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ANALYSIS OF THE FINANCING RENEWABLE ENERGY PROJECTS

SAMANDAR FAYZIEV

Department of Corporate finance and securities, PhD student,
Tashkent State University of Economics, Tashkent, Uzbekistan
E-mail: s.fayziyev1229@gmail.com

Abstract

As can be seen from the article which discusses the state of financing renewable energy projects in the energy sector and the problems observed in it, the development processes of the energy sector, the status of thermal, wind and solar power plants in our country and their difference from each other in terms of their effectiveness, as well as alternative financing directions. The purpose of the study is to analyze the financing and sustainability of renewable infrastructure projects inthe energy sector.

Keywords: renewable energy projects,private sector, energy, public-private partnership projects, financing, energy resources, thermal power plants, wind farms, nuclear power plant, hydroelectric power plant, renewable energy sources, power transmission networks, “green energy”.

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 renewable in Uzbekistan. After discussing the possible barriers to the deploymentof 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. These are presented as a set of overarching policy actions.

The ever-increasing demand for energy in the world, in particular, the expansion of the volume of electricity consumption, requires attracting financial resources to energy projects and expanding investments. In 2023, developing countries spent about 400 billion US dollars to finance green energy, in particular 190 billion US dollars from the state budget, while the private sector invested 180 billion US dollars. As the production of green energy has become a strategic goal of countries all over the world, there are measures that need to be taken and problems that need to be solved in this regard, including the fact that the infrastructure in the field of electricity is quite old, which causes a large part of the energy to be wasted due to the use of the existing ones, while The fact that the current methods of traditional electricity generation lead to air pollution shows the relevance of the research topic.

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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]

For example, Robert Priddle studied energy security and potential problems in the cross-examination of financial mechanisms in the formation of projects in the energy sector.[2] D.Sh. Yavmutov, J.Kh. Burkhanov, K.S. Karimova, A.V. Vakhabov, Sh.Kh. Khajibakiyev, Sh. Rakhmonov, I. Gafurov, K. Rakhimova, M. Akhmadaliyeva, J. Odilov, M. Vapayev. S. Shomurodov. M. Pathullayeva. Sh.Shodmonov, U.Gafurov highlighted the types of infrastructure, their importance and common problems in their research.

D.Sh.Yavmutov, J.Kh.Burkhanov focused on the experience of foreign countries in the transition to green energy and the possibilities of its implementation in Uzbekistan.

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

ANALYSIS AND RESULTS

Access to financing for solar energy technologies is a precondition for their deployment. Technological viability depends on financing costs due to the high upfront capital costs involved, the long-term economic lifetimes and the impact of the weighted average cost of capital (Table 1).

[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. Archived from the original on 15 August 2021. Retrieved 15 August 2021. Retrieved 30 December 2020. 4. 2013, p. 8 Oskar Kowalewski, Pawel Pisany, What drove the growth of the corporate bond markets in Asia?, Research in International Business and Finance, Volume 48, 2019, Pages 365-380, ISSN 0275-5319, https://doi.org/10.1016/j.ribaf. 2019.01.014. Vera, Ivan; Langlois, Lucille (2007). "Energy indicators for sustainable development". Energy. 32 (6): 875-882. Doi:10.1016/j.energy.2006.08.006. ISSN 0360-5442. Archived from the original on 15 August 2021. Retrieved 15 August 2021.

[2] Robert Priddle Principles of project finance, 2023. – P. 235. (745 p).

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Table 1

Possible barriers to the deployment of solar energy in Uzbekistan: Financing and economic factors.[3]

Possible barriers	Instances
Investment costs andeconomics	• Solar technology's levelised cost of electricity may be uncompetitiverelative to other sources of power • The levelised cost of solar thermal heat may be uncompetitiverelative to other sources of heat • Solar technologies can compete on a levelised cost basis, butupfront capital investment costs are too high
Investor confidence and perceived risk	• Technology risks are considered too high by investors • Lack of previous investment experience in target countries makescommitments too risky • Instability in the policy and/or regulatory framework • Mismatch of currencies for revenue and repayment
Availability of financing	• Project promoter or developer unable to provide equity for project.Investment banks may be unwilling to offer project financing • In the buildings sector, those who pay for energy services may nottake the decisions on new supply-side investments

The Uzbek government, with financial and technical assistance from international financial institutions, has implemented competitive bidding processes to attract private sector investment in large-scale solar power projects since the enactment of the Law on PPP in 2019. Looking at one of the latest bidding projects, Abu Dhabi Future Energy Company PJSC, known as Masdar, was awarded a 220 MW solar PV project in the Samarkand region to supply electricity through the National Electric Grid of Uzbekistan JSC (NEGU) for 25 years at 17.91USD/MWh (IFC, 2021). This is already lower than the global average auction prices for solar PV.

In line with the Law on the Use of Renewable Energy Sources Business, entities and individuals who install renewable energy facilities are eligible for the following benefits and incentives, including tax incentives:

- ❖ Manufacturers of renewable energy facilities are granted the right to create local networks and conclude agreements with legal entities and individuals for the sale of energy.
- ❖ Renewable energy generators are exempted from property tax for these installations and from land tax on the sites occupied by these installations (more than 0.1 MW) forten years from the date of their commissioning. They are also granted the right to create local networks and conclude agreements with legal entities and individuals for the sale of energy.
- ❖ Individuals are exempted from property tax on property owned by persons using renewable energy facilities in residential premises with complete disconnection from the existing energy networks for three years from the date of using the facilities.

[3] Prepared by the author using data from the IEA website

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Different levels of variable renewable energy sources, including solar and wind,require an evolving approach to providing power system flexibility, which is defined as the ability of a power system to reliably and cost effectively manage the variability and uncertainty of demand and supply across all relevant timescales, from ensuring instantaneous stability of the power system to supporting long-term security of supply(IEA, 2019b). Sufficient grid infrastructure and its appropriate operation could help maximise the development of solar energy capacity and encourage the development of solar projects (Table 2).

Table 2

Possible barriers to the deployment of solar energy in Uzbekistan: Energyinfrastructure[4]

Possible barriers	Instances
Infrastructure obstacles	• Insufficient grid capacity; delayed arrival and late connection of newprojects to grid
Grid connection constraints	• Transmission system operator may lack capacity to enable gridconnection (or have no interest) • Point of connection may be disputed among developers or with thetransmission owner • Long distance between potential site and grid node can be a barrierdue to costs or existing rights-of-way
Curtailment and other operational constraints	• Impact on voltage, frequency and power quality and system stability
Mismatch with solar availability	• Differences between annual solar availability and the load curve maybe significant
Solar thermal for district heating	• Change in operation due to solar resource variability • Inadaptability of network temperature levels for efficient solarproduction • Strong competition from natural gas networks, leading to suboptimalresults

Currently, the domestic electricity network in Uzbekistan consists of more than9 700 km of transmission lines (220-500 kV) and more than 250 000 km of distribution lines (0.4-110 kV) owned by NEGU and the Regional Electric Power Networks JSC, respectively. With a view to ensuring further power supply stability and allowing new generation assets to connect to the network, more than 700 km of the transmission lines in the north-western region of Uzbekistan (Republic of Karakalpakstan and the Navoi region) are expected to be developed by 2025 in linewith the Concept Note for ensuring electricity supply in Uzbekistan in 2020-2030,which could also help take advantage of an enormous potential of solar and wind energy in the region. Moreover, to help NEGU modernise obsolete transmission/distribution lines and substations, the World Bank approved the Electricity Sector Transformation and Resilient Transmission Project in June 2021,which includes the rehabilitation, upgrade and expansion of 22 existing high-voltage

[4] Prepared by the author using data from the IEA website

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substations and the construction of a 500 kV transmission substation and associated transmission lines (World Bank, 2021)

More than 260 km of interconnection lines are planned to be constructed by 2025between Uzbekistan and its neighboring countries Afghanistan and Tajikistan, toexploit the potential electricity trade and interoperation. With regard to the distribution lines, more than 18 000 km will be modernized or constructed by 2025.

As can be seen from the data in the above table, the share of renewable energy sources in investments in the energy sector in 21 developing economies is presented. At the same time, the ratio of these investments to GDP, as well as the share of renewable energy sources in the source section, are indicated. In particular, if we analyze the share of renewable energy in total energy, this amount is significantly higher in countries such as Brazil, Colombia, Kenya, and Mozambique. 94 percent of Kenya's energy is generated from renewable sources. For comparison, in Saudi Arabia, this amount is only 0.2 percent. Kazakhstan, Russia, and Saudi Arabia rank high in energy investment as a percentage of GDP. In particular, Kazakhstan allocates more than 6 percent of GDP to energy. If we take the amount of investments made for clean energy in relation to the total energy, we can see that more than 50 percent of the investments made in the total energy in countries such as Bangladesh, Brazil, Chile, China, Colombia, India and the Republic of South Africa are directed to the production of clean energy.

The National Dispatch Centre under NEGU is in charge of dispatching all power plantsin accordance with the Rules for the Production, Transmission and Distribution ofElectrical Energy approved by the Cabinet of Ministers. Both NEGU and territorial JSCs under the Regional Electric Power Networks JSC are responsible for electricity transmission and distribution, respectively. The TPPs and some HPPs with reservoirsprovide flexibility to the power system, and are dispatched depending on electricity demand.Business entities such as independent power producers are guaranteed connection to the energy system, including electricity and thermal, and contract with NEGU to supply energy produced from renewable energy sources; the cost of connecting tothe energy system, including grid enhancement, is mainly borne by the entities. The technical procedure of the grid connection, including non-discriminatory access to the system for the business entities, is defined by the Regulation for Connecting Businesses that Produce Electricity, Including from Renewable Energy Sources, to the Unified Electric Power System, approved in July 2019.

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Table 3

The amount of investment in energy by the countries of the world.[5]

(2022, in percent)

Countries	Share of renewable sources in total energy	Investment amount relative to GDP)	Investing in clean energy (Relative to total energy)
Argentina	26	1,8	26
Bangladesh	2	3,1	68
Brazil	84	3,5	65
Chile	49	1,9	67
China	28	3,6	67
Colombia	66	1,9	67
Egypt	12	2,8	34
India	21	2,6	57
Indonesia	19	1,8	38
Kazakhstan	11	6,1	25
Kenya	94	2,4	48
Mexico	20	1,5	42
Morocco	18	2,8	34
Mozambique	84	2,4	48
Nigeria	24	2,4	48
Russia	20	4,4	22
Saudi Arabia	0,2	5,7	15
Senegal	12	2,4	48
Republic of South Africa	5	1,7	63
Thailand	17	2,5	45
Vietnam	35	2,5	45

Uzbekistan has great renewable energy potential, especially for solar energy. Witha view to ensuring energy security while optimising renewable energy resources,the government has implemented a wide range of measures to promote the integration of renewable energy into the energy system and private sector participation in the energy sector, including in large-scale solar energy projects. Uzbekistan has made a positive effort toward that end, including by setting clear

[5] Compiled by a researcher using data from World Energy Investment.

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targets and reforming the energy sector and has been progressing toward achieving the solar power capacity target of 4 GW by 2026 and 5 GW by 2030.Nevertheless, a more comprehensive set of policies and support mechanisms will be required to reach Uzbekistan's maximum capacity of solar energy and further increase solar energy toward 2030. The government should consider bundling the range of actions needed to ensure the use of all types of solar energy resources.This section presents a solar energy roadmap for Uzbekistan by 2030. It is based on current measures being implemented in Uzbekistan to break down the possible barriers to solar energy deployment discussed in the previous section. It aims tofacilitate the government's deliberation of its solar energy strategy and focuses on:

- ✓ maximising the benefits of solar energy in the energy system
- ✓ policy and regulatory frameworks enabling further solar energy deployment
- ✓ increasing power system flexibility to integrate the increasing amount of solar generation.

To maximise the benefits of solar energy, solar plants need to be installed inplaces where they can bring the highest value for the entire power system, i.e.they generate power where and when it is needed the most. This depends on thewhole system infrastructure, including the grid network and other non-solar powerassets, as well on electricity demand profiles.

Transparent information on electricity infrastructure and markets is therefore essential for creating an efficient electricity system as well as for providing current and prospective market participants with a level playing field and electricity market predictability. For example, EU member states are required to submit fundamental information such as generation, load and transmission for publication through the ENTSO-E Transparency Platform based on the EU's Transparency Regulation. Another example can be found in Germany, where one of the transmission system operators voluntarily makes its hourly network load data public.In the context of Uzbekistan, locational and capacity information on existing major power plants and transmission lines are available on the Ministry of Energy's and the JSCs' websites, while actual data such as generation by technology and network load currently are not available. As a part of the ongoing electricity market reform, the government should also consider improving the transparency of information and requiring the JSCs to provide this information.

Key policy actions for exploiting the potential of solar energy applications

Explore the techno-economic potential of solar energy applications for both electricity and heat, including solar thermal in buildings, industry and district heat systems.

- ➢ Ensure there is transparent information on electricity markets and infrastructure, including on generation facilities and transmission/distribution lines, in order to foster the development of solar installations in places where they maximise value to the whole power system.
- ➢ Encourage investment in small- and medium-scale solar projects by setting clearpolicy targets with attractive incentive mechanisms, and monitor economic attractiveness as well as unintended system integration impacts and make relevant adjustments, if needed.
- ➢ Explore the relevance of off-grid solar PV, solar thermal and solar PV2heatapplications in remote areas.

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- Assess the potential of floating solar PV on existing hydropower reservoirs.
- Assess the options to integrate solar thermal energy into district heating networks, taking advantage of existing district heating infrastructure.
- Consider the possibility of facilitating electric heat pumps.

Phasing out fossil fuel subsidies

Fossil fuel subsidies could not only create structural risks to government budgetsand the financial performance of the energy sector, but also hamper cleaner andmore efficient energy in the future by increasing fossil-based carbon emissions. During the COP26 in November 2021, almost 200 countries, including Uzbekistan,agreed to phase out inefficient fossil fuel subsidies.Such subsidies have significantly decreased in Uzbekistan in recent years, fromUSD 9.0 billion in 2018 to USD 3.8 billion in 2020 (Figure 12), but they still amountto 6.6% of total GDP in Uzbekistan (IEA, 2021c). As the power mix in Uzbekistanis dominated by natural gas, fossil fuel subsidies are also reflected in electricity prices.

CONCLUSION

Uzbekistan has abundant renewable energy potential, most of which lies in solar energy thanks to high solar irradiation. However, until now energy supply has been dominated by fossil fuels, with renewable energy – almost exclusively hydropower – accounting for only 1% of its total energy production in 2019.To satisfy growing energy demand while promoting renewable energy use, the government of Uzbekistan has adopted a wide range of energy strategies and laws and has been undertaking energy sector reform to increase solar energy useand make it a key energy source by 2030.These efforts could be complemented by: further exploring the potential of solarenergy applications; establishing policy and regulatory frameworks to enablegreater deployment of solar energy facilities; and increasing power system flexibility to address the variability of VRE generation. These aspects includephasing out inefficient fossil fuel subsidies while protecting economically vulnerable consumers, implementing tariff reform, and investing in upgrading and improving the capacity and reliability of the power transmission system. All of thiswould allow Uzbekistan to better integrate increasing amounts of solar energy through 2030.

Moreover, integrating the country's solar energy strategy into the larger Uzbekenergy strategy, while also looking towards increased regional co-operation, particularly on electricity trading, will allow Uzbekistan to truly take advantage ofits significant solar potential in a cost-efficient manner.The possible actions need to be undertaken in a timely and systematic manner to achieve a solar energy future in Uzbekistan by 2030. As a first step through 2025,the solar roadmap should duly consider short- and medium-term policy targets already set, including the formation of an electricity market formation 2023 and the renewable generation ratio of 20% by 2025. Accordingly, the government should properly explore the potential of solar energy applications for both electricity andheat with clear targets and attractive incentive mechanisms, while progressively phasing out fossil fuel subsidies to level the playing field with renewable energy sources. During the process of developing electricity market design and regulations, the government also needs to ensure non-discriminatory access tothe power grid for all generators and formulate clearer rules on permitting. The needs for power system flexibility remain limited during this term, but the government should consider necessary measures to ensure that existingconventional power plants and solar PV itself could serve as flexibility options.

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