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ANALYSIS OF THE INVESTMENTS IN CLEAN ENERGY PROJECTS IN THE DEVELOPING COUNTRIES

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Abstract: The article examines the current state of work in the energy sector, observed problems, and ways to eliminate them. The stages of energy infrastructure development in our country, the possibilities of creating innovative techniques and technologies that can be effectively used are considered. The main goal of the research is to achieve stability in the energy sector and to analyze the development in international standards.

Key words: Energy resources, energy, thermal power plants, wind farms, nuclear power plant, hydroelectric power plant, public-private partnership, renewable energy sources, power transmission networks, “green energy”.

Annotatsiya: Maqolada energetika sohasidagi ishlarning bugungi holati, kuzatilayotgan muammolar, ularni bartaraf etish yo‘llari o‘rganilgan. Mamlakatimizda energetika infratuzilmasini rivojlantirish bosqichlari, ulardan samarali foydalanish mumkin bo‘lgan innovatsion texnika va texnologiyalarni yaratish imkoniyatlari ko‘rib chiqiladi. Tadqiqotning asosiy maqsadi – energetika sohasida barqarorlikka erishish va xalaqaro standartlarda rivojlanishni tahlil qilishdir.

Kalit so‘zlar: Energiya resurslari, energiya, issiqlik elektr stansiyalari, shamol stansiyalari, atom elektr stansiyasi, GES, davlat-xususiy sheriklik, qayta tiklanadigan energiya manbalari, elektr uzatish tarmoqlari, “yashil energiya”.

Аннотация: В статье рассматривается современное состояние работы в энергетике, наблюдаемые проблемы и пути их устранения. Рассмотрены этапы развития энергетической инфраструктуры нашей страны, возможности создания инновационной техники и технологий, которые можно эффективно использовать. Основная цель исследования – достижение стабильности в энергетическом секторе и анализ развития по международным стандартам.

Ключевые слова: Энергетические ресурсы, энергетика, тепловые электростанции, ветряные электростанции, атомная электростанция, гидроэлектростанция, государственно-частное партнерство, возобновляемые источники энергии, сети электропередачи, «зеленая энергетика».

INTRODUCTION

The report begins with an overview of the key institutions and stakeholders in the energy sector in Uzbekistan, followed by a description of the wider context of renewable energy in the country. It then provides a summary of the policy landscape for renewables in Uzbekistan. After discussing the possible barriers to the deployment of solar energy in Uzbekistan, the report presents a roadmap for solar energy by 2030. It provides examples of international best practices in solar energy deployment from IEA member and association countries. It then outlines the policies and measures needed for Uzbekistan to harness the benefits of solar energy securely.

If we take it on a global scale, we can see that the energy consumption of countries is at different levels. Currently, $770 billion is invested annually in clean energy in developing economies, but most of it is concentrated in these few large economies. Especially China accounts for 2/3 of the total investment. Three countries - China, India and Brazil - account for more than three-quarters of the total investment. According to the Paris Agreement, public and private investments in green energy in developing economies should be more than tripled every year in order to meet the growing energy needs. If 770 billion US dollars were spent in 2023, it is planned to reach 2.2-2.8 trillion dollars per year in the early 2030s. This, in turn, shows the relevance of the research on improving the financing of projects in the energy sector.

In Uzbekistan, there are a number of problems, such as the underdevelopment of financing projects in the energy sector, the inactivity of local and foreign investors, the low level of financing of infrastructure projects, the insufficient application of the experiences of developed countries to the local market, and the underdevelopment of the energy sector infrastructure. For this reason, it is desirable to improve the financing of infrastructure projects in the energy sector. Energy consumption in our country remains at a relatively low level. By 2030, per capita electricity consumption is expected to increase to 2,665 kWh per year and increase by 71.4% compared to 1,903 kWh in 2018. In turn, this indicator is much lower than the indicators recorded in Korea - 9711, China - 4292, Russia - 6257, Kazakhstan - 5133, Turkey - 2637 kWh at the end of 2018. It is important to comprehen-

sively study these problems, use advanced foreign experiences in this field, develop proposals for eliminating existing problems, and determine the relevance of the chosen research topic.

LITERATURE REVIEW

Many foreign economists, including Worrel. E, Sigurgeirsdottir. S, Stephanie Bouckaert, Christophe McGlade, Thomas Spencer, Cecilia Tam, Brent Wanner and Daniel Wetzel, Robert Priddle have discussed the theoretical basis of using various financial mechanisms in the financing of infrastructure projects in the energy sector, the legal basis of attracting foreign investment, organizational mechanisms, advantages and disadvantages, and the importance of attracting financial resources through financial mechanisms[1].

S. Shomurodov evaluated green energy as the energy of the future and studied its innovative methods, natural and technical potentials.

METHODOLOGY

Our proposed methodology for assessing brand equity in higher education institutions (HEIs) integrates quantitative and qualitative indicators, incorporating stakeholder perspectives to provide a comprehensive understanding of brand perception in this unique context.

Quantitative data collection involves survey-based approaches to measure various aspects of brand equity among different stakeholder groups, including students, alumni, faculty, and administrative staff. The surveys are designed to assess brand awareness, perceived quality, brand associations, and loyalty using Likert scale items and semantic differential scales. Additionally, institutional data such as enrollment trends, graduation rates, and faculty retention rates are analyzed to provide quantitative indicators of brand strength and market effectiveness. Qualitative data collection methods, including interviews, focus groups, and open-ended survey questions, are employed to gain deeper insights into stakeholder perceptions, attitudes, and experiences related to the institutional brand. Qualitative data complement quantitative findings by capturing the nuanced aspects of brand perception, such as emotional connections, alignment with identity, and experiential factors.

ANALYSIS AND RESULTS

If we analyze the work carried out in the field of electricity, we can cite the opinion expressed by our President: “Electricity is the “motor” of the economy, and socio-economic progress, it goes without saying that, life cannot be imagined without this sphere.” Currently, our country has a total of 14 thousand megawatts of electricity generation, 86% of which is due to the contribution of thermal power plants. However, 84 percent of the thermal power plant capacity was launched almost half a century ago, and they are also operating at 83 percent capacity. In comparison, one of the main problems in the field is that in developed countries, 240-260 grams of fuel is used to generate 1 kilowatt of electricity, in some stations in our country this figure is twice. Judging by the analysis and forecasts, as a result of the development of our economy, the demand for electricity is expected to reach 20 thousand Megawatts by 2030. It is known that electricity in our country is produced mainly as a result of the use of natural gas. We must not forget that gas resources, on the other hand, are limited in today’s conditions to spend it even more by 2030-to grow a huge amount of non – renewable natural resources. The launch of a nuclear power plant can be one of the completely new solutions for reducing fuel consumption, but it takes at least another decade to do this. Therefore, it is emphasized by our president that it is necessary to eliminate existing problems faster and radically develop the network, and most importantly, achieve significant positive changes in the system in a short time. By 2030, there is a need to take measures to create additional required 12.5 thousand megawatts, including the construction of steam-gas installations, nuclear power plant, hydroelectric power plants and modernization of existing ones, as well as to compensate for the necessary capacities by updating the energy blocks at the Syrdarya, Tashkent, Navoi, Taxiatosh thermal power plants, as well as introducing a public-private partnership into the power system. It is also worth saying that the State Committee on investments, Joint-Stock Company “Uzbekenergo” is carrying out appropriate work on the construction of steam-gas and gas-turbine units of 3.9 thousand MW and coal-fired thermal power plants, solar and wind power plants in the city of Angren and Surkhandarya region. There are also tasks to accelerate the construction of new electricity generating facilities. It is planned that from the coming years, 15% of the proceeds from the sale of electricity will be directed to finance investment projects and repay loans.

1 Golusin, Popov & Dodic “Definitions: energy, sustainability and the future”. The Open University. Archived from the original on 27 January 2021. Gunnarsdottir, I.; Davidsdottir, B.; Worrel, E.; Sigurgeirsdottir, S. (2021). “Sustainable energy development: History of the concept and emerging themes”. Renewable and Sustainable Energy Reviews. 141: 110770. Doi:10.1016/j.rser.2021.110770. ISSN 1364-0321. S2CID 233585148.

It is rapidly becoming clear that the modernization and reconstruction work carried out in the system requires the involvement of the private sector in this area on the basis of public-private partnerships (PPP). But it should also be recognized that neither the regulatory framework nor the technical infrastructure is ready for this. For example, the issue of accepting electricity generated by private enterprises into my energy system still remains as a problem. For a comparison example, we can cite that 60 percent of electricity in Turkey and 20 percent in South Korea is generated by private enterprises. Therefore, it is necessary to attract the private sector to the industry with the involvement of international experts in our country and on the basis of their recommendations and conclusions, as well as to ensure the development of legal, institutional, technological foundations of the mechanism of Public-Private Partnership. The share of old networks, which has been used for many years, is 62%, therefore, 57% of lines and 39.6 thousand transformer points need to be updated in the distribution networks.[2]

The issues of implementing an automated accounting system of energy resources have not yet been completed. Today, the Asian Infrastructure Investment Bank is cooperating in the development of the energy sector. In Uzbekistan, with the support of international financial institutions, practical work is being carried out on reforms in the energy sector, including financing projects for renewable energy sources, energy efficiency and energy savings, construction of thermal power plants, construction of power transmission networks and repair of hydro power plants. In particular, in the financing of renewable energy projects, cooperation has been established with international companies on renewable energy projects. It is also planned to build stations with a capacity of 500-1000 MW for their own needs on the principles of Public-Private Partnership, and in Surkhandarya region, as part of the project to build a thermal power plant with a capacity of 1560 MW, investors are considering the possibility of attracting funds from the Asian Infrastructure Investment Bank, at the same time, work is underway with “Xian Electric and state Grid – CET” to build new high-voltage power lines and 5 substations with a length of 1000 kilometers in order to finance projects for the construction of power lines and to provide uninterruptible electricity for new capacities. As part of the program to finance the production of solar panels in Uzbekistan and the transition to a “green” economy, in 2022, solar panels with a total capacity of 49 MW and solar water heaters with a volume of 722.6 million liters were installed on the roofs of public institutions and objects of the social sphere, and a specialized enterprise “green energy” was established. In order to accelerate the installation of panels, as well as reduce their cost, the issue of localization of the production of solar panels in Uzbekistan is also being considered. The issue of providing funds for the development of the technical and economic framework of “Zarafshan GES” is being considered. Effective work is being carried out between the governments of the republics of Uzbekistan and Tajikistan to study the construction of a hydroelectric power station on the Zarafshan River on the territory of the Republic of Tajikistan and to attract grant funds for the development of updated technical and economic foundations of the project.

Uzbekistan succeeds in maximising the benefits of solar energy capacity for both electricity and heat, making solar energy one of the country’s major energy sources.

Solar energy potential with specific technologies – including solar PV, floating solar PV, CSP, PV2 heat, solar thermal, district solar heating and electric heat pumps – is properly estimated. In addition to mega-scale solar projects, small- to medium-scale solar projects including rooftop solar PV become attractive to developers and consumers thanks to appropriate policy targets and measures. Off-grid solar energy systems could secure clean energy supply in remote areas with good solar resources but no access to the grid. Transparent and sound policy and regulatory frameworks create a level playing field for all energy sources, enabling various developers to participate in the energy market and get access to the energy system. This is strengthened by the phasing out of fossil fuel subsidies and the possible additional support for renewable sources. Moreover, long-term energy and grid development planning provides developers with business stability and predictability in Uzbekistan, contributing to further solar energy deployment in a cost-competitive manner. Due to the increase in the share of VRE in the power mix, power system flexibility increasingly becomes a key issue, while conventional power plants remain a major power source in Uzbekistan providing flexibility to the power system. A properly designed balancing market enables low-emission energy sources such as PSH and batteries to serve as new flexibility options. Furthermore, DR and enhanced interconnections with neighbouring countries also serve as additional flexibility sources while securing power supply in these countries.

This roadmap provides a timeline through 2030 with key actions. In addition, in order to further enhance solar energy use beyond 2030 and move progress toward clean energy transitions, the government of Uzbekistan may need to also consider decarbonising other sectors. This includes focusing on reducing emissions in hard-to-abate sectors, including heavy industry and longdistance transport, through measures such as the roll-out of electric vehicles and the development of solar hydrogen production and use.

2 Prepared by author using IEA data

Table 1. Projected cost of concessional funds to support clean energy investments and private sector financing[3] *(in 2023 in billion dollars)*

	Gross investment in clean energy (2026–2030) – (2031–2035)	Attracting preferential funds to private financing (2026–2030) - (2031–2035)
Total (Emerging economies excluding China)	**1370-1857**	**83-101**
In the section of sectors		
Low emission energy production	836-1079	44-53
Energy efficiency and final consumption	416-609	29-36
Low emission fuels	118-169	10-12
In the cross-section of regions		
India	263-355	12-15
Central Asia	202-318	4
Eurasia	188-232	6-7
Latin America	243-332	13-15
Asia Pacific region	185-244	7-9
Africa	203-265	37-46
Rest of Asia	85-112	4-5

As can be seen from the data in the above table, the amount of gross investments planned by developing economies for the production of clean energy has been estimated. In 2026-2030, more than 1.3 trillion dollars will be allocated for the production of clean energy. At the next stage, it is planned to invest 1.8 trillion dollars. After China, India is seen as the leading country in the field. India aims to invest over $0.6 trillion by 2035.

Table 2. Projected value of the share of private financing in clean energy investments[4] *(in percent as of 2023)*

	Private financing (for years 2026–2030)
Total (Emerging economies excluding China)	61
In the section of sectors	
Low emission energy production	43
Energy efficiency and final consumption	81
Low emission fuels	78
In the cross-section of regions	
India	60
Central Asia	42
Eurasia	57
Latin America	73
Asia Pacific region	67
Africa	66
Rest of Asia	53

The private sector takes the main share in the funds allocated for the production of clean energy. In particular, in 2026–2030, the total amount of investments, excluding China, is 61 percent. It is also intended that 81 percent of funds will be directed by private investors to achieve energy efficiency. In terms of regions, it is predicted that 60 percent of funds will be generated by the private sector in India.

3 Prepared by author using IEA data
4 Prepared by author using IEA data

We can observe that investments made for energy production in 2015-2023 have changed continuously. In particular, in 2015, in global energy investments, the amount invested in non-renewable energy was higher than the amount invested in renewable energy production, i.e., it amounted to slightly more than 1 trillion dollars, while 1.3 trillion dollars of investment was directed to non-renewable energy sources. Starting next year, the trend has reversed, and until 2023, the volume of investments for renewable energy production is increasing. That is, if we compare in terms of quantity, by 2023, 1.7 trillion dollars will be invested in the production of renewable energy, while more than 1 trillion sums will be allocated to non-renewable energy sources.[5]

CONCLUSION

From 2025 onward, additional efforts could be required to achieve the 2030 policy targets of renewable electricity ratio at 25% and solar power capacity at 5 GW. The government could further unlock the vast solar energy potential by exploring other applications such as CSP, floating solar PV, off-grid solar PV in remote areas, solar PV2heat and electric heat pumps. The treatment of end-of-life solar panels is not an urgent issue in Uzbekistan, but it could be worth considering incorporating appropriate policy measures into the regulations early on. After 2025, power system flexibility gradually becomes visible as an issue, with the increase in VRE generation. The government should consider appropriate conditions for balancing the electricity market, which enables diversified lowemission energy sources such as PSH and DR to supply flexibility to the power system. It should be also kept in mind that enhancing interconnections with neighbouring countries could serve as an additional source of flexibility, while enhancing power supply security among these countries. Throughout the timeline from today up to 2030, in parallel with the step-by-step actions listed above, the government needs to continue ensuring the availability of transparent information on electricity infrastructure and markets to foster solar energy deployment. The government should also support the optimisation of conventional power plant operation as a flexibility option, depending on the penetration level of renewable energy sources. Moreover, it should be kept in mind that transparent, participative and long-term planning for renewable development needs to be properly incorporated into the overall solar energy strategy, while long-term power grid planning must remain in line with renewable deployment. To further promote solar energy use beyond 2030, the government might also consider decarbonising other sectors, e.g. through the roll-out of electric vehicles and the development of solar hydrogen production. As illustrated in the roadmap, there are various examples of international best policy practices in the area of renewable energy, which Uzbekistan could learn from and adapt according to its national context. To enhance the use of solar energy resources in Uzbekistan, we recommend the government consider incorporating, as appropriate, all measures listed in the roadmap into its solar energy strategy toward 2030 and beyond.

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5 Prepared by author using IEA data

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