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MARKET ANALYSIS OF THE RENEWABLE ENERGY MARKET OF UKRAINE IN THE CONTEXT OF CHANGES IN FINANCIAL AND ECONOMIC PROCESSES

ABSTRACT

Diversification of the economic base through the development of the bioeconomy will not only contribute to the sustainability of Ukraine's economy but also create new opportunities for its post-war recovery. The greatest potential in Ukraine's bioeconomy lies in bioenergy, namely renewable energy sources. In the context of Russia's military aggression, the development of renewable energy sources is one of the key factors in ensuring Ukraine's energy independence and energy security. Therefore, a market analysis of the Ukrainian renewable energy market in the context of changes in financial and economic processes is an urgent scientific problem.

The paper identifies medium-term, endogenous, production, deterministic, regulated, direct, and quantitative market-forming factors of the renewable energy market in Ukraine.

The classic form of market conditions is the ratio of supply and demand and price dynamics. However, the use of energy prices as market factors in the renewable energy market in Ukraine during a full-scale invasion is not adequate. The established prices are not market-based and are controlled by the state. That is why the market analysis proposed in this paper includes the following stages: analysis of the dynamics of electricity production in Ukraine, billion kWh, which includes the definition of thirteen statistical indicators and their visualization; determination of the share of alternative energy sources in the structure of electricity production for 2017-2024 and construction of a trend line; analysis of seasonality in the renewable energy market; construction of a linear multivariate regression model; analysis of the correlation between electricity production in Ukraine, billion kWh. For the purpose of the market analysis, the statistical data for 2023-2024 are forecasted using the moving average method, due to the lack of statistical data during the war.

Keywords: bioeconomy, renewable energy sources, market analysis, market-forming factors, correlation and regression analysis

JEL Classification: M31, O11, C44, C53

INTRODUCTION

The development of the bioeconomy is an important area of Ukraine's post-war reconstruction and European integration.

The war in Ukraine is causing ecological genocide: animals are dying en masse, vegetation is disappearing, and water bodies are drying up. The main environmental benefits of introducing the bioeconomy are (Ecological genocide, 2022): reducing carbon emissions, combating climate change; economical and rational use of natural resources; conscious consumption; preserving the health of citizens by improving the environment (food quality - organic products; air and water quality); solving the problem of landfills in Ukraine.

The economic benefits of implementing the bioeconomy include (Ecological Genocide, 2022): reducing the cost of waste disposal and the purchase of raw materials (waste is

converted into raw materials for production); reducing the cost of production by reducing energy and fuel costs; diversification of energy resources and the rejection of imported fossil fuels; the possibility of attracting investment to rebuild destroyed industrial areas, taking into account international environmental standards; creation of new jobs for new industries; change of the economic model - transition from extraction of raw materials to their processing; reduction of imports of raw materials and energy through local solutions.

Thus, the introduction of biotechnology, on the one hand, has a positive impact on the country's environment, and on the other hand, increases the competitiveness of Ukrainian enterprises in the European market.

The sectors with the greatest potential in Ukraine's bioeconomy are bioenergy, agriculture, green tourism, bioplastics, new advanced biomaterials, green chemistry, and food. The sectors with the lowest potential in Ukraine include pulp and paper, textiles, wood products and furniture, and non-wood forest products (e.g., mushrooms, resins, etc.) (Analytical Report, 2024).

In the context of Russia's military aggression, the development of renewable energy sources is one of the key factors in ensuring Ukraine's energy independence and energy security.

Renewable energy sources (RES) are energy sources that are not limited in time and can be used without exhausting their resources. They are constantly or periodically available in the natural environment and do not require the release of harmful emissions or significant environmental damage. Such sources include solar energy (energy from the sun), wind energy, geothermal energy (heat energy extracted from the earth's crust), hydropower (energy from moving water), tidal energy, biomass (organic materials that can be used for energy production) and others (Alternative energy, 2024).

The share of renewable energy sources in the structure of electricity production in March 2024 was 8%, which is 2% higher than in February 2024 (Alternative Energy, 2024).

For comparison, in March 2023, the share of renewable energy sources in the generation structure was 7%, and in April it increased to 8%. In general, in 2023, renewable energy sources accounted for the largest share in July and August - 16% each (Alternative Energy, 2024).

Ukraine has significant potential for wind energy development. According to experts and international organizations, wind conditions in many areas of Ukraine are very favourable for the installation of wind power plants. In particular, the southern part of Ukraine, including the Kherson region, has great potential for using wind to generate electricity (Alternative Energy, 2024).

However, 2/3 of large power plants are located in the occupied territory. That is why about 312 MW of new RES capacities were built in 2022, and about 350 MW were commissioned in 2023. These are solar and wind power plants, as well as biogas and small hydropower plants (Ukrinform, 2023).

The introduction of renewable energy sources (RES) is an important component of Ukraine's energy policy. According to the approved Energy Strategy of Ukraine, the country plans to increase the share of electricity generation from renewable energy sources, such as solar, wind, hydropower, and others, to 25% in the energy balance by 2030. By 2050, Ukraine should achieve climate neutrality, which implies reducing greenhouse gas emissions and increasing the use of energy from clean sources (Ukrinform, 2023).

That is why the market analysis of the renewable energy market in Ukraine is an urgent scientific issue.

LITERATURE REVIEW

The problem of an integrated assessment of market conditions has not yet been fully resolved.

Market analysis is one of the most complex types of marketing analysis, as its purpose is to identify the main trends in market development, and its fluctuations, and to assess its potential and basic proportions.

The concept of "conjuncture" has a long history and was used in ancient times to describe situations and connections between different phenomena. Translated from Latin, "conjunqo" means "combination" or "connection", and "conjuncte" means "together".

In economics, the concept of "conjuncture" (konjunktur - a combination of circumstances) appeared in the early twentieth century in the economic works of F. Lassalle and F. Schulze-Delitzsch, A. Scheffl, in which the concept of conjuncture is identified with the idea of a connected set of existing unknown social circumstances surrounding a person.

Ferdinand Lassalle, a German philosopher and economist, was one of the first to define the concept of "conjuncture". He interpreted it as a chain linking known and unknown circumstances, which is not subject to rational prediction (Smesova, 2022).

Albert Eberhard Scheffl, a German and Austrian economist and sociologist, compared the situation to a set of unpredictable and independent external influences that an actor is exposed to at any given moment (Smesova, 2022).

The definition of conjuncture proposed by the Swiss economist Wilhelm Repke reflects the essence of this concept quite accurately. He sees the conjuncture as the relationship between supply and demand in a particular market, which is subject to constant change and is difficult to calculate accurately (Smesova, 2022).

One of the first Ukrainian scientists to study the theory of conjuncture was M. I. Tugan-Baranovsky. According to his definition, "conjuncture" is the result of the factors, conditions of production and consumption of certain goods, which is reflected in the ratio of supply and demand, as well as in the trends in the development of this ratio depending on the dynamics of prices and other factors (Smesova, 2022).

Thus, on the basis of scientific research by representatives of various economic schools, the theoretical and methodological foundations of the theory of market conditions were formed.

Modern scholars continue this research. In her research, V. L. Smesova (2022) summarized scientific approaches and clarified the essence of the category "market conditions" (Smesova, 2022). She carried out a retrospective analysis of theories of economic conditions and approaches to defining the category "market conditions". She found that there is no established approach to understanding the essence of this category. She found out that market conditions are interpreted by some scholars as a state or situation in the market, and by others as a chain or set of circumstances that connects market processes and characterizes changes, movement, i.e., as a static or dynamic phenomenon (Smesova, 2022).

A fairly innovative approach to management and economics was proposed by the authors, who emphasized the need to use processing (Voznyuk et al., 2022).

Aranchiy, V., Ganushchak-Efimenko, L., Khrystenko, L., Shkoda, M., Hnatenko, I., & Fastovets, N. (2022) proposed modelling of a comprehensive assessment of the effectiveness of management of the financial condition of economic entities, the logic and methodology of which are used in our article.

Babukh I.B. and Yeremiia M.M. (2021) analyzed the features of market research in the system of marketing analysis as an integral part of the marketing complex at the enterprise. Based on the definition of market conditions, the main tasks of market research and the main approaches for their implementation were identified. It was noted that a certain system of indicators is developed in the market analysis, which differs by individual types of markets, but it should reflect the real state of the market conditions in the most complete and systematic way. The author presents the stages of market research, and methods of analyzing market conditions, among which the methods of comparison, grouping, correlation and regression analysis, index method, etc. dominate (Babukh et al., 2021).

Buehler H., Horvath, B., Lyons, T., Arribas, I.P. and Wood B. (2020) contrasted classical market modeling approaches with modeling based on generative modeling and highlighted some advantages and disadvantages of the new approach. The authors provide an overview of currently used generative modelling approaches and performance metrics for financial time series. The authors also propose an appropriate performance metric for financial time series and discuss some of the links between market generators and deep hedging.

In our study, we used the system for determining the appropriate indicators according to the methods proposed by the authors, which can be adapted to our article (Vasylchak et al., 2022).

Tanvir Ahmad, Hongcai Zhang, and Biao Yang (2020) conducted a critical and systematic review of renewable energy and electricity forecasting models used as an energy planning tool. The forecasting intervals are divided into three sections: short-term, medium-term, and long-term. Three renewable energy sources, namely wind, solar and geothermal energy, as well as the demand for electricity are considered for the forecasting analysis. The authors used three main modern classifications of forecasts: machine learning algorithms, ensemble approaches and artificial neural networks. These approaches are investigated for their applicability in forecasting, spatial and temporal forecasting accuracy, and relevance to policy and planning goals (Ahmad et al., 2020).

Adaptive models of financial and economic processes were proposed by the authors, the study of which was useful to us when selecting indicators for our financial analysis (Ovcharenko et al., 2022).

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Foued Saadawi (2024) proposed a segmented multifractal analysis of trend deviations to assess the inefficiency of North African stock markets.

The proposed method, an adapted version of multifractal trendless fluctuation analysis (MF-DFA), combines wavelet-based change point detection to identify and separate the two most dynamically changing phases. Subsequent multifractal measurements are made for each of these identified intervals. Focusing on three stock indices - the Egyptian Stock Exchange Index (EGX30), the Moroccan All Share Index (MASI) and the Tunisian Stock Index (Tunindex) - which collectively represent the financial and economic landscape of North Africa, the empirical results show significant asymmetric multifractality of the two indices. These results prompt to study the impact of major events on financial market efficiency. The segmented multifractal analysis proposed by the author represents a new approach to studying the dynamics and resilience of markets, contributing to a deeper understanding of their complex behaviour and reactions to various changes (Saadaoui, 2024).

Financial aspects of management accounting and finances of the subject of the national economy in the conditions of globalization, the indicators of which are used in the authors' article, are useful for our research (Zhyvko et al., 2022).

Generalization of approaches to defining the essence of market conditions, identification of the main tasks of market research and approaches to their implementation are the basis for the market analysis of the renewable energy market of Ukraine in the context of changes in financial and economic processes.

AIMS AND OBJECTIVES

The purpose of the article is to analyze the market conditions of the renewable energy market of Ukraine in the context of changes in financial and economic processes. In accordance with this goal, the following tasks were set and solved:

- to determine the peculiarities of conducting an opportunistic analysis of the renewable energy market of Ukraine in the context of changes in financial and economic processes;
- to analyze the dynamics of electricity production in Ukraine, billion kWh;
- to determine the share of alternative energy sources in the structure of electricity production for 2017-2024 and to build trend lines;
- to analyze seasonality in the renewable energy market;
- to analyze the correlation between electricity production in Ukraine, billion kWh, and all market-forming factors;
- to determine the stability (fluctuations) of market development;
- to analyze exports, imports and capacity of the electricity market in Ukraine, billion kWh;
- to make a forecast of statistical data for 2023-2024 due to their absence during the war.

METHODS

Thus, market analysis involves a comprehensive, interconnected characterization of the state of the market as a whole and its individual elements and parts. The methodology of market analysis consists of six stages:

1. Defining the object of market analysis.
2. Collecting and processing market information.
3. Assessing the peculiarities of the market under study, identifying the behaviour of market players.
4. Assessment and analysis of the market potential and key proportions.
5. Identifying the main trends in market development, its fluctuations, seasonality, and cyclicality.
6. Forecast of the market situation.

The most accurate analysis is provided by quantitative measurements of the market situation.

The dynamics of the financial and economic process can be described by a number of economic indicators based on a certain effective multidimensional function:

$$Y = f(x_1, x_2, x_3 \dots x_n)$$

where Y - is the value of the performance indicator that describes the dynamics of an economic process or system; x_i $(i = 1, \dots n)$ - market-forming factors that affect the dynamics of the process.

For the market analysis of the renewable energy market in the context of changes in financial and economic processes, the value of the performance indicator is Y we select a set of statistics on electricity production in Ukraine, billion kWh (State Statistics Service of Ukraine, 2024).

The quality of the analysis and forecast of market conditions depends on the choice of market-forming factors that reflect the state of the market. It is necessary to take into account their conditionality and relativity in determining the size and strength of their impact on the development of the electricity market in Ukraine in the context of changes in financial and economic processes.

The main classification criteria for identifying groups of market-forming factors are (Babukh et al., 2021):

1. Relationship to the economic cycle of reproduction (cyclical, non-cyclical);
2. Duration (short-term, medium-term, long-term);
3. Relevance to the object under study (endogenous, exogenous);
4. Belonging to different aspects of the market mechanism (production, consumer);
5. Predictability (deterministic, stochastic);
6. Controllability (adjustable, non-adjustable);
7. Directionality of impacts (stimulating, restraining, neutral);
8. Closeness of connection (direct, indirect);
9. Nature of origin (scientific and technical, technical and economic, socio-economic, military and political, state and legal, natural);
10. Nature of the information (quantitative, qualitative scale);
11. Homogeneity of dynamics (simple stationary, quantitative stationary, evolutionary, chaotic).

Based on the classification features, we will define the medium-term, endogenous, production, deterministic, regulated, direct, quantitative market-forming factors of the electricity market in Ukraine in the context of changes in financial and economic processes (Table 1):

- x_1 - electricity generation of thermal power plants (TPP);
- x_2 - electricity generation of hydroelectric power plants (HPP);
- x_3- electricity generation power of combined heat and power plants (CHP) and cogeneration units (CU);
- x_4- electricity generation of pumped-storage hydroelectricity plants (PSH);
- x_5- electricity generation of nuclear power plants (NPP);
- x_6- electricity generation of checkpoints;
- x_7- electricity generation renewable energy sources (wind farms, solar power plants, biomass).

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Table 1. Market-forming factors of the electricity market in Ukraine in the context of changes in financial and economic processes. Note: 2023*,2024* - statistical data are projected using the moving average method due to the lack of statistical data during the war. *(Source: elaboration of the authors)*

Year	Electricity generation, billion kWh Y	TPP x_1	HPP x_2	CHP and CU x_3	PSH x_4	NPP x_5	Check-points x_6	RES (wind farms, solar power plants, bio-mass) x_7	Smoothed values of electricity generation, billion kWh $\hat{Y}$
2015	157.7	49.4	6.1	5.2	1.6	87.6	6.2	1.6	157.5
2016	154.8	49.9	6.7	7.5	1.6	81	6.6	1.6	154.9
2017	155.4	45	10.9	9	1.6	85.6	1.5	1.9	157. 2
2018	159.4	47.8	11	10.4	1.6	84.4	1.5	2.6	158.1
2019	154	44.9	10.9	6.5	1.3	83	1.8	5.5	153.8
2020	148.9	39.6	12.8	6	1.6	76.2	1.8	10.9	148.7
2021	156.6	37.2	8.6	9.2	1.3	86.2	1.6	12.5	156.4
2022	113.5	24.3	5.8	9.7	1.3	62.2	0.7	9.5	113.2
2023*	130.113	38.7	9.8	8.36	1.42	60.4	38.76	9.82	129.1
2024*	126.273	36.9	9.5	7.952	1.384	56.2	36.952	9.584	127.7

We will use descriptive and analytical methods to process and group the collected data. Analytical methods that can be used in the process of assessing market conditions include:

- summarizing and grouping (classification of phenomena and processes, causes and factors that determine their change and development);
- analysis of dynamics series (growth rates, growth, average sizes of market indicators);
- the method of relative and average values (comparison of momentary characteristics of the market);
- correlation and regression analysis (building multifactor models of elasticity of demand from marketing agents);
- variation and dispersion analysis (analysis of market price variation);
- index method (building multiplicative and additive turnover models);
- analytical alignment (identifying the main trends in the development of market parameters, their stability and cyclicality).

RESULTS

Let's plot the dynamics of electricity production in Ukraine, billion kWh (Figure 1). The aggregated data show that the amount of renewable energy (wind, solar, biomass) produced in Ukraine is constantly growing. In 2015, it amounted to 1.6 billion kWh and increased almost 5 times in 2023 to 9.8 billion kWh.

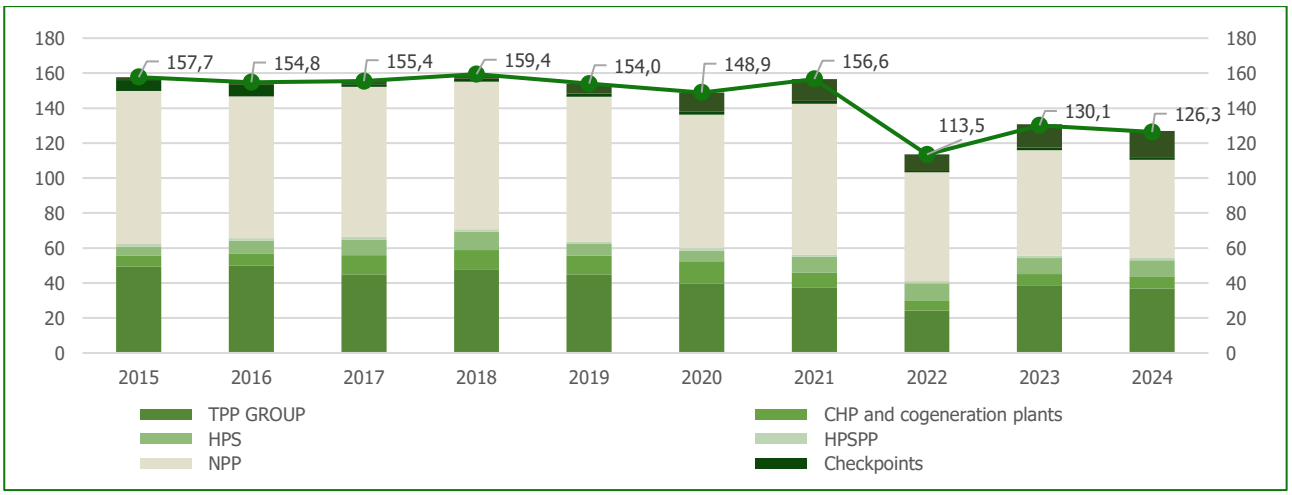

Figure 1. Dynamics of electricity production in Ukraine, billion kWh.

To analyze the series of dynamics of electricity production in Ukraine, let's use the Descriptive Statistics function from the analysis package of Excel (Table 2).

Table 2. Analysis of the series of electricity generation dynamics in Ukraine.

	Electricity generation, billion kWh	TPP	HPP	CHP and CU	PSH	NPP	Checkpoint	RES
Mean	145.67	41.38	8.55	8.23	1.44	78.48	2.47	6.55
Standard Error	5,12	2.46	0.83	0.57	0.05	2.78	0.66	1.38
Median	154.40	42.25	7.65	9.10	1.45	82.00	1.55	7.50
Mode	-	-	10.90	-	1.60	-	1.50	1.60
Standard Deviation	16,21	7.76	2.62	1.79	0.17	8.80	2.10	4.35
Sample Variance	262,64	60.27	6.85	3.21	0.03	77.44	4.40	18.91
Kurtosis	-0.03	1.51	-1.67	-1.15	-2.38	-0.68	1.31	-2.02
Skewness	-1.19	-1.09	0.42	-0.64	-0.08	-0.82	1.69	-0.04
Range	45.90	25.60	7.00	5.20	0.39	25.40	5.90	10.90
Minimum	113.50	24.30	5.80	5.20	1.21	62.20	0.70	1.60
Maximum	159.40	49.90	12.80	10.40	1.60	87.60	6.60	12.50
Sum	1456.69	413.81	85.54	82.31	14.37	784.77	24.66	65.50
Count	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00

We have thirteen statistical indicators that provide information about the average value of the series, standard error, median, variance, skewness, maximum and minimum values, standard deviation, and more. To visualize them, let's build a chart (whisker chart) (Figure 2).

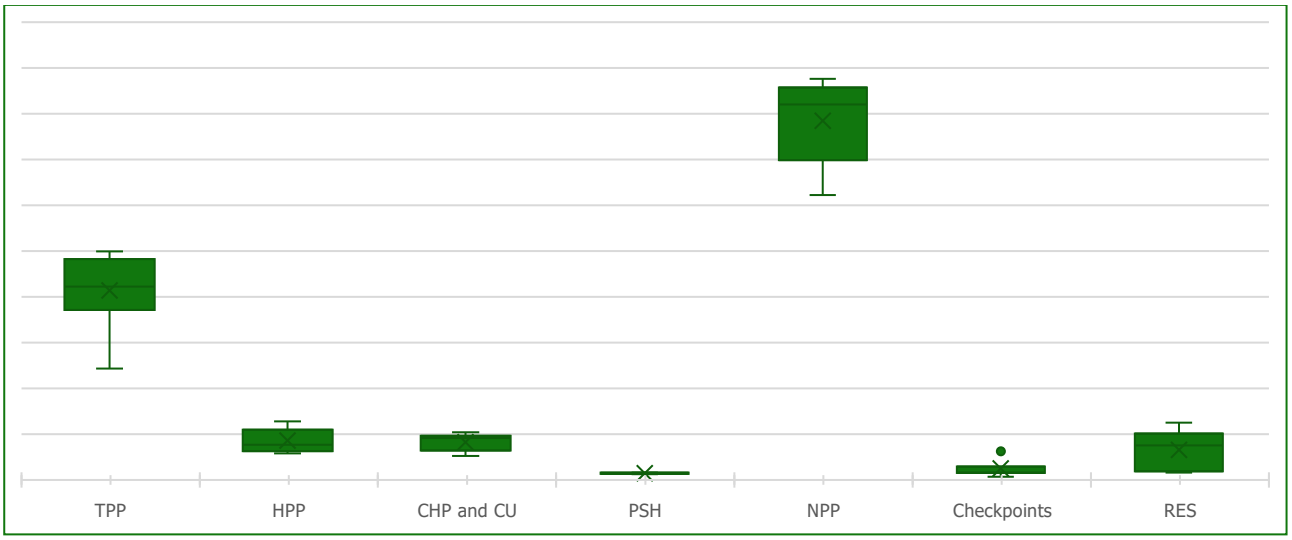

Figure 2 Analysis of the series of electricity generation dynamics in Ukraine, billion kWh.

The visualization of statistical indicators shows that renewable energy sources occupy the third position, along with CHP and CU and HPP. The average value of RES production in Ukraine over the past 10 years is 6.55 billion kWh, the median value (the average value of the sample ranked in ascending order) is 7.5 billion kWh, the modal value (the value that occurs most often in the set of observations) is 1.6 billion kWh. kWh, the minimum and maximum values are 1.6 billion kWh and 12.5 billion kWh, the standard deviation (characterizing the dispersion of values around the distribution centre) is not high at 4.3 billion kWh, so there are no strong deviations in the RES market.

Let's determine the share of renewable energy sources in the structure of electricity production for 2017-2024 (Figure 3) (Share of electricity production from renewable energy sources, 2022).

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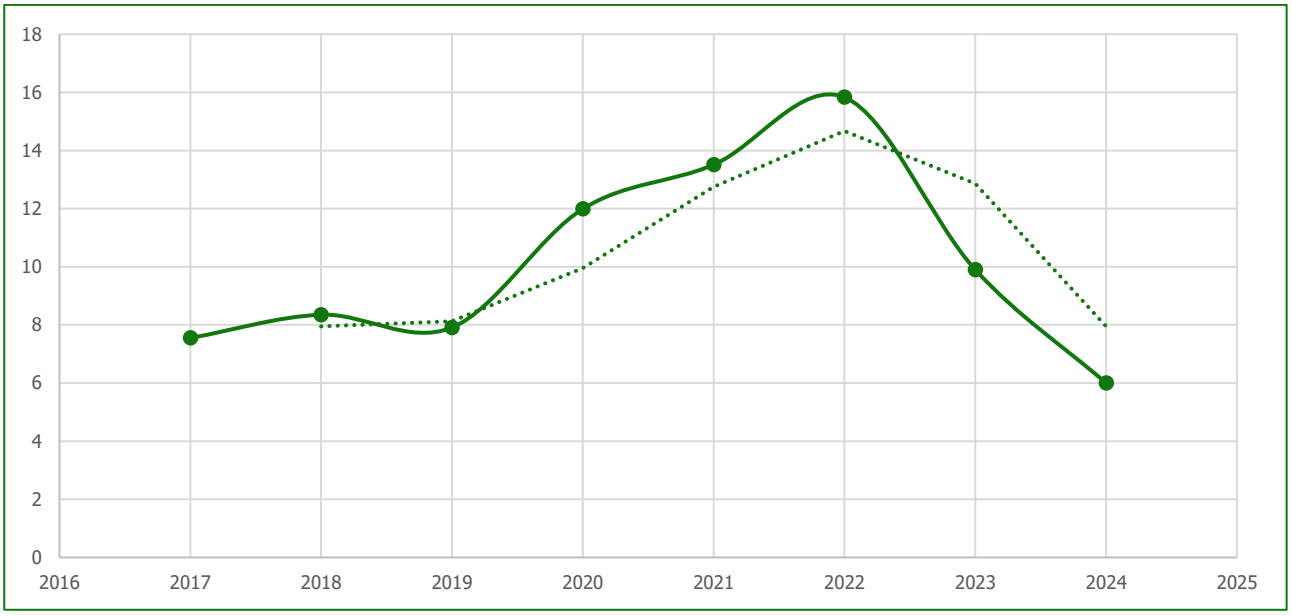

Figure 3. Share of renewable energy sources in the structure of electricity generation in 2017-2024.

The trend line shows a steady increase in the share of renewable energy sources in the structure of electricity production.

To analyze the seasonality in the renewable energy market, we will analyze the share of alternative energy sources in the structure of electricity production for 2023-2024 on a monthly basis (Figure 4).

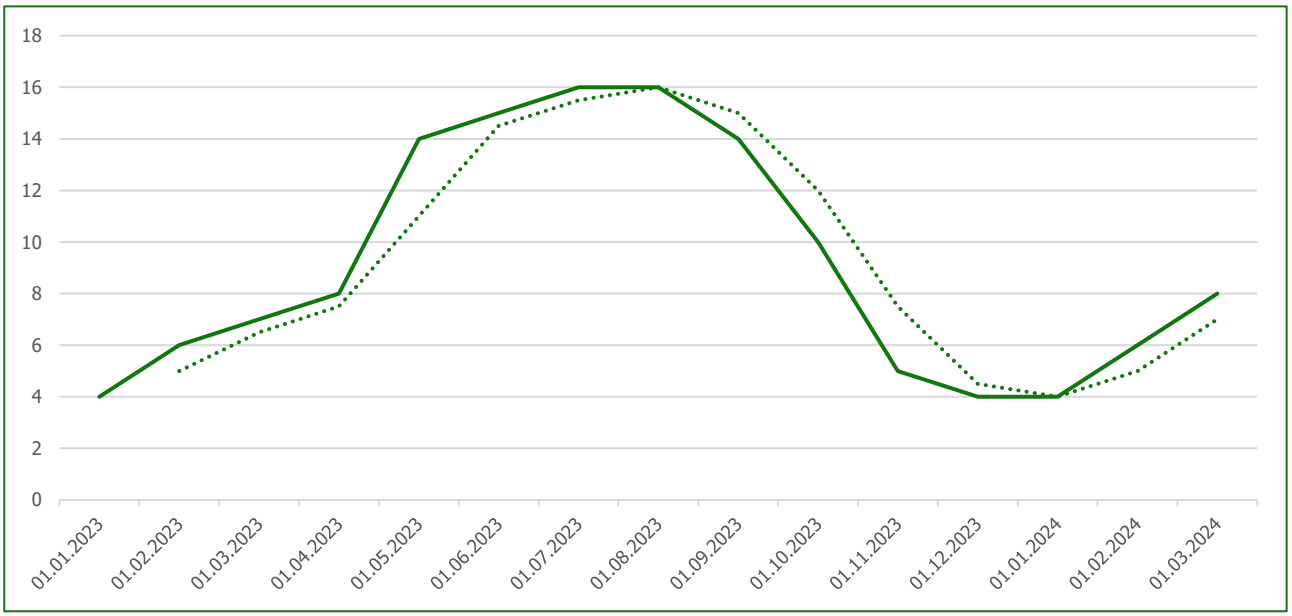

Figure 4. Monthly analysis of the share of renewable energy sources in the structure of electricity generation in 2023-2024.

The share of renewables in the structure of electricity generation in March 2024 reached 8%, which is 2 pp higher than in February 2024. Thus, the monthly analysis of the share of renewables in the structure of electricity generation for 2023-2024 shows a clear seasonality in the market.

Let's build a linear multivariate regression model using the function.

Regression from the Excel analysis package (Table 3).

Table 3. Linear multivariate regression model.

Regression Statistics								
Multiple R	0.998909							
R Square	0.99782							
Adjusted R Square	0.990188							
Standard Error	1.605298							
Observations	10							
ANOVA								
	df	**SS**	**MS**	**F**	**Signifi-cance F**			
Regression	7	2358.581	336.9401	130.75	0.007611			
Residual	2	5.15396	2.57698					
Total	**9**	**2363.735**						
	Coeffi-cients	**Standard Error**	**t Stat**	**P-value**	**Lower 95%**	**Upper 95%**	**Lower 95.0%**	**Upper 95.0%**
Intercept	-1.08922	12.02688	-0.09057	0.936092	-52.8367	50.65827	-52.8367	50.65827
TPP	0.206556	0.207481	0.995539	0.42437	-0.68616	1.099275	-0.68616	1.099275
HPP	2.417035	0.651233	3.711473	0.065539	-0.385	5.219065	-0.385	5.219065
CHP and CU	1.353591	0.547157	2.473862	0.131844	-1.00064	3.707818	-1.00064	3.707818
PSH	-3.33705	7.500503	-0.44491	0.699902	-35.6091	28.93501	-35.6091	28.93501
NPP	1.285405	0.109505	11.7383	0.007179	0.814242	1.756568	0.814242	1.756568
Checkpoint	3.009064	1.019168	2.952471	0.098123	-1.37606	7.394191	-1.37606	7.394191
RES	0.442043	0.251622	1.756772	0.221037	-0.6406	1.524687	-0.6406	1.524687

So, the linear multivariate regression equation is as follows:

$$Y = -1{,}1 + 0.21 * x_1 + 2.41 * x_2 + 1.35 * x_3 - 3.34 * x_4 + 1.28 * x_5 + 3.09 * x_6 + 0.44 * x_7$$

The results show that the multiple correlation coefficient is 0.9982, which indicates a high total correlation between the variable Y - a set of statistical data on electricity production in Ukraine, billion kWh, and all independent market-forming variables x_i (i=1...7).

The coefficient of determination of 0.9965 is also close to 1, indicating the overall high quality of the model.

The calculated Fisher's coefficient is higher than the tabulated one, so the model corresponds to real data and is adequate.

The stability (fluctuations) of market development over time is manifested in the nature of deviations of actual levels of development from the main trend.

The stability (fluctuations) of the market development in time (K_α) will be measured by the approximation coefficient (from the Latin approximare - to approach).

$$K_\alpha = \frac{100}{\overline{Y}} \sqrt{\frac{\sum_{i=1}^{n}(Y_i - \hat{Y}_i)^2}{n}},$$

where K_α - stability (fluctuations) of the electricity generation market in Ukraine over time; $\overline{Y_i}$ - is the average value of the dynamic series of electricity generation, billion kWh; Y_i -i-th level of the dynamic series of electricity production, billion kWh; $\hat{Y}_i$ - i-th level of the dynamic smoothed series of electricity generation, billion kWh; n - the number of levels of the dynamic series.

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This indicator, which varies between 100% and 0, reflects the level of sustainability of market development. Stability (fluctuations) of the RES market development in Ukraine $K_\alpha = 62\%$is equal to 1.0, which indicates a fairly stable development.

Let us analyze the correlation between the variable Y - a set of statistics on electricity production in Ukraine, billion kWh, and all independent variables x_i (Table 4). Let's use the Correlation function from the Excel Analysis Package. The correlation between electricity generation, billion kWh, and RES is 0.64 and is quite significant.

Table 4. Matrix of correlation dependence.

	Electricity generation, billion kWh
Electricity generation, billion kWh	1
TPP	0.84
CHP and CU	0.546
HPP	0.41
PSH	0.66
NPP	0.972
Checkpoints	0.439
RES	0.64

Let us estimate the market capacity (E_{MC}) by the formula (Figure 5):

$E_{MC} = HB + I - E$,

where E_{MC} - market capacity; HB - the volume of national production; I - import volume; E - export volume.

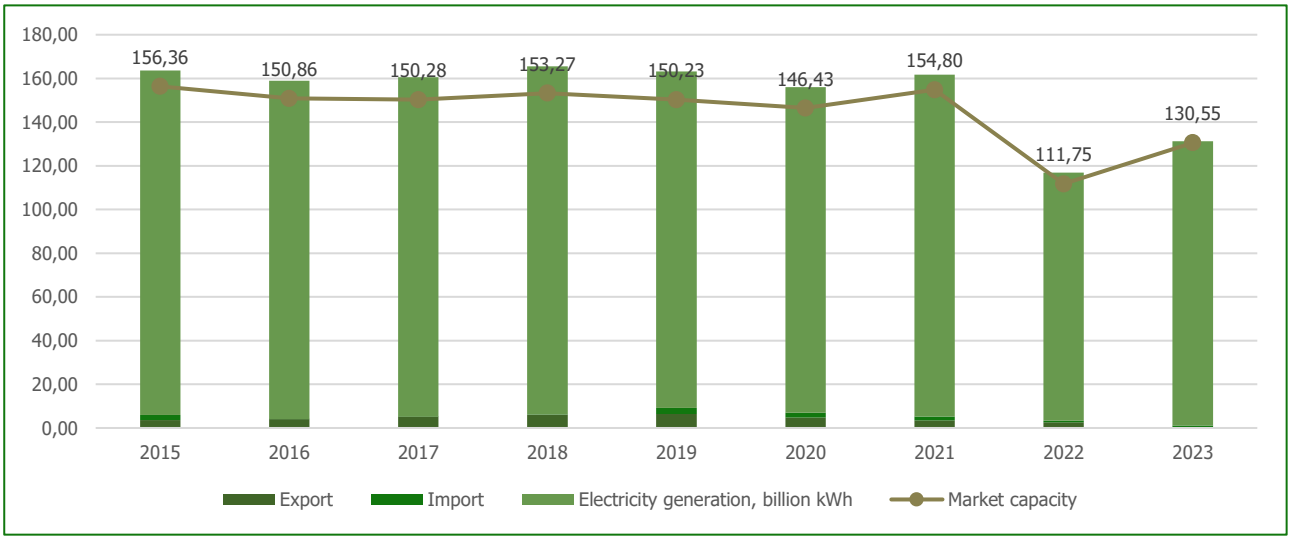

Figure 5. Capacity of the Ukrainian electricity market, billion kWh.

Market capacity reflects the volume of sales of goods over a specific period of time. It is determined by the number of consumers in the market, their purchasing power and propensity to exchange. Market capacity is determined by the size of consumer demand and the size of supply. The capacity of the Ukrainian electricity market, billion kWh (Figure 6), averages 144.95 billion kWh.

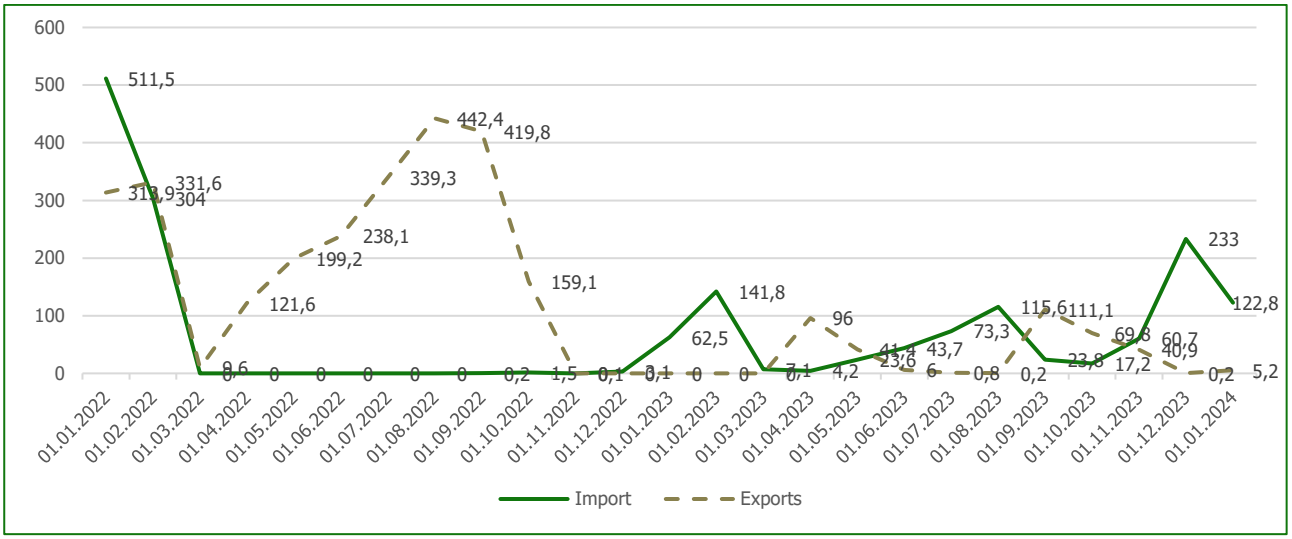

Figure 6 Electricity exports and imports in 2022-2023 in Ukraine, thousand MWh

However, the situation with electricity exports and imports in Ukraine in 2022-2023 was extremely volatile due to Russia's military aggression against Ukraine (Figure 6). The energy sector has become one of the main targets of the aggressor. In 2022, Ukraine's power system was disconnected from the power systems of Russia and Belarus and synchronized with the united European power system ENTSO-E.

Russia continues to deliberately destroy Ukraine's energy infrastructure, targeting energy facilities. Ukraine's energy sector has lost a significant portion of its capacity: more than 50% of thermal, 30% of solar, and 90% of wind generation is out of commission or occupied, and a number of state-owned mines have been shut down. The Zaporizhzhia nuclear power plant is under occupation. The Chornobyl NPP was occupied for over a month and looted. Power grids and substations, gas distribution networks are being destroyed (Omelchenko, 2022).

That is why it is not possible to take into account the value of the analytically calculated market capacity indicator when conducting a market analysis of the renewable energy market in Ukraine in the context of changes in financial and economic processes.

DISCUSSION

The study of market conditions traditionally focuses on the analysis of demand and its fluctuations under the influence of major factors. This approach is supported by many authors, who believe that the main market-forming indicator - demand - is sufficient to analyze dynamic and variation processes in the market (Okrepkyi R.B., Gargula D.V., 2013). The proposed models of multiplicative trend modelling of demand include absolute values of demand, relative values of seasonal fluctuations in demand and relative values of random fluctuations in demand (Okrepkyi R.B., Gargula D.V., 2013).

However, in our opinion, in the current environment, especially during the changes in financial and economic processes caused by the full-scale invasion, it is not enough to limit oneself to demand assessment. The renewable energy market is complex and multifaceted, and a wider range of factors must be taken into account for an adequate market analysis. In our opinion, such factors may include the growth rate of electricity production from RES, the share of RES in the country's overall energy balance, investments in renewable energy, the number of new RES projects, the number of commissioned RES facilities, tariff and regulatory conditions for RES, and infrastructure capacities for integrating RES into the energy system.

In addition, the calculation of market capacity, which includes: production; imports and exports, is too simplified and inaccurate (Andreichenko A.V., Gorbachenko S.A., Grinchenko R.V., Karpov V.A., Kucherenko V.R.). In our opinion, the market capacity calculated by this formula does not take into account the volatility of the situation with electricity exports and imports in Ukraine in 2022-2023 and may not reflect its potential value.

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CONCLUSIONS

Thus, the market analysis of the renewable energy market of Ukraine in the context of changes in financial and economic processes is proposed to be carried out using a system of economic indicators that quantify qualitative changes and allow making a forecast. The medium-term, endogenous, production, deterministic, regulated, direct, quantitative market-forming factors of the renewable energy market in Ukraine in the context of changes in financial and economic processes are electricity generation by TPPs of the GC; electricity generation by HPPs; electricity generation by CHPs and cogeneration plants; electricity generation by PSPs; electricity generation by NPPs, electricity generation by power plants, electricity generation by RES (wind, solar, biomass).

The system of indicators characterizing the market conditions includes those that adequately and promptly reflect the main directions, changes, trends and rates of development of the renewable energy market of Ukraine in the context of changes in financial and economic processes and are least affected by random, uncontrollable and unpredictable factors during the military aggression against Ukraine. The classic form of market conditions is the ratio of supply and demand and price dynamics. However, the use of energy prices as market factors in the renewable energy market in Ukraine in the context of changes in financial and economic processes, during a full-scale invasion is not adequate. The established prices are not market-based and are controlled by the state.

The proposed system of market factors makes it possible to analyze both general processes and identify the peculiarities of the development of individual processes. Along with general data, namely electricity production in Ukraine, billion kWh, less aggregated indicators are analyzed.

For the purpose of the market analysis, the statistical data for 2023-2024 are forecasted using the moving average method due to the lack of statistical data during the war.

The proposed market analysis includes the following stages: analysis of the dynamics of electricity production in Ukraine, billion kWh, which includes the definition of thirteen statistical indicators and their visualization; determination of the share of alternative energy sources in the structure of electricity production for 2017-2024 and construction of a trend line; analysis of seasonality in the renewable energy market; construction of a linear multivariate regression model; analysis of the correlation between electricity production in Ukraine, billion kWh and all the market-forming factors; determining the stability (fluctuations) of market development; analysis of exports, imports and capacity of the electricity market in Ukraine, billion kWh.

The market analysis of the renewable energy market in Ukraine in the context of changing financial and economic processes indicates that further development of renewable energy sources can contribute to the flexibility and sustainability of Ukraine's energy security, significant socio-economic and environmental benefits of the country's post-war reconstruction and its European integration.

Prospects for further research in this area relate to various aspects of market development, including public policy, financial models, technological innovation, and the integration of renewable energy sources (RES) into the country's overall energy system. As Ukraine seeks integration with European energy markets, a promising area of research is:

- analyzing the interaction of the Ukrainian RES market with European markets and the prospects for exporting energy from RES to the EU;
- studying the opportunities for integration of the Ukrainian power system into the pan-European grid (ENTSO-E), taking into account the production of electricity from RES;
- assessing Ukraine's role in fulfilling Europe's climate commitments, in particular within the framework of the European Green Deal.

ADDITIONAL INFORMATION

AUTHOR CONTRIBUTIONS

All authors have contributed equally.

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CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

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КОН'ЮНКТУРНИЙ АНАЛІЗ РИНКУ ВІДНОВЛЮВАНИХ ДЖЕРЕЛ ЕНЕРГІЇ УКРАЇНИ В КОНТЕКСТІ ЗМІН ФІНАНСОВИХ ТА ЕКОНОМІЧНИХ ПРОЦЕСІВ

Економічна диверсифікація шляхом розвитку біоекономіки не тільки сприятиме стійкості економіки України, а й створить нові можливості для її післявоєнного відновлення. Найбільший потенціал біоекономіки України має біоенергетика, а саме відновлювані джерела енергії. В умовах воєнної агресії росії розвиток відновлюваних джерел енергії є одним із ключових факторів забезпечення енергетичної незалежності та енергетичної безпеки України. Тому аналіз ринку відновлюваної енергетики України в контексті змін фінансово-економічних процесів є актуальною науковою проблемою. У статті визначено середньострокові, ендогенні, виробничі, детерміновані, регульовані, прямі, кількісні ринкоутворюючі фактори ринку відновлюваної енергетики в Україні. Класичною формою кон'юнктури ринку є співвідношення попиту й пропозиції та динаміка цін. Однак використання цін на енергоносії як ринкового фактора на ринку відновлюваної енергетики в Україні під час повномасштабного вторгнення є неадекватним. Установлені ціни не є ринковими, їх контролює держава. Тому запропонований у роботі аналіз ринку включає наступні етапи: аналіз динаміки виробництва електроенергії в Україні, млрд кВт/год, що включає визначення тринадцяти статистичних показників та їх візуалізацію; визначення частки альтернативних джерел енергії в структурі виробництва електроенергії на 2017-2024 роки та побудова лінії тренду; аналіз сезонності на ринку відновлюваної енергетики; побудова лінійної багатовимірної регресійної моделі; аналіз співвідношення між виробництвом електроенергії в Україні, млрд кВт/год. З метою аналізу ринку статистичні дані за 2023-2024 роки прогнозуються за методом ковзної середньої через відсутність статистичних даних під час війни.

Ключові слова: біоекономіка, відновлювані джерела енергії, аналіз ринку, ринковоутворюючі фактори, кореляційно-регресійний аналіз

JEL Класифікація: M31, O11, C44, C53