounts of data;
- the ability to integrate with other bank systems;
- scalability.

IBM OpenPages is a risk management software that allows you to identify, assess and manage risks in various sectors. The technical indicators of IBM OpenPages include:

- data processing speed;
- the ability to integrate with other systems;
- user-friendly interface;
- the ability to expand functionality.

These examples show that the technical characteristics of risk management software can vary and depend on the specifics of the product and its functionality.

In addition to technical performance, an important characteristic of risk management software is its cost and availability. Some software tools can be very expensive and complex to deploy, which can put them out of reach for smaller businesses.

CONCLUSIONS

In general, the analysis of scientific papers shows that risk management in the energy sector is an important component of the successful functioning of companies, as this sector is exposed to significant technological,

environmental, economic and social risks. A large number of scientists and researchers around the world are studying various aspects of risk management at energy companies. However, despite the considerable amount of research, many aspects of risk management in the energy sector remain insufficiently studied or require additional research and improvement.

The analysis also suggests that most studies focus on risk identification and analysis, development of risk management methodologies and models, and consideration of the specifics of risk management at individual energy companies. At the same time, little attention is paid to the implementation of risk management systems in practice, as well as to the evaluation of the effectiveness of such systems. Thus, there is a need for further research to develop practical recommendations for the implementation and effective risk management at energy sector enterprises.

In current research in the field of risk management at energy enterprises, some aspects can be identified that receive less attention. For example:

- The impact of risks on the profitability of energy companies: most studies focus on risk mitigation and safety improvements, but little attention is paid to the economic impact of risks on the financial performance of energy companies.
- Interconnection of risks and resilience of the energy sector: an important aspect is to study the interaction of different risks and their impact on the resilience of the energy sector.
- Development of new risk management methods: although there is a significant amount of research on risk management, an important task is to develop new effective methods for forecasting and managing risks in the energy sector.
- Analysing energy sector risks at the macroeconomic level: little research has been devoted to analysing energy sector risks at the macroeconomic level and their impact on the development of the national economy

Risks are an integral part of any business activity, especially in the energy sector. Risk management is an effective tool for reducing the negative effects of risks and ensuring the stable operation of the enterprise.

The analysis of scientific papers on the research problem has made it clear that approaches to risk management are different and their choice depends on the specifics of the enterprise and its industry. However, all approaches are based on general principles: risk identification, risk assessment, selection of risk management strategy and monitoring.

Modern methods of risk management at energy companies are based on the use of integrated approaches that combine methodological, organisational, economic and technical means to identify, analyse, assess and control risks.

The implementation of the risk management process in the energy sector should be carried out within the framework of the security management system, which includes

the definition of policy, organisational structure, procedures and management tools.

Risk management in the energy sector has its own peculiarities associated with a high level of technical complexity, large financial volumes, increased level of responsibility to society and other factors.

Based on the analysis, it can be concluded that the effectiveness of risk management at energy companies depends on the correct risk assessment, development and implementation of effective risk management strategies, as well as ongoing monitoring and analysis of risks.

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