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Integration of Renewable Energy Sources in Uzbekistan: Efficiency Analysis and Development Prospects on the Example of JSC «O‘ZLITINEFTEGAZ»

Nashvandov Sh.M., Abdullaeva H.N

Deputy Chairman of the Management Board -Head of the Department of Economics and Finance
Chief Economist, Department of Financial and Economic Analysis and Forecasting

ABSTRACT: The article examines Uzbekistan's strategic approach to achieving energy independence and sustainability through the integration of renewable energy sources. With the ambitious goal of increasing the share of renewable energy sources to 25% by 2030, the country is demonstrating its commitment to global trends and environmental responsibility. An analysis of the dynamics of electricity consumption of O‘ZLITINEFTEGAZ JSC from 2021 to the first quarter of 2024 revealed significant changes in consumption and financial costs associated with seasonal fluctuations, repair work and expansion of production capacity. The introduction of a photovoltaic plant in 2023 allowed the company to significantly reduce its dependence on external energy sources, emphasizing the desire for self-sufficiency and innovative development. The results of the study confirm the effectiveness of the measures taken and indicate prospects for further improvement of the energy system of Uzbekistan.

KEYWORDS: Electricity, energy consumption, solar energy, energy transition, renewable energy sources.

I. INTRODUCTION

The electricity industry of the Republic of Uzbekistan is currently undergoing a significant transformation. On the one hand, it is characterized by a high level of wear and tear on main equipment and losses, and on the other hand, it is highly regulated. In this regard, the government developed the “ Concept for providing the Republic of Uzbekistan with electrical energy for 2020-2030.” The main goal of the concept for providing the Republic of Uzbekistan with electrical energy for 2020-2030 is to provide the population and economy of the country with electricity at *competitive prices* . This strategy was developed with the participation of international experts and is based on the high priority given by the President of the Republic of Uzbekistan Shavkat Mirziyoyev to the development of the electric power industry, radical reform of the sector to meet the growing demand for energy from the population and the rapidly developing economy of the country.

Table 1 - Dynamics of electricity consumption in the energy system of Uzbekistan

Year	2015	2016	2017	2018	2019	2020	2021	2022
Energy consumption, GWh	58.8	60.5	61.3	62.8	65.0	69.0	74.8	81.9
Growth, %	2.9	1.3	2.5	3.5	6.2	6.15	8.4	9.5

Source: report of the Energy Council of the CIS countries (Electric power industry of the Commonwealth of Independent States 2013-2022), Annual report of CDC "Energy" for 2018, 2019 and 2020 **.** [5]

In terms of electricity consumption per capita, Uzbekistan occupies one of the leading places in the Central Asian region and is slightly second only to Kazakhstan (in 2018 it amounted to 1903 kWh). In recent years, the energy system of Uzbekistan has seen a steady increase in electricity consumption at an annual rate of 1.3-6.2%. For the period from 2015 to 2022. electricity consumption increased by almost 40% and reached 81.9 TWh. Reporting data on the dynamics of electricity consumption for the period 2015-2022. are presented in table 1.

Uzbekistan is one of those countries that fully meet the needs of the energy system from its own energy resources. The generation base is mainly built on the use of fossil fuels. Structure of consumption of primary energy resources for electricity production: natural gas – 79.4%; fuel oil – 2.1%; coal – 14.6%, hydrogen generation – 3.9%. At the same time, in recent years the share of coal in the structure of primary energy resources has increased (in 2017 it was 7.0%).

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Table 2 - Electricity production by type of generation, TWh .

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
TPP	48.8	49.5	50.7	52.1	52.8	56.9	57.0	61.4	65.6	55.9
Hydroelectric power station	5.8	6.2	6.9	7.0	7.9	5.9	6.5	5.0	5	5.3
Total	54.6	55.7	57.6	59.1	60.8	62.9	63.6	66.4	79.9	79

Source: report of the Energy Council of the CIS countries (Electric power industry of the Commonwealth of Independent States 2013-2022), Annual report of CDC "Energy" for 2018, 2019 and 2020 **.** [5]

Uzbekistan, a country endowed with rich natural resources, is entering a new era of energy independence and sustainability. With the ambitious goal of increasing the share of renewable energy sources (RES) in the electricity generation mix from the current 10% to 25% by 20301, Uzbekistan is committed to transforming its energy system. This rapid transition reflects global trends and underscores the country's determination to harness wind and solar energy to create a sustainable future where every hour of sunshine and every gust of wind contributes to the prosperity and well-being of its people.

II. ANALYSIS OF JSC ELECTRICITY CONSUMPTION DYNAMICS "O'ZLITINEFTEGAZ"

As part of the analysis of the dynamics of electricity consumption of O'ZLITINEFTEGAZ JSC for the period from 2021 to the first quarter of 2024, the following data was obtained: in 2021, the total volume of electricity consumed reached **613 356 kW/h** , with financial costs of **347 682 thousand soums** . A particularly high demand for electricity was noted in June, which correlates with the active use of air conditioning systems in the summer.

In 2022, a **38% decrease in consumption was recorded** compared to the previous year, which was accompanied by a decrease in financial costs to **249 078 thousand sum** This reduction in consumption is due to the completion of intensive renovation work that requires significant energy consumption. The commissioning of new laboratories in 2022 led to an increase in electricity consumption, reflecting the development of the company's production capacity.

According to Table 3, in 2023 the total demand for electricity was **605 792 kW/h**, while the introduction of a photovoltaic station in May made it possible to cover **23%** of the demand, producing **140 601 kW/h** of electricity operating only from May 2023. The remaining **77%** of the needs were met through purchases from the Distribution Zone. The **58.8%** increase in consumption in 2023 compared to 2022 was driven by the expansion of laboratory activities, which also led to a **6% increase in energy costs** .

In the first quarter of 2024, electricity consumption was **57 248 kW/h** , of which **21 962 kWh** were covered by photovoltaic plant production. The increase in electricity consumption in the reporting period was due to an increase in the cost of electricity from October 1, 2023 [7] and the ongoing expansion of laboratory activities.

Table 3 - Dynamics of electricity consumption

Year/Quarter	Consumption volume (kWh)	Financial expenses (thousand soums)	Photovoltaic power plant production (kW/h)	Purchases from distribution networks (kW/h)
2021	613 356	347 682	-	-
2022	38% reduction	249 078	-	-
2023	605 792	6% increase	140,601 (since May)	465 191
1 sq. 2024	57 248	-	21,962	35 286

Source: data from the company O'ZLITINEFTEGAZ JSC (made by the author)

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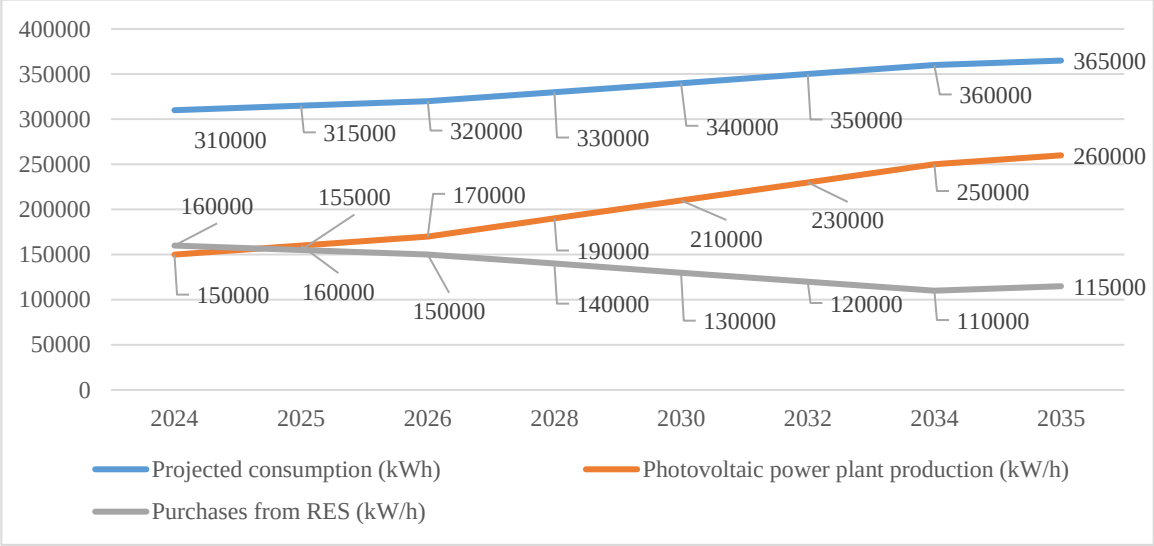
These data reflect the strategic focus of O‘ZLITINEFTEGAZ JSC on increasing energy efficiency and developing renewable energy sources in the context of the national goals of Uzbekistan.

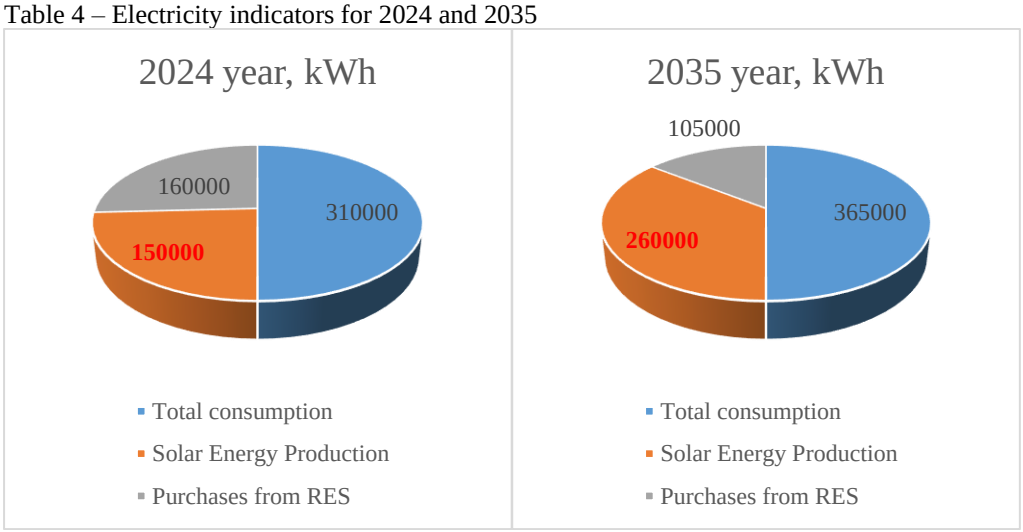
Diagram 1 – Forecast of electricity consumption of O‘ZLITINEFTEGAZ JSC



Source: data from the company O‘ZLITINEFTEGAZ JSC (made by the author)

Chart 1 and Table 4 show the forecast for electricity consumption until 2035, and it is based on the assumption that the company will continue to improve its energy efficiency and expand the use of renewable energy sources, which will reduce its dependence on electricity purchases from distribution centers and increase its own production.

Table 4 – Electricity indicators for 2024 and 2035



Source: data from the company O‘ZLITINEFTEGAZ JSC (made by the author)

Investment and payback:

Initial investment: The photovoltaic plant was purchased for **UZS 1.980 billion** .

Annual production: The plant is capable of producing **200,000 kWh** of electricity per year.

Cost of electricity: From May 1, 2024, the cost of electricity will be **900 soums** per 1 kWh .

Annual savings: The production of solar electricity will save **180 million soums** per year.

Payback period: The estimated payback period for the station is **11 years** .

To calculate the profit from solar energy consumption over the next three years, we can use data on the electricity production of the photovoltaic plant and the cost per 1 kWh. Based on the fact that Tashkent has 2,500 hours of sunshine per year, we can assume that the station will operate at maximum efficiency during these hours.

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Assume that the PV plant output remains at the last known value, i.e. 21,962 kWh for the first quarter of 2024. To simplify the calculations, we will assume that the station produces the same amount of electricity every quarter.

Thus, the annual photovoltaic energy production will be:

21,962 kW/h X 4 = 87,848 kW/h

Now, multiplying this by the cost per 1 kWh, we get the annual revenue:

87,848 kW/h X 900 soum /kWh = 79.06 million soum

To calculate the amount for three years, simply multiply this amount by three:

79,063,200 soums X 3 = 237.2 million soums

Thus, the amount received by the organization from the consumption of solar energy over the next three years will be **237 189 600 soums** , provided that the station's productivity and the cost of electricity remain unchanged .

Using a photovoltaic plant to produce electricity is an effective way to optimize costs for the company O'ZLITINEFTEGAZ JSC . This not only reduces dependence on traditional energy sources and reduces the environmental footprint, but also allows the company to significantly save on energy costs. In the long term, this strategy can lead to significant reductions in operating costs and increased profits.

Also, the absence of a solar energy storage system in the company leads to the fact that excess energy produced on weekends, when consumption within the company decreases due to vacations, is sold to distribution centers (for example, in 2023 the company sold energy in the amount of 3.5 million soums). This not only avoids energy losses, but also creates an additional source of income.

However, to further develop and improve the efficiency of the energy produced, one proposal is to invest in the creation of a backup storage unit. This will allow the company to store excess energy on weekends and use it on weekdays, which can lead to additional savings and reduced dependence on external energy sources. As for the cost of a backup energy storage unit, it can vary depending on many factors, including capacity, technology and manufacturer. For example, the cost of a lithium LFP battery can be 8 times lower than that of lead-acid batteries, given that the lifespan of a lithium battery is at least 5 times longer.

III. CONCLUSION

Changes in the volumes of electricity consumption of O'ZLITINEFTEGAZ JSC and its subsidiaries in recent years reflect the influence of both internal and external factors. The introduction of energy efficient technologies such as photovoltaics and optimization of production processes can play a key role in managing energy consumption. Strategic planning and investment in renewable energy, as well as reviewing energy consuming operations, can help companies adapt to changing economic conditions and achieve Uzbekistan's energy transition goals. This highlights the need for continued investment in innovation and sustainability to ensure long-term energy security and economic efficiency.

To further develop and strengthen the position **of O'ZLITINEFTEGAZ JSC** in the market, the company can consider the following strategic directions:

1. **Expansion of photovoltaic plant capacity** : Increasing production capacity will allow the company not only to meet its own electricity needs, but also to increase the volume of sales of excess energy from the RES.
2. **Invest in Research and Development** : Developing new technologies and improving existing ones can lead to lower costs and improved energy efficiency.
3. **Collaboration with other companies** : Partnerships with other renewable energy businesses can open up new opportunities for technology exchange and joint investment.
4. **Improving production energy efficiency** : Optimizing production processes and introducing energy-saving technologies will help reduce overall energy consumption.
5. **Educational programs for employees** : Increasing employee awareness and competencies in the field of energy conservation and renewable energy sources will strengthen the internal culture of sustainable development.

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