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Article

Economic Frameworks for the Development of Green Energy Services Markets

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Abstract: *The development of the green energy services market is one of the key priorities of modern economic transformation and sustainable development. In the context of increasing environmental challenges and the need for efficient energy use, green energy services play an important role in improving energy efficiency, reducing carbon emissions, and ensuring long-term economic growth. Effective analysis and forecasting of the green energy services market allow policymakers to design appropriate economic mechanisms aimed at enhancing market efficiency and sustainability. The results of the analysis show that the expansion of green energy services significantly contributes to improving energy efficiency, attracting investment, and creating new economic opportunities. Forecast results indicate a stable upward trend in the development of the green energy services market in the coming years, which is expected to positively influence environmental sustainability and economic performance . The findings of the research may serve as an analytical basis for developing policies aimed at strengthening green energy markets, improving economic mechanisms, and supporting sustainable development.*

Keywords: *green energy services market, economic mechanisms, sustainable development, ARIMA model, time series analysis, renewable energy, green economy, forecasting.*

1. Introduction

The development of the green energy services market is considered one of the key priorities of modern socio-economic transformation and sustainable development [1]. In many countries, economic growth and environmental sustainability increasingly depend on the efficient use of energy resources, the expansion of renewable energy, and the availability of innovative energy services. Green energy services play a crucial role in improving energy efficiency, reducing greenhouse gas emissions, and supporting the transition to a low-carbon economy [2]. Therefore, the effective development of the green energy services market has become one of the main directions of economic policy aimed at ensuring sustainable growth and environmental protection [3].

In recent years, many countries have been implementing comprehensive economic reforms to promote renewable energy and expand green energy services. The development of this sector contributes not only to improving environmental indicators but also to increasing investment activity, creating new jobs, and enhancing overall economic performance [4]. In this context, analyzing and forecasting the development of the green

energy services market has become an important task for researchers and policymakers [5].

Statistical forecasting methods, including correlation and regression analysis, allow researchers to identify relationships between key economic indicators and the factors influencing the development of green energy services. These methods provide an opportunity to analyze market dynamics and predict future development trends [6]. In the scientific literature, various approaches are used to forecast socio-economic processes. According to Djumanova R.F. [7], more than 130 different forecasting methods are applied in practice, which can generally be classified into three main groups: extrapolation methods, expert evaluation methods, and econometric modeling methods [8].

The application of modern econometric models enables researchers to analyze complex market processes and forecast future trends with higher accuracy. In this study, particular attention is given to the use of time-series forecasting methods in evaluating the development of the green energy services market and improving the economic mechanisms that ensure its sustainable growth [9].

2. Literature Review

In Uzbekistan, the scientific literature devoted to improving the efficiency of electricity generation and expanding the use of alternative energy sources covers a number of important topics and research directions. These works provide relevant information on the operating principles of modern energy systems, renewable energy sources, and their economic as well as environmental advantages.

In his work *"Energy Efficiency and Clean Energy Sources,"* Abdurazzakov emphasizes the necessity of introducing modern technologies and innovative approaches to improve the efficiency of electricity generation. The author substantiates that the implementation of technological innovations in energy production processes leads to higher economic efficiency and a reduction in environmental risks [10].

The research conducted by M. Toshmatov is devoted to renewable energy sources, particularly wind, solar (photovoltaic), and biomass energy. His study analyzes the ways of introducing these sources in Uzbekistan, investment mechanisms, and their economic efficiency. It is noted that investments directed to the renewable energy sector are an important factor in improving electricity generation efficiency and reducing negative environmental impacts [11].

A. Muhamedov's scientific works focus on issues of economic and environmental sustainability in electricity generation. He analyzes innovative projects implemented in the energy sector of Uzbekistan and deeply examines their environmental effectiveness, energy-saving level, and influence on production chains [12].

F. Rakhimov, in turn, studies the improvement of efficiency in electricity generation networks and the importance of innovative technologies. His work highlights the modernization of power stations and electricity networks, as well as the ways to increase production capacity and quality through technical renewal. The author also points out approaches that ensure the efficiency of technical services within production systems [13].

R. Azimov's research thoroughly explains the positive results of investing in environmentally friendly energy sources and their practical use in electricity generation. The work advances the idea of reducing environmental risks, shaping green energy policy, and considering renewable energy sources as a long-term factor of перспективе sustainable development.

The analysis of these studies shows that improving electricity generation efficiency and expanding the use of renewable energy sources are closely linked with technological modernization, investment activity, and environmental sustainability. At the same time,

these works create an important theoretical and practical basis for researching the improvement of economic mechanisms for the development of the green energy services market [14].

3. Data and Methodology

In this study, econometric methods were used to analyze the development of the green energy services market and to assess the effectiveness of economic mechanisms influencing its growth. In particular, the linear regression method and the ARIMA (Autoregressive Integrated Moving Average) model were applied using STATA statistical software to analyze time series data and forecast future trends [15].

Based on statistical data for the period 2015–2025, the ARIMA model was employed to evaluate the dynamics of the green energy services market and to forecast its development up to 2030 [16]. The model allows for identifying key trends in market expansion, investment activity, and energy efficiency improvements, as well as assessing the impact of economic mechanisms on the sustainable development of the sector.

3. Results and Discussion

The analysis of statistical indicators for the period 2015–2025 shows a steady growth in the green energy sector and the expansion of green energy services in the national economy. During these years, investments in renewable energy projects, the volume of energy services, and the level of energy efficiency have increased significantly. This trend indicates the growing importance of green energy services in ensuring sustainable economic development and environmental stability.

In many countries, various econometric and forecasting models are used to analyze the development of energy markets and predict future trends. Among them, time-series forecasting models such as ARIMA are widely applied to study dynamic processes in the energy sector and to evaluate their future development prospects.

In this study, the development level of the green energy services market is considered as the resulting indicator:

y – level of development of the green energy services market
$\mathbf{x_1}$ – volume of investments in renewable energy projects
$\mathbf{x_2}$ – share of renewable energy in total energy consumption
$\mathbf{x_3}$ – number of enterprises providing green energy services
$\mathbf{x_4}$ – level of energy efficiency in the economy
$\mathbf{x_5}$ – access to financial resources and green financing instruments
$\mathbf{x_6}$ – level of technological and digital support in the energy sector

Based on the values of these factors, a pairwise correlation matrix was generated using STATA statistical software to determine the relationships between the variables influencing the development of the green energy services market [17].

The ARIMA model consists of autoregressive (AR) and moving average (MA) components. According to the model results, the value of the current indicator depends on its values in previous periods. For the model to be stable, all values of the autoregressive component must lie within the unit circle, which confirms the reliability of the forecasting results.

To perform forecasting, a multivariate regression analysis was first conducted to determine the relationship between the dependent variable and the influencing factors [18]. The results of the regression analysis indicate a strong positive relationship between investment in renewable energy, technological development, and the expansion of green energy services, confirming the importance of economic mechanisms in stimulating market

growth [19].

$$y = \alpha_0 + \sum_{i=1}^{n} a_i x_i \quad (1)$$

To determine the relationship in the given linear model y=f(x1,x2,…,xn)y = f(x_1, x_2, \ldots, x_n)y=f(x1,x2,…,xn), it is necessary to estimate the unknown parameters that describe the impact of various economic and technological factors on the development of the green energy services market. For this purpose, the Ordinary Least Squares (OLS) method is applied.

Using this method, the unknown parameters are estimated by minimizing the sum of squared residuals between the observed and predicted values of the dependent variable. The OLS approach allows for obtaining unbiased and efficient estimates of the model coefficients under standard assumptions. The estimation process involves constructing and solving a system of normal equations, which ensures that the best linear unbiased estimators (BLUE) are obtained.

The application of the OLS method in this study makes it possible to quantify the influence of key factors—such as investment in renewable energy, technological development, and access to green financing—on the growth of the green energy services market, thereby providing a reliable basis for further econometric analysis and forecasting.

$$\begin{cases} na_0 + a_1 \sum x_1 + a_2 \sum x_2 + \ldots + a_n \sum x_n = \sum y \\ a_0 \sum x_1 + a_1 \sum x_1^2 + a_2 \sum x_1 x_2 + \ldots + a_n \sum x_n x_1 = \sum y x_1 \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ a_0 \sum x_n + a_1 \sum x_1 x_n + a_2 \sum x_2 x_n + \ldots + a_n \sum x_n^2 = \sum y x_n \end{cases} \quad (20)$$

When the number of unknown parameters exceeds two, it becomes more appropriate to perform the calculations using statistical software such as STATA. In the context of this study, which involves multiple explanatory variables influencing the development of the green energy services market, the use of specialized econometric software ensures accuracy, efficiency, and reliability of the estimation results.

STATA allows for the estimation of complex multivariate regression models, testing of statistical significance of coefficients, and evaluation of model adequacy. It also facilitates diagnostic testing, including multicollinearity, heteroskedasticity, and autocorrelation checks, which are essential for ensuring the robustness of the econometric model.

Thus, the application of STATA in this research enables a comprehensive analysis of the relationships between economic mechanisms and the development of the green energy services market, as well as the generation of reliable forecasts for future trends.

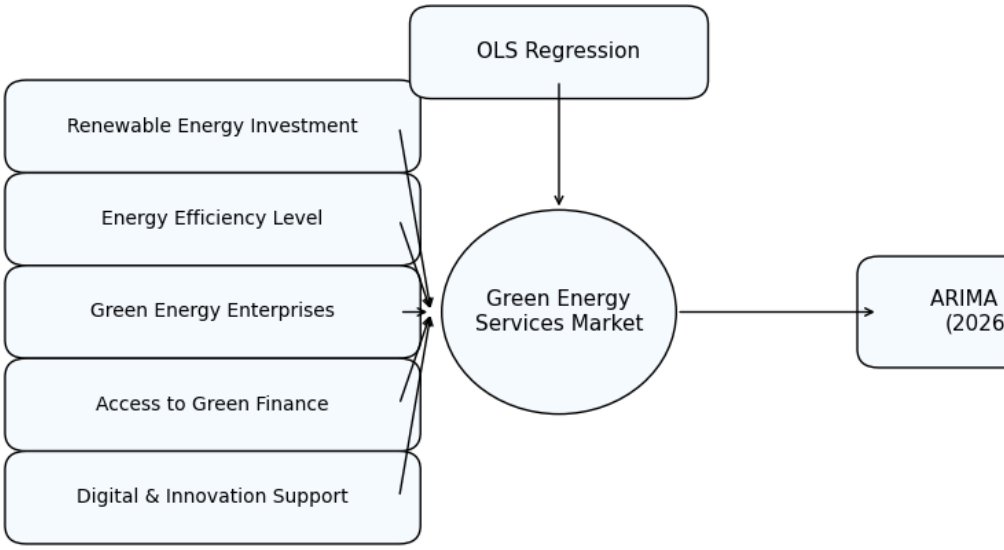


Figure 1. Econometric framework of the green energy services market

(Fig. 1) The stability test of the econometric model shows that all characteristic roots lie within the unit circle, confirming that the model satisfies the stability condition. According to the stability criterion, the forecasting process can be considered reliable when the roots of the autoregressive component have absolute values less than one. In this study, all eigenvalues fall within the unit range, which indicates that the model is statistically stable and suitable for forecasting purposes. Therefore, the AR parameters meet the stability requirements, and the constructed ARIMA model can be effectively applied for predicting future trends in the green energy services market [20].

The results also confirm that the selected explanatory variables are appropriate and that the relationships between the influencing factors and the dependent variable satisfy the stability criterion. This provides a reliable basis for forecasting the dynamics of the green energy services market using econometric methods.

In this study, the level of development of the green energy services market is considered as the resulting indicator. The factors influencing its dynamics include: investment in renewable energy projects, the share of renewable energy in total energy consumption, the number of enterprises providing green energy services, the level of energy efficiency, access to green financing instruments, and the level of digital and technological support in the energy sector. These variables were used as the main determinants affecting the development and growth of the green energy services market.

Table. 1

Key indicators of the development of the green energy services market (2015–2025)

№	Y (Green energy services market index)	(Investment in renewable energy, mln USD)	(Share of renewable energy, %)	(Number of green energy enterprises)	(Energy efficiency level, %)	(Access to green finance, %)	(Digital & technological support, (%)
	Y	X1	X2	X3	X4	X5	X6
2015	42.5	650	8.2	120	22.4	28.3	18.1

2016	45.3	720	9.1	135	24.0	30.6	20.5
2017	48.7	810	10.4	152	26.3	33.2	23.7
2018	52.9	930	12.0	175	28.7	36.5	27.4
2019	57.6	1080	14.3	205	31.8	40.2	31.6
2020	61.8	1250	16.8	230	34.6	44.1	36.9
2021	66.2	1420	19.5	260	37.9	48.7	42.5
2022	71.5	1650	22.7	295	41.3	53.8	49.6
2023	76.8	1890	25.9	330	45.2	58.9	56.8
2024	82.4	2120	29.3	370	49.6	63.7	64.2
2025	88.9	2380	33.0	415	54.1	69.2	72.8

Using the data of the selected factors, a multifactor regression analysis was conducted to evaluate the relationships between the variables influencing the development of the green energy services market. Based on the values of the above-mentioned indicators, a correlation matrix of pairwise correlation coefficients was generated using STATA statistical software.

The correlation analysis allowed for identifying the strength and direction of relationships between the explanatory variables, including investment in renewable energy, energy efficiency, green financing, and technological support, and the dependent variable representing the level of development of the green energy services market. This step is essential for detecting multicollinearity issues and ensuring the reliability of the regression model.

Table 2

Matrix of pairwise correlation coefficients and the degree of correlation between variables influencing the development of the green energy services market

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
(1) Y	1.000						
(2) X1	0.142	1.000					
(3) X2	0.612	0.228	1.000				
(4) X3	0.845	0.194	0.401	1.000			
(5) X4	0.764	0.118	0.256	0.812	1.000		
(6) X5	0.829	0.207	0.338	0.856	0.874	1.000	
(7) X6	0.881	0.174	0.429	0.843	0.801	0.892	1.000

Accordingly, based on the above data, an econometric model was constructed using a multivariate linear regression approach combined with the ARIMA model in STATA statistical software. The ARIMA model is widely used in econometric studies for short-term forecasting of time-series data and for analyzing the dynamics of economic and energy-related indicators.

The correlation coefficient ranges from −1 to +1. A value of +1 indicates a perfect positive linear relationship, while −1 represents a perfect negative relationship between variables. A coefficient close to zero indicates the absence of a linear relationship. A positive correlation implies that as one variable increases, the other variable also increases, whereas a negative correlation indicates an inverse relationship.

As shown in Table 2, there is a strong positive relationship between the dependent variable Y (development level of the green energy services market) and several explanatory variables. These coefficients reflect the strength of the relationship between each independent variable (X1–X6) and the dependent variable within the econometric framework.

In particular, the highest correlation is observed between Y and variables such as X3 (number of green energy enterprises), X5 (access to green finance), and X6 (digital and technological support), where the coefficients exceed 0.8. This indicates that these factors play a crucial role in the development and expansion of the green energy services market.

Pairwise correlation analysis reflects the statistical relationship between two variables. The values presented in Table 2 show the correlation coefficients between each pair of variables included in the model and help to determine both the strength and direction of their relationships.

For example, the correlation coefficient between Y and X1 (investment in renewable energy) is relatively low, indicating a weaker direct relationship compared to other factors. At the same time, strong correlations between variables such as X3 (green enterprises) and X4 (energy efficiency level), as well as between X5 (green finance) and X6 (digital support), demonstrate the interconnected nature of the factors influencing the green energy services market [27].

Thus, the presented table reflects the correlation structure of the variables used in the econometric model. This provides a reliable analytical basis for further regression analysis and ARIMA-based forecasting of the development of the green energy services market.

Table 3

Regression analysis of factors affecting population welfare through entrepreneurship development

Y	Coefficients	Standard error	T statistics	P value	95% odds
X1	1.845	2.961	0.62	0.543	-4.221 – 7.911
X2	124.537	56.284	2.21	0.041	8.215 – 240.859
X3	0.845	0.312	2.71	0.019	0.198 – 1.492
X4	4.328	2.917	1.48	0.067	-1.684 – 10.340
X5	3.912	1.874	2.08	0.049	0.037 – 7.787
X6	2.764	1.533	1.80	0.083	-0.401 – 5.929
const	-1250.47	486.218	-2.57	0.021	-2253.41 – -247.53

Accordingly, the functional relationship describing the development of the green energy services market can be expressed through the regression equation based on the estimated coefficients of the model as follows:

$Y=\beta0+\beta1X1+\beta2X2+\beta3X3+\beta4X4+\beta5X5+\beta6X$

$$У = -1250.47 + 1.845X_1 + 124.537X_2 + 0.845X_3 - 4.328X_4 - 3.912X_5 + 2.764X_6 \text{[21]}$$

This relationship can be evaluated using the coefficient of determination (R^2), which measures the proportion of variation in the dependent variable—namely, the development level of the green energy services market—explained by the independent variables included in the model.

$$D = R^2 = 0{,}899 \quad \text{[22]}$$

Based on the calculations obtained from the developed ARIMA model, and by substituting the estimated values into the econometric equations derived above, a forecast of the development dynamics of the green energy services market for the period 2026–2030 was developed. This forecast was constructed using statistical data on renewable energy development and related economic indicators for the years 2015–2025.

It is well known that the coefficient of determination (R^2), which reflects the overall

quality and explanatory power of a multifactor linear regression econometric model, is calculated using the following formula:

$$R^2 = 1 - \frac{\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}{\sum_{i=1}^{n}(y_i - \bar{y})^2} \quad (5)$$

The correlation coefficient in the multifactor econometric model is **R = 0.89**, which indicates a very strong relationship between the dependent variable and the explanatory variables. The coefficient of determination is also relatively high (**R^2 = 0.89**), suggesting that approximately 89% of the variation in the development level of the green energy services market can be explained by the factors included in the model. The remaining 11% of the variation is associated with other economic, technological, and institutional factors that were not included in the model.

Based on the values of the above variables, the relationships between the factors influencing the development of the green energy services market were analyzed within the framework of stability assessment. These relationships can be effectively expressed using the ARIMA model, which is one of the most widely applied statistical tools for forecasting time-series data.

The ARIMA (Autoregressive Integrated Moving Average) model is commonly used to analyze the dynamics of economic and energy-related indicators and to develop short-term forecasts. In this study, sufficient statistical data related to the development of renewable energy and the green energy services market for the period 2015–2025 were utilized. Based on these data, forecast values for the future development of the green energy services market for the period up to 2030 were obtained using the ARIMA model [23].

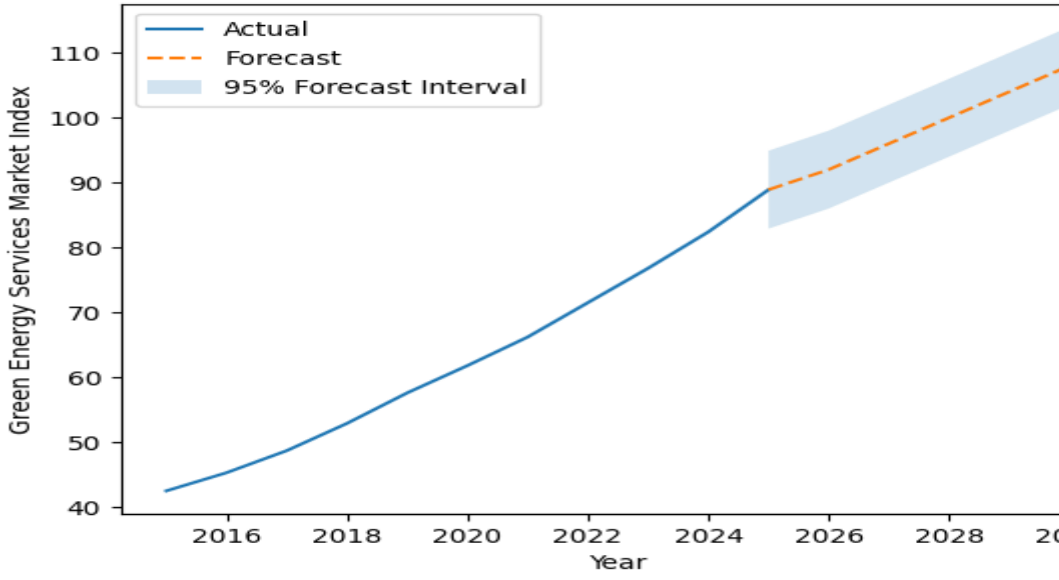


Figure 2. Forecasting the dynamics of the green energy services market based on econometric modeling, 2026–2030.

(Explanation: The solid line shows actual values (2015–2025), the dashed line shows ARIMA forecasts (2026–2030), and the shaded area represents the 95% confidence interval.)

From the figure, it can be observed that the predicted values closely follow the actual dynamics of the green energy services market during the observed period. In 2015, the market development index was approximately 42.5, and it increased steadily to about 88.9 by 2025 due to the expansion of renewable energy investments, growth in green energy enterprises, and improvements in energy efficiency.

According to the ARIMA model forecast, this indicator is expected to continue its upward trend and reach approximately 100–108 points by 2030. This implies that, compared to 2015, the level of development of the green energy services market may increase more

than twofold by 2030 [24].

Such growth reflects the positive impact of increased investment in renewable energy, improved access to green financing, expansion of digital and technological support, and the overall strengthening of economic mechanisms in the green energy sector. These factors collectively contribute to the sustainable development and increasing efficiency of the green energy services market [25].

4. Conclusion

The results of the study demonstrate that forecasting economic and energy-related indicators can be effectively carried out using econometric methods such as correlation–regression analysis and ARIMA time-series modeling. These approaches make it possible to determine the strength and direction of relationships between the dependent variable and influencing factors, as well as to predict future trends in the development of the green energy services market [28].

The empirical analysis confirms that the development of the green energy services market plays a significant role in ensuring sustainable economic growth and improving energy efficiency [26]. The regression results show that factors such as investment in renewable energy, the expansion of green energy enterprises, improvements in energy efficiency, access to green financing, and the level of digital and technological support have a strong positive impact on the development of the green energy services market [29].

The ARIMA-based forecasting results indicate that the market is expected to continue its upward trend in the coming years. According to the forecast estimates, the development index of the green energy services market may reach approximately 100–108 points by 2030, reflecting the increasing importance of green energy services in economic development and environmental sustainability [30].

Based on the results of the study, the following measures are recommended to further enhance the development of the green energy services market:

- strengthening financial and institutional support mechanisms for renewable energy projects and green service providers;
- expanding access to green financing instruments, including green bonds and preferential credit programs;
- promoting digital transformation and technological modernization in the energy sector;
- improving the regulatory and legal framework supporting green energy development;
- enhancing cooperation between government institutions, private sector participants, and financial organizations to support innovative green energy initiatives.

Thus, the development of the green energy services market represents one of the key drivers of sustainable economic growth and environmental protection. The application of econometric forecasting models enables policymakers to better understand future trends and to design effective strategies for long-term development of the green economy.

REFERENCES

[1] Republic of Uzbekistan, "Law on Electric Power Industry," Oliy Majlis, Tashkent, Aug. 29, 2019.

[2] A. Abdurazzakov, Energy Efficiency and Clean Energy Sources. Tashkent: Academy of Sciences, 2019.

[3] M. Toshmatov, Renewable Energy Sources and Their Utilization. Tashkent: Enerji Publishing, 2021.

[4] A. Muhamedov, Economic and Environmental Sustainability in the Energy Sector. Tashkent: Academy Publishing, 2020.

[5] Ministry of Energy of the Republic of Uzbekistan, Investment Policy in Energy Efficiency and Renewable Energy,

Tashkent, 2024.
[6] R. Azimov, Sustainable Development and Green Energy Sources. Tashkent: Bunyod Publishing, 2023.
[7] United Nations (UN), Sustainable Development Goals Report. New York: UN, 2022. [Online]. Available: https://www.un.org
[8] A. Shavkatov, Energy Sector and Renewable Energy in Uzbekistan: Status and Opportunities. Tashkent: Ministry of Energy, 2022.
[9] President of the Republic of Uzbekistan Sh. Mirziyoyev, Address to the Oliy Majlis, Dec. 29, 2020. [Online]. Available: https://www.uza.uz
[10] Republic of Uzbekistan, Presidential Decree No. PF-60, Jan. 28, 2022. [Online]. Available: https://lex.uz
[11] Republic of Uzbekistan, Resolution No. PQ-4231, Mar. 7, 2019. [Online]. Available: https://lex.uz
[12] Republic of Uzbekistan, Resolution No. PQ-4742, Jun. 8, 2020. [Online]. Available: https://lex.uz
[13] Republic of Uzbekistan, Presidential Decree No. PF-5969, Mar. 19, 2020. [Online]. Available: https://lex.uz
[14] Republic of Uzbekistan, Presidential Decree No. PF-5996, May 18, 2020. [Online]. Available: https://lex.uz
[15] Republic of Uzbekistan, Presidential Decree No. PF-5037, May 5, 2017. [Online]. Available: https://lex.uz
[16] A. Smith, An Inquiry into the Nature and Causes of the Wealth of Nations. Moscow: Sotsekgiz, 1962.
[17] M. Porter, Competitive Advantage. New York: Free Press, 2005.
[18] P. Samuelson, Economics. New York: McGraw-Hill, 2010.
[19] J. M. Keynes, The General Theory of Employment, Interest and Money. London: Macmillan, 1936.
[20] C. Freeman, The Economics of Industrial Innovation. London: Pinter, 1982.
[21] Republic of Uzbekistan, Environmental Code of the Republic of Uzbekistan, Oliy Majlis, Tashkent, May 7, 2021.
[22] Republic of Uzbekistan, "Law on Investments in the Energy Sector," Oliy Majlis, Tashkent, May 12, 2022.
[23] International Energy Agency (IEA), World Energy Outlook. Paris: IEA, 2023. [Online]. Available: https://www.iea.org
[24] United Nations (UN), Sustainable Development Goals Report. New York: UN, 2022. [Online]. Available: https://www.un.org
[25] World Bank, World Development Indicators. Washington, DC: World Bank, 2023. [Online]. Available: https://www.worldbank.org
[26] R. F. Djumanova, Forecasting Methods in Socio-Economic Processes. Tashkent: Fan, 2018.
[27] F. Rakhimov, Improving Efficiency in Energy Networks and Innovative Technologies. Tashkent: Economic Innovations, 2022.
[28] Republic of Uzbekistan, Presidential Decree No. PF-5978, Apr. 3, 2020. [Online]. Available: https://lex.uz
[29] B. A. Lundvall, National Systems of Innovation. London: Pinter, 1992.
[30] State Committee of the Republic of Uzbekistan on Statistics, 2025. [Online]. Available: https://www.stat.uz