Section 3.3. Paradigmatic Concept of Strategic Management of the Development of Alternative Energy Companies Using Modern Information Technologies

Svitlana Breus[1], Yurii Lytvyniuk[2], Mykola Denysenko[3]

[1]*Doctor of Economic Sciences, Professor, Professor at the Department of Management and Marketing, European University, Kyiv, Ukraine, ORCID: https://orcid.org/0000-0003-0624-0219*

[2]*Postgraduate Student, European University, Kyiv, Ukraine, ORCID: https://orcid.org/0009-0003-9324-5807*

[3]*Doctor of Economic Sciences, Professor, Habilitated Doctor of Economic Sciences, Professor of the Department of Management and Entrepreneurship, Volodymyr Vynnychenko Central Ukrainian State University, Kropyvnytskyi, Ukraine, ORCID: https://orcid.org/0000-0001-8767-9762*

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Abstract. *The study addresses the strategic management of Ukrainian companies that generate energy from renewable sources in the context of war, turbulence of the external environment and accelerated digitalisation of business processes. Its objective is to develop a paradigmatic concept and a level model of strategic management for alternative energy companies that integrates modern information technologies with sustainable development priorities and regulatory changes in the national energy sector. Methodologically, the research combines a review of relevant literature on strategic management, digital transformation and green energy with a quantitative cluster analysis of the twenty largest Ukrainian renewable energy companies based on Forbes ranking data. Using the k-means method in Statistica, enterprises are grouped according to installed capacity, revenues, profits, assets, liabilities and employment, which allows three clusters and differentiated strategic positions to be identified. On this basis, a matrix of management actions is proposed that links the degree of instability of the external environment with active offensive, stabilisation and defence or passive offensive strategies, and specifies how strategies should be adjusted when instability grows or decreases. The authors further develop a level model of strategic management for alternative energy companies that embeds the PDCA cycle in the DPSIR framework and connects strategic planning, organisation, control and improvement with economic drivers, pressures, states, impacts and responses. The conclusions emphasise that the proposed concept and tools increase the quality and timeliness of management decisions, support greater resilience of renewable energy companies under conditions of war and ongoing post war reconstruction, and are consistent with the new Law on Sustainable Transformation of the Country's Energy Sector. Directions for further research include empirical testing and digitalisation of the PDCA-DPSIR model at company and regional levels, further development of composite indices to monitor green economic progress, and refinement of key performance indicators for different clusters of enterprises.*

Keywords: *digital technologies; strategy; strategic management; risk; uncertainty; cluster analysis; k-means method; energy; sustainable development.*

1. Strategic challenges of renewable energy development in Ukraine under war and global energy transition. Against the background of the fundamental transformation of the global energy sector, the increasing volume and expansion of the impact of energy on climate change and the use of "green energy" (Denysiuk et al., 2022), along with the destructive impact on the domestic energy sector (along with the loss of life, the destruction of infrastructure: civil, military, transport, etc.), the actions of the aggressor country are radically changing the socio-economic landscape of Ukraine, which poses challenges for Ukrainian society and is a stimulating factor for solving global problems of preserving identity, survival and prosperity in the foreseeable future, which is impossible without taking into account the concept of changing the paradigm of strategic management of energy development using renewable energy sources based on digital technologies.

Conditions for the operation of modern Ukrainian enterprises in the field of renewable energy are characterized by increased instability of the internal and external environment, complication of internal business processes, constant attacks on generation facilities with subsequent decommissioning, which determines the probabilistic nature of the events that occur and contributes to the emergence of a significant number of risks in the activities of enterprises, both in the energy industry and other enterprises of Ukraine.

Among the current events, reformation and development problems of the Ukrainian economy, the vector aimed at ensuring the conditions for effective functioning and further implementation of managerial actions in Ukraine at all levels of management in the energy sector using leading world practices in this area stands out.

In such conditions, enterprise managers must make strategic decisions that actualize the issue of solving today's reform and development problems using the basic principles of strategic management and digital technologies and a systematic approach to considering management actions, current data, and modern tools for making management decisions, taking into account externalities in general and factors influencing the external and internal environment in particular.

A significant contribution to the study of issues related to strategic management was made by scientists in the context of: global trends in the conditions of fundamental transformation of the global energy sector, taking into account the possibility of introducing renewable energy sources and features for the recovery of the Ukrainian economy (Denysiuk, S. P., Bielokha, H. S., Cherneshchuk, I. S., & Lysyi, V. V., 2022); analysis of financial results of clean energy companies included in the S&P Clean

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Energy Index of North America and Europe using VIKOR and TOPSIS methods based on BWM for assessing investment opportunities (Cilesiz, A., Dayi, F., & Yucel, M., 2024); triadic relationship between knowledge management strategy and business strategy and between business strategy and IT strategy (Venkitachalam, K., & Ambrosini, V., 2017); understanding dynamic opportunities, processes and results in organizations, without delving into the specifics of energy sectors, government support or innovations in energy-saving technologies (Tondolo, V. A. G., & Bitencourt, C. C., 2014); strategic choices of enterprises regarding operational and research innovations based on the theory of two-way innovations (Zheng, Y., Li, M., Hao, C., Kiani, A., & Wang, Y., 2023); development of dominant designs, such as standardized solar panel architectures or wind turbine technologies, taking into account their role in shaping the development trajectories of the industry (Herrmann, P., 2005); strategic management concepts with an emphasis on the importance of structuring the strategic decision-making process through a strategic management model: from the combination of approaches to strategic management as a model and a plan, the focus of companies on capitalizing on their own resources or environmental impact, to globalization, digitalization, innovation and the pursuit of sustainable competitive advantage, all of which are important for understanding the paradigm shift in strategic management (Scobercia, O., Munteanu, V. P., Pantea, M. I., & Gligor, D., 2024); synthesis of a body of knowledge through the prism of opportunities and an inclusive perspective of strategic management regarding the study of the business model as a central element of strategic management of digital sustainability, complementarity and possible conflict between the three dimensions of the business model (value propositions, value creation and delivery processes, value capture mechanisms), between different digital technologies and capabilities, digitalization and sustainability and the results of the triple bottom line (Palmié, M., Aebersold, A., Oghazi, P., Pashkevich, N., & Gassmann, O., 2024); features of the use of energy-saving technologies as a mechanism for increasing the level of economic security in Ukrainian cities and a prerequisite for increasing the technological potential of production and competitiveness and reducing the degree of their impact on the environment (Khmara, V., & Koshova, S., 2023); energy saving in Ukraine and the world, which is associated with the shortage of basic energy resources, the cost of their extraction, and global environmental problems (Voloshyn, M. M., 2024).

However, despite the existence of significant scientific achievements of the authors in this area, certain aspects of management in the context of

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making and implementing management decisions with the appropriate development of measures to increase the effectiveness of strategic management of the development of alternative energy companies using modern information technologies within the framework of the concept of development of the energy sector of Ukraine require in-depth research.

2. Digital technologies and the evolution of enterprise management in Ukraine. In general, a strategic decision is the result of the management entity's choice of a course of action aimed at solving the enterprise's specific strategic objectives in the existing or prospective situation.

Information technologies have gone through many evolutionary stages, the change of which was determined predominantly by the development of scientific and technological progress and at the same time was a prerequisite for the digitalization of all processes in society. A “circular race” took place, so to speak.

The desire of companies to increase the efficiency of their information systems stimulates the emergence of newer hardware and software, which, in turn, push users to further modernize their information systems. Thus, for many years, the development of information technologies has been characterized by a “pendulum effect” (Pozhuev, n.d.), which to some extent does not meet the needs of modernity; within the framework of evolutionary changes in society, sometimes revolutionary changes occur, the root cause of which and at the same time the consequence is the development of information technologies. In modern conditions, the basic laws of economic theory come into contradiction.

The changes taking place in the world require a rapid response from companies in conditions of turbulence, risk and uncertainty and, as a result, a radical restructuring of approaches to the concept of information technology development, and therefore a revision of the basic laws of economic theory: information technologies simultaneously shape demand and supply, the "circular race" is ongoing and permanent, which indicates a radical change in worldview and restructuring of the information technology management system itself and a change in the organization of this system.

Back in the 1960s, traditional file systems and data processing initiated the use of information technology in companies. This was a time of design, development and implementation of centralized computing systems, most of which were engaged in mathematical modeling and calculations, as well as automation of warehouse inventory management systems (O’Leary, 2000; Rashid et al., 2002; Snellman, 2017; Zehetner et al., 2011) in companies. In the 1970s, information technology was used to manage databases in enterprises.

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In the 1980s and 1990s, companies developed systems for planning production volumes and planning production resources, i.e., synchronizing production to minimize unit cost and increase revenue. Today, the speed of information exchange has increased many times over, so managing companies using modern software has significantly simplified existing business processes and allowed us to achieve greater results in a shorter amount of time.

At the beginning of the 21st century, there was a rapid development of information technologies, which made it possible to use information systems not only for large enterprises, but also for medium and small ones. At a new stage in the evolution of company management, more and more enterprises in the world and Ukraine are using information technologies to manage relationships with customers, projects, supply chains, personnel, etc. Today, the main software products presented are ERP (enterprise resource planning system) (Enterprise resource planning, n.d.), CRM (customer relationship management) (Customer relationship management, n.d.), etc., which are auxiliary in the management of companies.

Taking into account the research issues, the focus was on small (including microenterprises) and medium-sized enterprises, since their total contribution to the creation of Ukraine's GDP is greater than that of large enterprises. In Ukraine, small (including microenterprises) and medium-sized enterprises quantitatively account for 99.8% of all registered ones, while creating 62.2% of GDP (State Statistics Service of Ukraine, 2023). That is why focusing on modern information technologies for small and medium-sized enterprises will make it possible to increase the GDP created by these enterprises and, in the long term, will lead to economic growth in Ukraine.

The feasibility of practical use of software packages depending on the types of economic activity and the specifics of the company's activities is justified by the current state of business processes, the need to dominate the market in case of an advantage over competitors, which is especially relevant for small and medium-sized business entities, which are important elements of the socio-economic system.

In general, there is a pressing need for a radical change in approaches to the selection, implementation, adaptation and use of modern software packages for small and medium-sized businesses in Ukraine in the case of rational use of available resources through process automation, which, in turn, contributes to improving the organization of business processes within the company, in particular in terms of receiving, registering, storing, accessing and using information.

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The research process analyzes existing software packages, their features and completeness in terms of solving today's business problems, the cost of the software package, the time of implementation of the software package, the availability of analytics, ease of use and implementation, and the possibilities of internal or external administration, cloud storage or on a server, accessibility of interfaces to user-employees, availability of a high-quality mobile version, etc.

In-depth research of existing software packages is aimed at helping owners, CEOs and top managers make decisions on using a particular software package for the company, depending on the specifics of its activities. This will make it possible to avoid mistakes when selecting and implementing these complexes, save money on the purchase, implementation and adaptation of this complex, and save the company's money from the erroneous selection and implementation of these complexes.

In general, it can be stated that the use of information technologies is becoming an integral part of the organizational and information support of a business and allows enterprises to analyze work results, effectively control the use of resources, reduce the cost of production, increase efficiency, increase sales, etc., which is a necessary element in managing any business.

The diverse application of information technologies is available to practically every enterprise, regardless of its size and sphere of economic activity. Over the past 50 years, information technologies have actively developed under the influence of rapid technological progress and the interaction of communicative, organizational and managerial technologies. The results of this development have been software complexes that integrate into existing businesses and their business processes, which significantly simplify and facilitate the exchange of information and data within companies, significantly reduce the time intervals for performing operations, and simplify control over the implementation of assigned tasks.

In Ukraine, the state level is already actively implementing the digitalization of every sphere of activity, including construction. However, over the past few years, the construction sector has begun to face various problems, including low efficiency, high project costs, labour shortages, to address which and increase construction efficiency, an increasing number of companies are using digital technologies to increase construction efficiency and quality, reduce project costs, etc. (Digitalization of the construction sector, 2025).

Given the trends towards the widespread implementation of digitalization processes, the digitalization of the construction sector, using effective technologies and tools (which have proven themselves in countries

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that have survived the war and achieved economic growth, such as building modelling software (BIM), Internet of Things (IoT) sensors, artificial intelligence (AI), process automation and other technologies) will not only improve the design, construction and operation of buildings and structures, but will also create the basis for the restoration of Ukraine's economy on an innovative basis.

The construction sector, with an appropriate effective mechanism for its digitalization, can play a significant role in the reconstruction of Ukraine in both the wartime and post-war periods, especially in the context of developing and implementing investment recovery strategies. In particular, as a result of involving domestic and international investors in the reconstruction process using the best global practices, especially those countries that were able to ensure prosperity and achieve sustainable economic growth trends both during the war and after the victory over the aggressors.

The information services market is changing under the influence of corporate information systems and, as a result, the sequence of interaction of material and information flows is changing (Neustroiev, 2021), and this is generally reflected in all areas of business.

Many business processes are undergoing significant changes in the new realities, which generally highlights the need for a fundamental change in approaches to the selection, implementation, adaptation and use of modern software packages for small and medium-sized businesses in Ukraine in the case of rational use of available resources through process automation, which, in turn, contributes to improving the organization of business processes within the company, in particular in terms of receiving, registering, storing, accessing and using information.

3. Cluster based differentiation of renewable energy companies and strategic options. In order to justify the choice of enterprise management strategy, it is advisable to conduct a cluster analysis. For this purpose, the 20 largest Ukrainian enterprises in the field of renewable energy sources were selected. Thus, according to Forbes (Top 20 largest companies in Ukraine, 2024), a cluster analysis for the 20 largest companies in Ukraine (Table 3.9) was conducted according to the following criteria: revenue, profit, assets, estimated value of the enterprise according to their positions in the ranking (Top 20 largest companies in Ukraine, 2024) using the statistical software product Statistica.

Based on the rating data, a dendrogram was constructed (Figure 3.15, Figure 3.16). The selected enterprises were divided into clusters using the nearest neighbour method, which works on the principle of finding the

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closest values for a given phenomenon under study.

Table 3.9. Renewable energy companies for which the calculation was made

№	Company name	EDRPOU
1	Elementum Energy	45197589
2	DTEK Renewable Energy	42053484
3	Scatec	42205062
4	Eco optima	33051806
5	Wind farms in Ukraine	37944343
6	Gelios Capital	43599272
7	Rengy Development (including Renji Solar, Nov Solar)	36845124 42003894 42168581
8	Solar Generation (including Wind Solar Energy-6, Ecotechnik - Tarasivtsi, Solar South 1)	37534816 42356847 38195808 42092209
9	Yuzhne Energy	41457925
10	Hydroenergoinvest-Aquanova	36885544
11	Furs Energy Groups	42729391
12	ETG	36716332

Note: Formed by Lytvynuk Yu. M. based on data from Top 20 largest companies in Ukraine (n.d.).

In 2023, the share of renewable energy sources (RES) in the structure of electricity production in Ukraine, including large hydroelectric power plants, reached 22% (Alternative energy, 2023). Before the full-scale Russian invasion of Ukraine, the share of renewable energy was 8.1% in the overall energy system (Alternative energy, 2023), and as a result of the occupation of part of the territory of Ukraine by Russia, the partial destruction of energy sector facilities and the accompanying destructive actions by the aggressor country, the construction of electricity generation facilities from renewable energy sources was shifted towards large cities in central and western Ukraine.

Increasing technological requirements and environmental standards for the functioning of energy enterprises: the development of all components of the energy sector of the economy, including the extraction, transportation, processing and consumption of resources, affects various areas of the environment. A characteristic feature of this impact is its multifaceted nature (simultaneous impact on various elements of the environment), the diversity of the nature of the impact (from mechanical changes in the landscape to radioactive contamination), as well as its scale (negative effects manifest themselves not only at the regional, but also at the global level).

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Energy consumption based on renewable energy sources (RES) in Ukraine (Table 3.10) (Energy consumption based on renewable sources, 2024).

Table 3.10. Energy consumption based on renewable energy sources (RES) in Ukraine

Indicator	Unit of measure	2013	2014	2015	2016	2017	2018
Total energy supply from (RES)	Thousand tons of COE	3166	2797	2700	3616	3907	4289

Source: developed by the authors

Accelerating the pace of electricity production from renewable energy sources (RES): the continuous development of alternative and renewable energy sources in legislative acts, strategies, and plans of the European Union, Ukraine, and the world is identified as one of the promising areas of energy development. The presence of an inexhaustible resource base and the ecological purity of renewable energy sources are their defining advantages in the conditions of exhaustion of economically feasible organic fuel resources and increasing rates of environmental pollution. Alternative energy as one of the basic directions of technological development in the world, together with information and nanotechnologies, is becoming an important component of the new post-industrial technological order.

According to the conclusions of the report "Global Energy Transformation: A Roadmap to 2050" (International Renewable Energy Agency, 2019; BloombergNEF, 2019; Digital transformation: A roadmap for billion-dollar organizations, n.d.; BP, 2020a, 2020b), the energy system must be transformed into a highly efficient system based on the widespread use of renewable energy sources and the potential of digital technologies.

Digitalization of energy enterprises of Ukraine: radical and dynamic changes in the energy sector both at the global and national levels are not possible without digital technologies and implementation of digital transformation measures. Over the past decades, digital technologies have been increasingly introduced into all major industries, and the energy sector is no exception.

Thus, by studying the trends of strategic management of company development and the prospects for the development of the energy industry, it can be argued that there is a growing demand for the implementation of digital technologies at energy enterprises, especially those that operate using renewable energy sources, which allow for quick, reliable, qualitatively and

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comprehensively solve the problems of production, generation, distribution, and supply of electrical energy, as well as create appropriate conditions for their economical use while minimizing the negative impact on the environment using the principles of sustainable development.

New trends and possibilities of modern information technologies put forward the need to develop new management models focused on the implementation of digital transformation measures and which will be, first of all, focused on the end consumer and characterized by resistance to external influences, given the instability and variability of the external environment of the functioning and development of modern energy enterprises.

The European Bank for Reconstruction and Development (EBRD), the Chinese state corporation (CNBM), the US International Development Finance Corporation (DFC, formerly OPIC), the French Fund (Pro-parco), the Danish Government Investment Fund for Developing Countries (IFU), and the financial funds of Finland (Finnfund) and Sweden (Swedfund), Netherlands Development Finance Company (FMO), Nordic Environmental Finance Corporation (NEFCO), Norwegian Export Credit Guarantee Agency (GIEK) and others are constantly investing in Ukrainian electricity generation from alternative energy sources.

In addition, a large-scale investment program in alternative energy until 2030 is also being implemented by the Ukrainian company DTEK (Razumkov Centre, 2020).

This situation had a major impact on the economy of the entire Ukraine and its socio-economic sphere, and digital technologies began to play a leading role, they became a catalyst for changes in the strategies of renewable energy companies and the relevance of transformations of their business models in the direction of changing the vector to value/customer orientation, which became the product of the value of the business model and strategy.

Digital technologies in the energy sector provide new ways to produce and sell electricity in business processes and services; in contrast, traditional energy companies cannot offer consumers electricity produced from alternative sources.

Typically, the lion's share of digital technologies in the business activities of the energy sector can be conditionally divided into two groups:

- focus on creating new values in the production of electricity from renewable energy sources;
- are used to stimulate growth, income and productivity in ways that were not possible with the production of electricity from traditional fossil and nuclear fuels.

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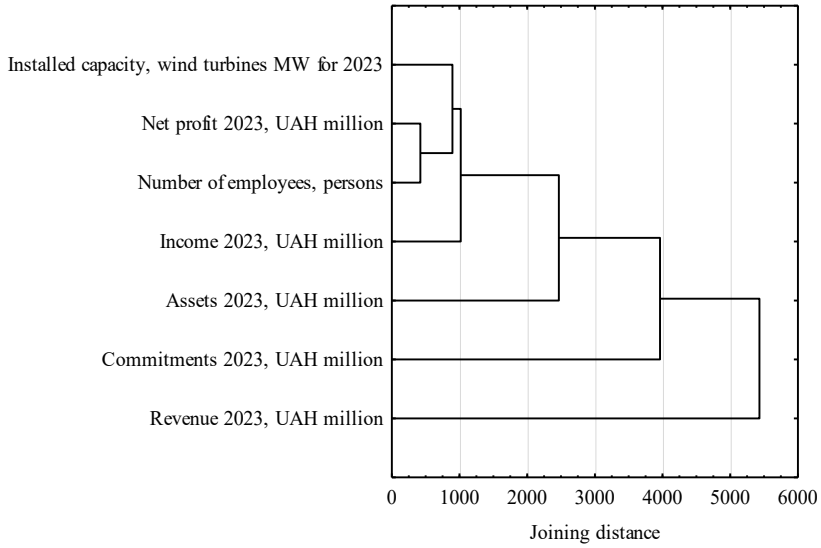


Figure 3.15. Dendrogram for observations being analyzed (single link method, Euclidean distance, vertical dendrogram)

Note: Formed by Breus S. V. and Lytvyniuk Yu. M. based on the results of calculations using the statistical software product Statistica according to Top 20 largest companies in Ukraine (2023).

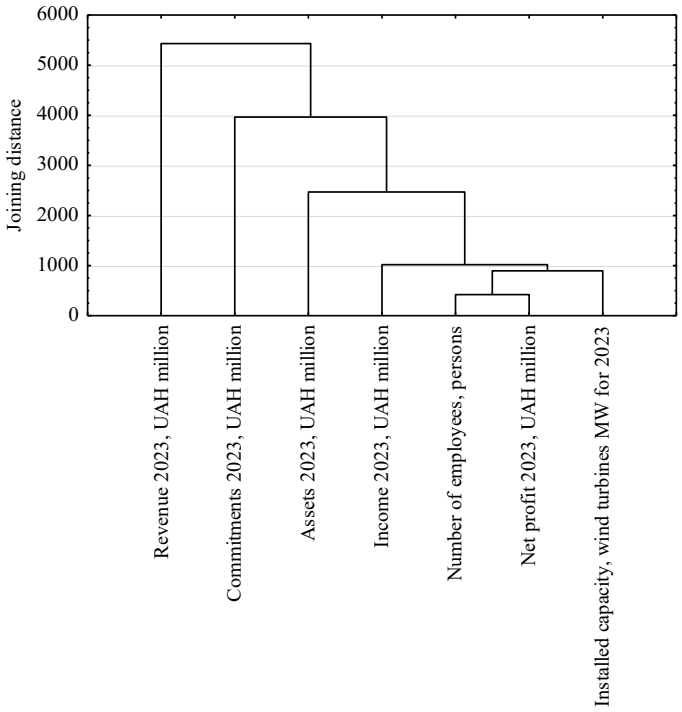


Figure 3.16. Dendrogram for observations being analyzed (single link method, Euclidean distance, horizontal dendrogram)

Note *. Formed by Breus S. V. and Lytvyniuk Yu. M. based on the results of calculations using the statistical software product Statistica according to (Top 20 largest companies in Ukraine, 2024).

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Thus, the issue of digital technologies by energy enterprises based on renewable energy sources as a tool for changing/improving the organization of business processes, developing and implementing innovations, increasing revenues, and strengthening competitiveness in the market is relevant and important and requires intensification and consolidation of efforts at all levels of management using the best global practices in this area. Union scheme is given in Table 3.11.

Table 3.11. Join table

	Object 1	Object 2	Object 3	Object 4	Object 5	Object 6	Object 7
421.2731	Net profit 2023, UAH million	Number of employees, persons					
896.0020	Installed capacity, wind turbines MW for 2023	Net profit 2023, UAH million	Number of employees, persons				
1018,907	Installed capacity, wind turbines MW for 2023	Net profit 2023, UAH million	Number of employees, persons	Income 2023, UAH million			
2469,804	Installed capacity, wind turbines MW for 2023	Net profit 2023, UAH million	Number of employees, persons	Income 2023, UAH million	Assets 2023, UAH million		
3963,535	Installed capacity, wind turbines MW for 2023	Net profit 2023, UAH million	Number of employees, persons	Income 2023, UAH million	Assets 2023, UAH million	Commitments 2023, UAH million	
5431,559	Installed capacity, wind turbines MW for 2023	Net profit 2023, UAH million	Number of employees, persons	Income 2023, UAH million	Assets 2023, UAH million	Commitments 2023, UAH million	Revenue 2023, UAH million

Note*. Formed by Breus S. V. and Lytvyniuk Yu. M. based on the results of calculations using the statistical software product Statistica according to (Top 20 largest companies in Ukraine, 2024).

The indicators, mean and standard deviation are given in Table 3.12.

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Table 3.12. Indicators, mean and standard deviation

Indicators	Installed capacity, wind turbines MW for 2023	Revenue 2023, UAH million	Income 2023, UAH million	Net profit 2023, UAH million	Assets 2023, UAH million	Commitments 2023, UAH million	Number of employees, persons
Installed capacity, wind turbines MW for 2023	0.00000	5585.64191	1278.74838	955.29366	3380.66896	4026.58208	896.00195
Revenue 2023, UAH million	5585.64191	0.00000	6045,22004	6411.81689	6028.32897	5431.55856	6436.45360
Income 2023, UAH million	1278.74838	6045,22004	0.00000	1018.90714	2469.80413	3963.53474	1300.15645
Net profit 2023, UAH million	955.29366	6411.81689	1018.90714	0.00000	3383.04077	4417.50812	421.27313
Assets 2023, UAH million	3380.66896	6028.32897	2469.80413	3383.04077	0.00000	4218.28666	3579.08266
Commitments 2023, UAH million	4026.58208	5431.55856	3963.53474	4417.50812	4218.28666	0.00000	4443.02633
Number of employees, persons	896.00195	6436.45360	1300.15645	421.27313	3579.08266	4443.02633	0.00000
Medium	208.51667	1405.50000	312.65883	86.20842	700.37508	722.95817	31.25000
Standard deviation	199.88676	1314.94227	247.62439	101.98908	819.71586	1134.55209	36.12384
№ observations	12.00000						
Matrix	3.00000						

Note*. Formed by Breus S. V. and Lytvyniuk Yu. M. based on the results of calculations using the statistical software product Statistica according to (Top 20 largest companies in Ukraine, 2024).

Descriptive statistics are presented in Table 3.13.

Table 3.13. Means and standard deviations

Indicator name	Average	Standard deviation
Installed capacity, wind turbines MW for 2023	208,517	199,887
Revenue 2023, UAH million	1405,500	1314,942
Income 2023, UAH million	312,659	247,624
Net profit 2023, UAH million	86,208	101,989
Assets 2023, UAH million	700,375	819,716
Commitments 2023, UAH million	722,958	1134,552
Number of employees, persons	31,250	36,124

Note *. Formed by Breus S. V. and Lytvyniuk Yu. M. based on the results of calculations using the statistical software product Statistica according to (Top 20 largest companies in Ukraine, 2024).

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A k-means cluster analysis was then performed to directly examine the cluster content. Descriptive statistics for each cluster (k-means clustering) are given in Table 3.14.

Table 3.14. Descriptive statistics for each cluster (k-means clustering)

Cluster 1 (2 observations)	Average	Standard deviation	Dispersion
Revenue	1.172510	2.816898	7.934916
Profit	1.662359	1.327705	1.762800
Assets	0.079597	0.269620	0.072695
Estimated cost	2.314208	0.810831	0.657447
Cluster 2 (9 observations)	Average	Standard deviation	Dispersion
Revenue	-0.151292	0.364535	0.132886
Profit	-0.214498	0.735562	0.541052
Assets	-0.010271	1.060712	1.125110
Estimated cost	-0.298608	0.511249	0.261375

Note*. Formed by Breus S. V. and Lytvyniuk Yu. M. based on the results of calculations using the statistical software product Statistica according to (Top 20 largest companies in Ukraine, 2024).

Descriptive statistics of the clusters are given in Table 3.15.

Table 3.15. Descriptive statistics of clusters

Variables	Average	Standard deviation	Dispersion
Cluster 1 (2 observations)			
Installed capacity, wind turbines MW for 2023	402,500	323,148	104425
Revenue 2023, UAH million	3250,000	1202,082	1445000
Income 2023, UAH million	158,278	74,639	5571
Net profit 2023, UAH million	66,869	90,749	8235
Assets 2023, UAH million	160,862	226,786	51432
Commitments 2023, UAH million	39,029	51,376	2640
Number of employees, persons	33,500	45,962	2113
Cluster 2 (9 observations)			
Installed capacity, wind turbines MW for 2023	125.3556	91.9430	8453.5
Revenue 2023, UAH million	740.6667	436.9903	190960.5
Income 2023, UAH million	348.5830	276.0053	76178.9
Net profit 2023, UAH million	96.5306	112.6595	12692.2
Assets 2023, UAH million	774.0823	903.8823	817003.2
Commitments 2023, UAH million	537.9514	681.4033	464310.5
Number of employees, persons	25.1111	34.1264	1164.6
Cluster 3 (1 observation)			
Installed capacity, wind turbines MW for 2023	569,000	0.00	0.00
Revenue 2023, UAH million	3700,000	0.00	0.00
Income 2023, UAH million	298,104	0.00	0.00
Net profit 2023, UAH million	31,988	0.00	0.00
Assets 2023, UAH million	1116,036	0.00	0.00
Commitments 2023, UAH million	3755,878	0.00	0.00
Number of employees, persons	82,000	0.00	0.00

Note *. Formed by Breus S. V. and Lytvyniuk Yu. M. based on the results of calculations using the statistical software product Statistica according to (Top 20 largest companies in Ukraine, 2024).

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The cluster elements and distances to the centers of gravity are given in Table 3.16.

Table 3.16. Cluster elements and distances to centers of gravity

Cluster 1	Association	Cluster 2	Association	Cluster 3	Association
C_1	340.1066	C_3	381.9510	C_2	0.00
C_5	340.1066	C_4	332.6594		
		C_6	252.6556		
		C_7	319.1779		
		C_8	240.0260		
		C_9	885.9667		
		C_10	225.1409		
		C_11	647.1569		
		C_12	246.6777		

Note*: Formed by Breus S. V. and Lytvyniuk Yu. M. based on the results of calculations using the statistical software product Statistica according to (Top 20 largest companies in Ukraine, 2024).

The Euclidean distances between clusters, the distance below the diagonal, and the squares of the distance above the diagonal are given in Table 3.17.

Table 3.17. Euclidean distances between clusters, distance below the diagonal, squares of distance above the diagonal

	Cluster 1	Cluster 2	Cluster 3
Cluster 1	0.000	1005099	2140096
Cluster 2	1002,546	0	2776630
Cluster 3	1462,907	1666	0

Note*: Formed by Breus S. V. and Lytvyniuk Yu. M. based on the results of calculations using the statistical software product Statistica according to (Top 20 largest companies in Ukraine, 2024).

The clustering results provided the basis for forming a strategy that would help increase the efficiency of management decisions depending on the level of changes in the instability of the external environment (Table 3.17).

On January 15, 2025, the Parliament of Ukraine adopted the Law on Sustainable Transformation of the Country's Energy Sector (Law of Ukraine No. 9381, 2025) in order to strengthen the energy system, which includes 5 key decisions:

1. Booking of capacities in Ukrenergo networks (guarantee of future acceptance while investment studies are being conducted, increasing the chances of attracting credit funds for a generation project);

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2. Simplification of the conditions for connecting distributed generation (Ukraine's energy system will become less vulnerable to hostile attacks);

3. Cable adjustment pooling - connecting different types of generation (solar, wind, etc.) to one generation facility. This will enable uninterrupted electricity supply to the grid, reduce grid connection costs, and increase the efficiency of the grid itself;

4. Disclosure of comprehensive data on existing infrastructure (faster connection to the network of new generation facilities, the opportunity for investors to plan their projects);

5. Consolidation of the terms of cooperation between consumers and potential investors in new energy generation facilities (more transparent and understandable interaction between the parties).

The implementation of these actions requires companies in the renewable energy sector to intensify their efforts and adjust their strategies in modern realities. Thus, taking into account the trends and proportions that are characteristic of the Ukrainian economy, it is optimal to implement a number of management actions within the considered variations of changes in the situation in the energy sector of Ukraine. At the same time, the implementation of a stabilization and defense strategy is considered optimal for most companies that, according to the results of clustering, are assigned to cluster 2 (Table 3.18), in the case of implementing decisions to strengthen the Ukrainian energy system in accordance with this Law (Law of Ukraine No. 9381, 2025). The positive consequences of implementing such a strategy may be a reduction in the instability of the activities of energy companies and an increase in the efficiency of implementing management decisions of energy companies.

4. PDCA–DPSIR level model and implications for strategic management of alternative energy companies. Achieving the goals of strategic management of the development of alternative energy companies using modern information technologies is advisable to carry out within the framework of the implementation of the main management functions, combined into the PDCA cycle (Shewhart-Deming method – (PDCA) or PDSA – Deming's wheel): "Plan" - "Do" - "Check" - "Act" (Sydorenko, 2020).

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Table 3.18. Matrix of management actions depending on the level of changes in the instability of the enterprise's external environment

Changing the external environment	Management actions		
	Essential	Moderate	Impalpable
Cluster 1 – Active-offensive strategy			
Growing instability	Adjusting the strategy implementation mechanism and determining the feasibility of its refinement	Adjusting the strategy implementation mechanism and determining the feasibility of clarifying the strategy	Adjusting the strategy implementation mechanism
Reducing instability	Adjusting the strategy implementation mechanism and determining the feasibility of its refinement	Possible adjustment of the strategy implementation mechanism	Stability of the strategy implementation mechanism
Cluster 2 – Stabilization and Defense Strategy			
Growing instability	Adjusting the strategy in the direction of comprehensive improvement of the mechanism of its implementation across all business processes	Adaptation of the strategy implementation mechanism and determination of the feasibility of business model transformation	Improving the existing strategy
Reducing instability	Implementation of the existing strategy and monitoring the effectiveness of business model implementation	Possible adjustment of the existing strategy	Continued implementation of the strategy implementation mechanism
Cluster 3 – Passive-offensive strategy			
Growing instability	Adjusting the strategy implementation mechanism and determining the feasibility of its refinement	Adjusting the strategy implementation mechanism	Adjusting the strategy implementation mechanism
Reducing instability	Adjusting the strategy implementation mechanism and determining the feasibility of its refinement	Mandatory adjustment of the implementation mechanism strategies	Strategy transformation towards enterprise reengineering

Note*. Formed by Breus S. V. and Lytvynuk Y. M. based on the results of calculations using the statistical software product Statistica according to Breus and Kharchenko (2019).

In essence, it is a systemic approach to management and involves managing a system of interdependent processes as a single whole with an orientation towards increasing the effectiveness and efficiency of process implementation as a result of minimizing interfunctional barriers (Figure 3.17):

- planning and forecasting - forming informed judgments about: the possible state and results of the activities of energy companies in the future; alternative options and terms of achieving such a state, setting goals, developing substrategies, forming and substantiating the feasibility of implementing processes and key performance indicators (KPIs);

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- organization and management: creation of a framework and appropriate implementation of strategic management processes, coordination, optimization of resources;
- control and analysis: constant monitoring, detection and identification of performance problems or confirmation that the company's goals are being achieved, as well as measuring the effectiveness of innovation activities in comparison with the values of its target indicators and providing results for analysis and making further management decisions;
- performance assessment and adjustment: assessment of the enterprise's achievement of KPIs, development and implementation of measures for continuous improvement of strategic management.

The use of DPSIR (What drivers are in the DPSIR structure?, n.d.) in analyzing ecological and economic interactions allows us to identify bottlenecks and assess the correctness of establishing cause-and-effect chains, and helps us choose the right sets of indicators to create the most favorable organizational and economic conditions for the balanced development of the renewable energy sector by developing effective measures and procedures for their implementation in cities and towns of Ukraine.

In the process of research, components of an index for assessing progress in the development of a green economy will be developed, which practically reflects all DPSIR categories and allows us to reflect various aspects of ecological and economic development at the regional and local levels.

The development of the DPSIR framework is a method for systematizing information and establishing cause-and-effect relationships between drivers, pressures, states, and societal responses. This flexible framework is widely used to relate human activity to the state of the environment and to address emerging issues. The starting point of this framework is the identification of “drivers” (driving forces) of economic development. Driving forces reflect the need for activities, for example, by individuals and industries, and are the main causes that lead to environmental pressures (What drivers are in the DPSIR structure?, 2025).

The practical implementation of the proposed version of the level model in the practice of managing alternative energy companies using modern information technologies in the case of using the PDCA cycle, taking into account the possibility of continuous improvement of management processes by incorporating them into the DPSIR framework model, implementing them, monitoring the results of their impact, and developing a set of key performance indicators (KPIs) at each stage of the cycle will allow for

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constant monitoring of the effectiveness of the implementation of stages with the formation of a circle within the circle of the PDCA cycle.

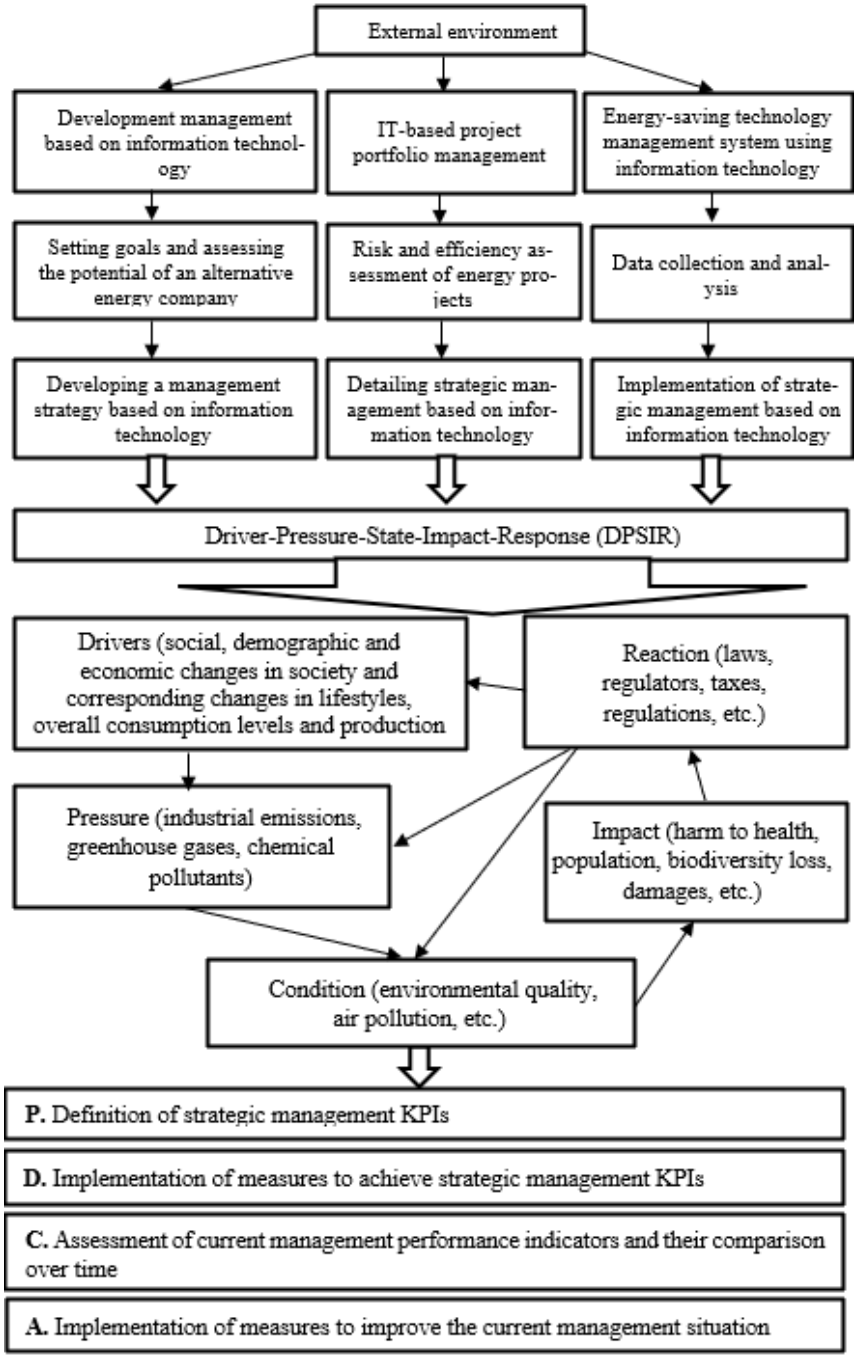


Figure 3.17. Level model of strategic management of the development of alternative energy companies using modern information technologies

Note: Formed by Breus S. V. and Lytvynuk Y. M. based on the results of calculations using the statistical software product Statistica according to Sydorenko (2020).*

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It will contribute to increasing the efficiency of management in conditions of significant influence and changes in the external environment in the conditions of a full-scale war between Russia and Ukraine.

To make a decision on adjusting the strategy or the mechanism of its implementation, it is important to identify the reasons for failure to achieve the planned strategic parameters of the development of energy companies. Solving the problem depends on the quality of a comprehensive analysis of management actions (Grinko et al., 2020; Sokhan et al., 2024; Breus, 2015, 2016; Breus et al., 2019), factors of influence of the external environment, primarily related to Russia's military aggression against Ukraine and state regulation of electricity tariffs from renewable energy sources, and a corresponding proactive response to externalities and factors of influence of the external environment on the activities of companies in the field of energy from renewable energy sources to ensure the achievement of the strategic goals of the companies within the framework of the strategy chosen for implementation and the dynamism of the external environment.

Conclusion. The cluster analysis can be interpreted as a leadership tool for strategic sense-making, because it helps executives differentiate renewable energy firms by development profiles and link each profile to an appropriate set of management actions under varying levels of external instability. From this standpoint, the proposed stability assessment is not merely an analytical exercise but a governance instrument that enables leaders to position the enterprise relative to environmental pressures, set realistic priorities, and recalibrate strategic parameters before disruption escalates into operational or financial loss. The management action matrix strengthens leadership accountability by translating diagnostic results into explicit strategic choices, clarifying what must be stabilized, accelerated, or redesigned in response to specific instability regimes.

The proposed level-based strategic management model, supported by modern information technologies, reinforces leadership capacity by institutionalizing disciplined improvement cycles rather than relying on ad hoc reactions. Embedding PDCA within a DPSIR-informed logic and monitoring progress through stage-specific KPIs frames leadership as continuous steering, where decisions are documented, results are measured, and corrective actions are triggered by evidence. In conditions of war-related turbulence and post-war recovery, this leadership architecture improves coherence across organizational levels, aligns operational execution with long-term sustainability goals, and supports coordinated adaptation to regulatory and market change. Overall, the section concludes that strategic leadership in alternative energy should combine analytics-driven

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segmentation, transparent decision pathways, and iterative governance routines to strengthen resilience, accelerate sustainable transition, and maintain competitiveness under persistent uncertainty.

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