The role of structural reforms and attracting investment in improving the electricity supply of the Republic of Uzbekistan

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Annotation. The article analyzes the role of structural transformations and attracting investments in improving the electricity supply of the Republic of Uzbekistan, the correlation-regression dependence of net profit received from income before tax and profit tax of electricity generated by enterprises of the energy system of the Republic of Uzbekistan for 2005-2020, and proposals for its improvement are developed. The econometric model of this process is analyzed and the net profit indicators obtained from the supply of electricity to complete the task are determined.

Key words . Electricity, production, electricity supply, net profit, profit before tax, income tax, econometric modeling.

Introduction

The Decree of the President of the Republic of Uzbekistan "On the Action Strategy for the further development of the Republic of Uzbekistan" [1] analyzes the large-scale reforms carried out in the country over the years of independence and defines the Action Strategy for 2017-2021. Point 2 of the third of these five priorities, entitled "Priorities for Economic Development and Liberalization," is dedicated to "deepening structural transformation, increasing its competitiveness through modernization and diversification of key sectors of the national economy." introduction of energy-saving technologies into production, expanding the use of renewable energy sources, increasing labor productivity in various sectors of the economy" [1]. In this regard, an analysis of the economic indicators of the electricity supply of the Republic of Uzbekistan over the years of independence for 2017 and beyond and econometric modeling of these processes were carried out .

In the Decree of the President of the Republic of Uzbekistan " On the development strategy of the new Uzbekistan for 2022 - 2026 " dated January 28, 2022 No. UP-60 the goal was set [2] : " Uninterrupted supply of electricity to the economy, active implementation of green economy technologies in all areas, increasing the energy efficiency of the economy by 20 percent ," which defines the following tasks:

- Increasing the volume of electricity generation by an additional 30 billion kW/h by 2026, bringing the total generating capacity to 100 billion kW/h.
- Savings up to 3 billion cubic meters. meters of natural gas by increasing the share of renewable energy sources to 25 percent by 2026.
- Ensuring stable operation of the energy system of Uzbekistan and ensuring its reliability in interaction with the energy systems of neighboring countries.
- Reducing losses in industries and increasing the efficiency of resource use.
- Widespread introduction of renewable energy sources and increased energy efficiency in housing and communal services, social facilities and other areas.
- Taking action on the production and use of electric vehicles.
- Reducing the volume of emissions of harmful gases into the atmosphere per unit of GDP by economic sectors by 10 percent.

To accomplish this task, it is necessary to carry out an economic analysis and develop proposals.

Level of knowledge of the topic

Supplying electricity and generating net profits are one of the priorities of every country. Therefore, scientific research is carried out and conclusions and recommendations are developed for creating uninterruptible power supplies and generating net profit. Below is an analysis of several scientific studies on this issue.

D. Knock et al. [3] developed a methodology for finding the optimal expansion of the power system to maximize social benefits, since it assumes an equal distribution of electricity use, taking into account budgetary constraints. This differs from traditional models, which reduce the cost of meeting electricity demand. The authors formulate the problem of planning production expansion in the form of a program for the maximum number of linear utility networks and use it to analyze the situation in a country with low incomes and limited power supply infrastructure. This methodology will help decision makers evaluate the social trade-off between improving energy access, reducing energy inequality and poverty, and increasing overall electricity consumption while working within their countries' budget constraints.

F. Belaid et al. [4] developed an empirical model to study the relationship between renewable and non-renewable electricity consumption, GDP and carbon emissions using panel data from 9 Mediterranean countries between 1980 and 2014. Using PMG ARDL panel and panel econometric techniques, heterogeneity and interdependence among panels were examined to test long-run and short-run dynamic relationships as well as the accuracy of the proposed model. The results obtained by the authors prove through panel empirical data that there is a short-run two-way relationship between gross domestic product, renewable energy consumption and $CO_{2\ \text{emissions}}$, non-renewable energy consumption, GDP and renewable energy consumption.

The purpose of the article by D. Stefan et al. [5] is to determine the relationship between energy, $CO_{2\ \text{emissions}}$, economic growth and urbanization on a global scale. To achieve the goal, the authors used a number of statistical methods to study cointegration between variables, an impulse response function to track the impact of the shock that occurred, and finally studied their types. The authors selected 106 government annual data from 1990-2014. Empirical results confirmed the existence of a long-term correlation. Separating impulse and variance functions allowed the authors to understand how variables change: how renewable energy consumption, energy types, economic growth, $CO_{2\ \text{emissions}}$ and urbanization are explained by other variables. The empirical results are of interest to researchers, regulators and investors.

B. Bride et al. [6] studied the impact of electricity on income, education, health and productivity in Nepal. Simultaneously, the system of equations was estimated using the three-step least squares method. The authors found that connecting households to electricity has a very large and significant impact on income, education, and agricultural productivity. The positive effects of electricity on health have been established. The impact of electricity on income was measured directly and through proxies in education, health, and agricultural production. The enormous impact

of electricity on quality of life has been shown to be an important evidence of the addition of energy poverty to the development debate.

A study by E. Kantar [7] et al. used hierarchical structuring methods to examine the relationship between energy consumption and economic growth in a sample of 30 Asian countries covering the period from 1971 to 2008 . These countries are divided into four panels based on the World Bank's income classification, namely upper, upper middle, lower middle and lower income. In particular, the authors used per capita electricity consumption and real gross domestic product (GDP) data to determine the topological characteristics of countries. The relationship between electricity consumption and economic growth is shown. In addition, the bootstrap method was used to examine the significance of statistical significance. Finally, a cluster linking procedure was used to track cluster structure. The results of the structural topologies of these trees are as follows: different groups of countries are identified depending on their geographical location and economic growth; revealed a close relationship between energy consumption and economic growth.

S. Niu et al. [8] analyzed the cause-and-effect relationship between electricity consumption and human development and assessed the trend of electricity consumption. These research models were created using panel data for the years 1990–2009. For 50 countries, it is divided into four groups based on revenue. The human development indicators chosen were GDP per capita, consumption expenditure, level of urbanization, fertility rate and adult literacy rate. The authors' results show that there is a multi-year, two-way causal relationship between electricity consumption and the five indicators. Moreover, the higher the country's income, the higher the electricity consumption and the higher the level of human development. In addition, the variables of the four income groups differ significantly. Specifically, as income rises, electricity consumption will increase relative to GDP and consumption expenditure, but the level of urbanization, life expectancy at birth, and adult literacy will decrease. This has been shown to be mainly due to increasing rates of convergence in high-income countries. Electricity has been shown to be included in basic utilities to increase electricity supply to the poor and improve human development.

F. Tahiyaade et al. [9] conducted a model assessment using a generalized moment system panel estimation for 35 Asian countries from 2000 to 2017. According to the authors, the main findings confirm that the energy sector transition (fossil transition fuels to energy sources) will have a positive impact on electricity consumption in high- and middle-income countries in Asia. In addition, the authors of the results note that inflation, electricity pricing, and population growth in electricity consumption are higher in middle- and lower-middle-income countries in Asia than in high- and middle-income countries in Asia. The bottom line is that the relationship between the electricity sector and transition economies is very sensitive to countries' income levels and macroeconomic stability. This means that Asian countries across income levels must first take steps to improve economic and overall stability, then transition away from fossil fuels to green energy and improve technological efficiency in the electricity generation sector.

The purpose of the study by S. Nguyen et al. [10] was to examine the impact of government spending on energy poverty in a global sample of 56 developing countries. Specifically, the study primarily examined the impact of government spending on four indicators of energy poverty. Secondly, the role of institutional quality as the rule of the game in society as a result of government spending is explored. Finally, the channels through which government spending influences energy poverty were examined. The results are important when using multiple panel estimations. First, government spending affects energy poverty, which means that increasing government spending can reduce energy poverty to a certain extent; however, any excessive consumption from this oscillation point will be detrimental to energy well-being. Second, institutions serve as a critical catalyst in shaping the quality of public spending. Third, the impact of government spending is transmitted in two ways: through economic growth and income inequality.

Research methodology

Based on the economic indicators of the electricity supply of the Republic of Uzbekistan, a correlation and regression analysis of the dependence of net profit on income before tax and profit

tax was carried out and an econometric model was developed. The reliability of the model was determined.

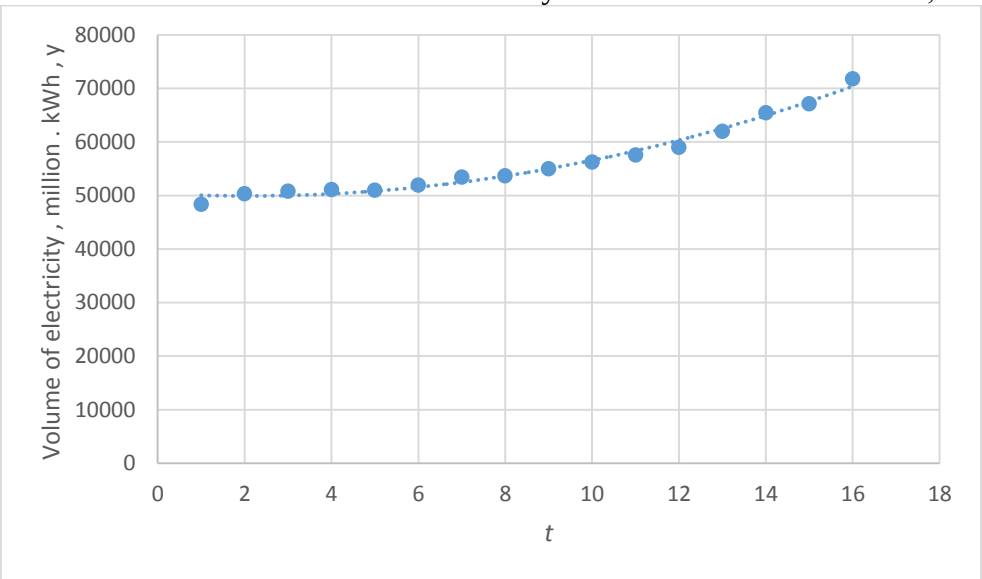
Analysis and results

In fulfillment of the tasks set in the Decrees of the President of the Republic of Uzbekistan "On the Action Strategy for the further development of the Republic of Uzbekistan" [1] and " On the development strategy of the new Uzbekistan for 2022 - 2026 " An analysis of the economic indicators of the electricity supply of the Republic of Uzbekistan for the years of independence for 2017 and beyond and econometric modeling of these processes were carried out.

The concept of power supply of the Republic of Uzbekistan for 2021-2030 provides for an increase in electricity generation by 2030 to 120.8 billion kWh per year [11].

It was revealed that the dynamics of the development of the country's electricity supply in 2005-2016 did not satisfy the planned plans (Fig. 1), which are described by the following models

$$y = 132.65t^2 - 821.9t + 51277;\ R^2 = 0.977. \quad (1)$$



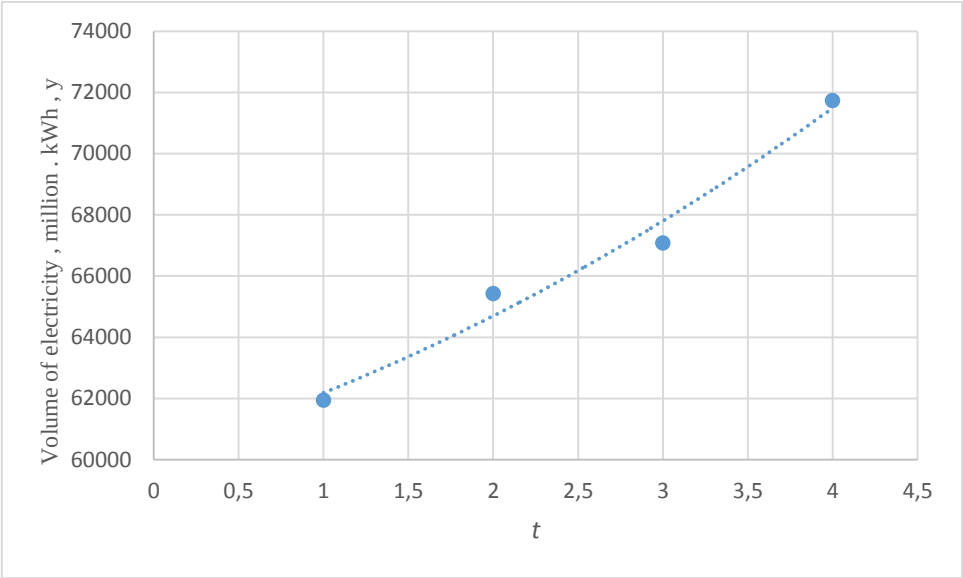
Rice. 1. Electricity supply of the Republic of Uzbekistan for 2005-2016

The fact that the approximation accuracy value in this model is $R^2 = 0.977$ means that the dynamic characteristics of the model are determined with a high degree of accuracy.

As a result of structural changes in the energy system of the Republic of Uzbekistan in 2017, based on analysis, scientific research and adopted documents, significant changes occurred in the supply of electricity. In particular, in 2017-2021, additional capacity was introduced at a number of enterprises (3834.7 MW).

As a result, the supply of electricity in the Republic of Uzbekistan in 2017-2020 became the following mathematical model (Fig. 2)

$$y = 293.52t^2 + 1635.1t + 60254;\ R^2 = 0.9763. \quad (2)$$



Rice. 2. Electricity supply of the Republic of Uzbekistan in 2017-2020

The fact that the value of the approximation accuracy in this model is $R^2 = 0.9763$ means that the dynamics of the indicators of the determined model represents a high degree of accuracy.

The results of the analysis show that after 2017, positive results began to be achieved in the energy system.

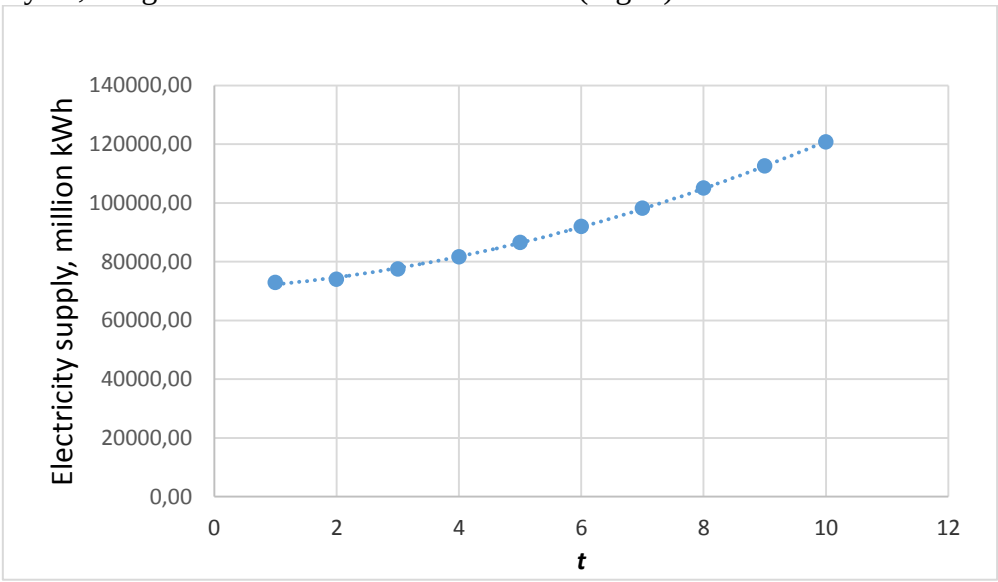
However, this development model (1) also does not allow achieving the intended goal.

To achieve this goal, two options for the dynamics of energy supply development were proposed:

1) if we make the following changes to the model,

$$y_t = 293.52t^2 + 1635.1t + 60254 + by_{t-1} \quad (3)$$

and based on the available data we make the following calculations, 120.8 = 105.957 + 98.745b, we obtain that b = 0.15, i.e., with an annual increase in energy production of 0.15 times compared to the previous year, the goal set for 2030 can be achieved (Fig. 3).



Rice. 3. Forecast of power supply to the Republic of Uzbekistan in 2021-2030.

2) Linear model defined with dependence

$$y = 5.1336t + 62.925; R^2 = 0.9961. \quad (4)$$

To achieve these goals, the following additional facilities are planned to be introduced in 2021-2026 (Table 1):

Table 1. Power plants planned for commissioning in the Republic of Uzbekistan in 2021-2026. (MW)

Years	2021	2022	2023	2024	2025	2026	Zhami
Wind power plants	0	0	1000	500	100	200	1800
Photovoltaic power plants	200	0	1097	0	1000	0	2297
Thermal power plants	1154	440	1470	1560	1500	0	6124
Total	1354	440	3567	2060	2600	200	10221

To speed up the tasks, structural reforms and attraction of investments were adopted to improve the electricity supply of the Republic of Uzbekistan.

JSC "National Electric Networks of Uzbekistan" was formed in accordance with the Decree of the President of the Republic of Uzbekistan dated March 27, 2019 No. PP-4249 "On the strategy for further development and reform of the electric power network in the Republic of Uzbekistan." The joint stock company operates within the system of the Ministry of Energy of the Republic of Uzbekistan.

The main task of JSC “National Electric Networks of Uzbekistan” is the use and development of the main electric networks of the Republic of Uzbekistan, the supply of electricity through the main electric networks of the Republic and the implementation of interstate transit, cooperation with neighboring countries.

Work done in recent years and achievements – 1:

• A modern corporate governance system has been introduced;

• Standards ISO-9001 “Quality Management System” and ISO-37001 “Anti-Corruption Management Systems”, a transparent procurement system have been implemented. In 2021, the international audit company Grant Thornton audited the procurement process and provided a positive opinion;

• In 2019-2021. 45.0 km of 500 kV overhead lines , 443.8 km of 220 kV overhead lines and 60.8 km of 110 kV overhead lines were reconstructed. In total, 4,222 MVA of additional capacity was created on a network with a length of 549.6 km;

• In 2019-2021, a total of 25 transformers and 3,440.5 km of overhead networks were repaired on 110-500 kV main lines;

• Since 2019, preparation of consolidated financial statements in accordance with International Financial Reporting Standards (IFRS);

• For the first time in the industry, the European Bank for Reconstruction and Development agreed to provide corporate loans without government guarantees;

Work done in recent years and achievements – 2:

• A “complex control” service was created in the company and its enterprises.

• Recommendations from the international consulting company McKinsey & Company have been developed for in-depth diagnostics and identification of system deficiencies, cost reduction and creation of a modern operational management system. Optimization of operating costs, medium- and long-term development plans have been determined;

• A digital model of the energy system of the Republic of Uzbekistan and an interactive map of the main power grid were created;

• In 2021, 1,428 of our employees were trained in our country, 60 (including 54 free of charge) were trained abroad, 53 of our employees were trained in higher educational institutions.

Work done in recent years and achievements – 3:

Cooperation with neighboring countries:

• Construction of the L-507 Guzar-Regar network connecting the energy system of the Republic of Tajikistan;

• Parallel operation of Afghanistan's energy system with the Central Asian energy system will increase exports to approximately $3.5 billion. Construction of a new 500 kV section Surkhan -Puli- Khumri of Uzbekistan, which will increase the kWh capacity;

• An agreement was reached with the Kyrgyz Republic on transboundary water and electricity regimes;

• In order to attract foreign direct investment in the energy system on the basis of public-private partnership, long-term contracts with a total capacity of 7421 MW were concluded for 17 projects. In particular, in 2021, the first industrial solar power plant with a capacity of 100 MW was put into operation in the country.

Investment project plan – 1.

In 2022, the company plans to implement 30 large investment projects totaling $1,385.4 million for the creation, modernization and reconstruction of existing production facilities. Of these, it is planned to invest $146.2 million, including:

Loans guaranteed by the government - 107.10 million US dollars;

From the sphere's funds account – 39.19 million US dollars.

Of them:

22 new construction projects - 87.52 million rubles. U.S. dollars;

Modernization and reconstruction projects 8 - 58.77 million dollars. In US dollars.

Investment project plan – 2 (Table 2)

Table 2. Dynamics of investments for the implementation, modernization and reconstruction of investment projects in 2021-2022. (USD million)

Name	According to the Decree of the President of the Republic of Uzbekistan dated December 28, 2021 No. PP-4937		According to the Decree of the President of the Republic of Uzbekistan dated December 30, 2021 No. PP-72	
	Total capital investment in 2021	including industry funds	Total capital investment in 2022	including industry funds
General:	124.0	16.6	146.3	43.5
New construction	69.9	11.4	87.5	37.8
Modernization and reconstruction	54.1	5.2	58.8	5.7

Key indicators of society (Table 3).

Table 3. Main indicators of the joint-stock company

T / R	Indicators	Unit	2021		Completion, percentage	Forecast for 2022	Rates of growth
			Forecast	In real			
1	Transportation of electrical energy	billion kW / h	57.2	63.8	111.5	65.0	101.9
2	Export	million dollars	111.8	110.6	98.9	132.8	120.0
3	Development of investments	million Doll.	71.45	97.69	136.7	133.3	136.5
4	Reduction in import volume	thousand dollars	230.0	350.0	152.2	230.0	65.7
5	Cost reduction	billion soums	11.0	11.1	100.9	6.1	54.9
		%	1.4	1.4	100.7	0.4	29.0
6	Creation of new	Human	6	28	466.7	18	64.3

	jobs						

Payments to the state budget (Table 4).

In 2022, tax payments in the amount of 47.5 billion soums are expected to be paid to the state budget. In particular, for the use of water resources 0.07 billion soums, for property tax 37.9 billion soums, for land tax 8.8 billion soums and for other taxes 1.7 billion soums.

Table 4 . Payments to the state budget
billion soums

No.	Payments	2021	2022	Including			
		(Fact)	(Plan)	1st quarter	2nd quarter	3rd quarter	4th quarter
1	VAT	-230.9	-265.5	-66.4	-66.4	-66.4	-66.4
2	Water tax	0.05	0.08	0.02	0.02	0.02	0.02
3	Property tax	31.5	37	9.1	9.3	9.3	9.3
4	Land tax	8.5	8.8	1.8	1.9	1.9	1.9
5	Other taxes	0.004	1.7	0.41	0.41	0.43	0.43

Expected payments in 2022 (table 5):

• In national currency – 46,586.0 million soums to repay the budget loan from the Ministry of Finance, including 46,471.4 million soums of principal and 114.6 million soums of interest.

• In foreign currency - 37,959.8 thousand US dollars, including services on the principal debt in the amount of 27,921.6 thousand US dollars and commission services and interest on loans in the amount of 10,038.2 thousand US dollars.

Table 5 . Loan obligations

In national currency, million soums at the expense of soums

No.	Purpose of the loan	2022	Including		
		Total	Main debt	%	Bank commission
1	Budget loan from the Ministry of Finance	46,586.0	**46,471.4**	**564.6**	**0.0**

In foreign currency, in thousands of US dollars

No.	Purpose of the loan	2022 _	Including		
		Total	Main debt	%	Bank commission
1	Total loans from the Islamic Development Bank	**6,063.00**	**5,679.40**	**383.6**	**0.0**
2	Total loans from the International Bank for Reconstruction and Development	**13,133.50**	**9,983.80**	**2,958.20**	**191.5**
3	Total World Bank Lending	**3,348.90**	**1,913.90**	**786**	**649**
4	Total loans from Asian Development Bank	**3,577.60**	**3,036.20**	**537.1**	**4.3**
5	Total loans of Eximbank (UzPSB)	**2,908.70**	**2,191.90**	**716.8**	**0.0**
6	Total loans from the Bank for Reconstruction and Development of the	**1,770.10**	**1,529.40**	**240.7**	**0.0**

	Republic of Uzbekistan				
	Total:	**37,959.80**	**27,921.60**	**8,881.30**	**1,156.90**

In 2022, the total number of employees of National Electric Networks of Uzbekistan JSC is expected to be 4,566 people, and the wage fund excluding social taxes will amount to 305.2 billion soums (Table 7).

In accordance with the Decree of the President of the Republic of Uzbekistan dated December 22, 2016 No. PP 2692 "On additional measures to reduce production costs in industry, as well as update physically and morally obsolete equipment", "National Electric Grids of Uzbekistan" According to the JSC, a forecast plan for to reduce production costs by 2021 to 11.0 billion soums and corresponding measures have been developed. At the end of 2021, JSC National Electric Grids of Uzbekistan achieved a cost reduction of 11.1 billion soums or 100.9% of the forecast.

In 2022, it is planned to implement these measures and reduce costs by a total of 6.1 billion soums.

Work done during the transformation process

- A Deputy Chairman of the Board for Transformation and a Transformation Implementation Group have been created.
- The Company and its affiliates have established compliance control services.
- The quality management system (ISO-9001) and anti-corruption management (ISO-37001) was created on the basis of international standards and received an international certificate of conformity.
- A roadmap has been developed for entering global financial markets and attracting investment funds without government guarantees (international rating)
- The "Concept of Digital Transformation" was developed jointly with "ICS Holding" for the implementation of "Digital Transformation".
- The 1C enterprise program has been integrated and international reporting standards have been introduced.
- Obtained an audit opinion on financial statements prepared in accordance with international standards.
- Optimization of operating costs, a medium- and long-term development plan has been developed.
- The company has created a Procurement Transformation Office.
- Long-term 10-year program for the strategic development of backbone electrical networks and integration with renewable energy sources.

Stages of transformation

II quarter 2022:

- Separation of the function of purchasing unified electricity;
- Separation of national dispatch functions.
- introduction of tariffs for electricity transportation;

I quarter 2023:

- Obtain a high credit rating in the long term.

IV quarter 2024:

- Rent of waltz lines based on contractual proposals;
- (SCADA) Implementation of an automated dispatch control system;
- Create a resource planning (ERP) system by 2024.

Digital transformation

- Design and construction of smart networks based on the IEC 61850 standard of the International Electrotechnical Commission, construction of active-flexible, material-smart networks.

Project goal 1: Creation of an automated dispatch control system.

- Implementation period: I quarter of 2020 - IV quarter of 2024.
- Source of funding: World Bank.

• Total project cost: $125 million.

Expected economic effect:

• Reducing capital costs by reducing equipment failures and optimizing the planning of equipment repairs, taking into account the assessment of the consequences of an accident;

• Improving the reliability and quality of power supply through the introduction of modern integrated control automation solutions;

• Reduced dispatch efforts through rapid analysis and active emergency simulation;

• Ensuring stable and safe operation of the power system.

Project goal 2: Creation of an automated resource management system.

• Implementation period: I quarter 2020 -IV quarter 2024.

• Source of funding: World Bank

• Total project cost: $70 million.

Expected economic effect:

• Increasing the efficiency and effectiveness of the financial and economic activity system;

• Optimization of the enterprise management system

Conclusions and offers

An analysis of the electricity supply indicators of the Republic of Uzbekistan for 2005-2016 showed that they did not meet the needs of the country, and based on structural reforms, positive results began to be achieved in 2017. However, with the help of mathematical models and analysis, it was found that these changes are also not enough. Using these models, new models were developed to achieve the planned results and forecast indicators were obtained based on them. The proposed models will help improve the country's electricity supply.

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