DEVELOPMENT RESOURCES FOR ENERGY IN MODERN UZBEKISTAN

https://doi.org/10.5281/zenodo.15491657

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Abstract: The integration of clean energy solutions in Uzbekistan—encompassing solar, wind power, biogas derived from organic matter, as well as micro-hydropower harnessed from both natural and manmade water channels—has been a pressing societal issue over the years. Viewing this through a lens that extends into the future, reliance on renewable energy sources is undoubtedly imperative for securing robust energy supplies alongside ensuring environmental and economic stability in the country. Furthermore, it is pivotal not only to foster sustainable development within its energy sector but also to safeguard natural resources for posterity and enhance ecological conditions. Uzbekistan actively promotes the development of renewable energy sources as part of a broader strategy to diversify the energy portfolio, reduce dependence on fossil fuels and address environmental issues. The government aims to generate at least 30% of its electricity from RES by 2030, with a focus on solar and wind energy, given the country's abundant natural resources. Significant investments have been made in solar power projects, such as the Navoi Nur Solar Power Plant, and wind farm developments. Additionally, Uzbekistan is fostering international partnerships and collaborations to enhance its technological capabilities and improve infrastructure related to renewable energy, reflecting a strong commitment to sustainable development and energy security.

Key words: solar energy, renewable energy sources, energy, and potential fuels energy, energy resources.

INTRODUCTION

For the last decade-and-a-half, a global surge has seen renewable energy systems advancing rapidly across numerous nations. This progress has propelled these clean technologies to reach performance benchmarks and cost-efficiency rivaling or exceeding those of conventional methods—specifically those relying on fossil fuels or nuclear power for thermal and electrical generation.

As of now, global installed electric power capacity hovers around a massive 5000 GW across all types of power plants. Non-hydropower renewables alone stand at approximately 1000 GW and surpass the total nuclear power generation (about 350 GW) by an impressive threefold margin. The financial landscape significantly tilts towards renewable energy: investments have soared to over $250 billion annually, marking a thrice increase compared to traditional energy sources and five times that of both atomic and large-scale hydropower combined. This shift has been especially pronounced since 2013 when annual additions in renewable capacity began outpacing the expansion of conventional power plants by substantial measures.

MATERIALS AND METHODS

The advancement of renewable energy is not uniform across the globe, with the most rapid progress occurring in nations that deal with high energy prices and are largely dependent on imported energy sources. However, even though renewable energy will soon play a big role in the energy sector of every nation, including those who are currently wealthier, reserves organic fuel. In this communications support research and developments in region promising technologies practical use renewable sources energy is relevant task for everyone countries, caring development prevention of complete technological dependence from future equipment and technology deployment, as well as national scientific and technical competencies in this prospective region.

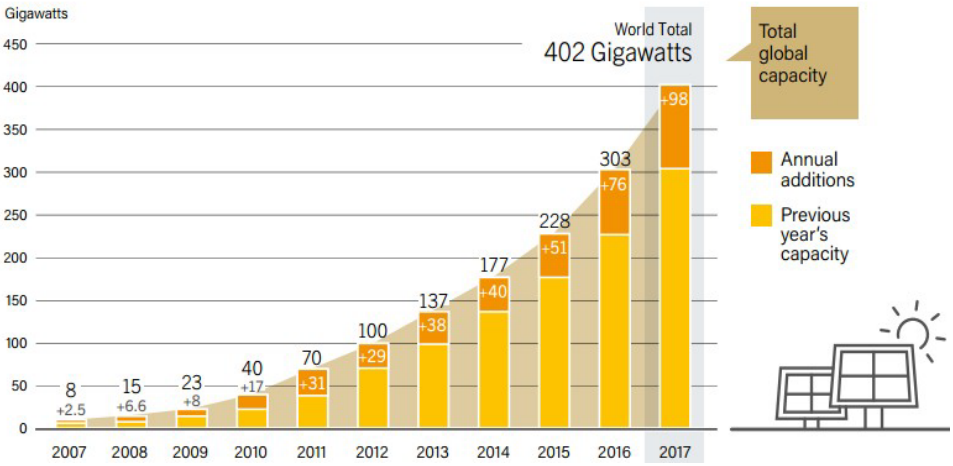
The Republic of Uzbekistan's renewable energy resources. Utilizing renewable energy sources is essential in the Republic of Uzbekistan's present economic expansion

phase, not only to provide energy security but also to raise living standards in areas far from centralized electrical systems. Equally significant is the opportunity to conserve hydrocarbon resources, pr oviding fuel for future generations and alleviating environmental challenges.

Main components RES in Republic Uzbekistan's energy sources include geothermal, wind, hydraulic, solar, and biomass. The technological potential of renewable energy sources in the Republic of Uzbekistan is more than three times greater than the yearly need for energy resources, reaching 270 million tons of conventional fuel, according to the findings of a study carried out by Uzbek scientists. There are 250–270 cloudless days and 2850–3050 hours of sunshine.

Kinds renewable sources energy	**Potential in million t.e.t./year**		
	In Uzbekistan		In world
	gross	**technical**	gross
Solar energy	76459.5	265.1	**131x10 6**
Wind energy	3.33	0.64	**2x10 6**
Hydraulic energy	3.43	0.39	**7x10 6**
Energy biomass	13.8	2.92	**0.1x10 6**
Total	**76480.0**	**269.05**	**1401x10 6**

Regions	$q_{\perp}$, *MJ / m2*	n, *watch*	$q^{\Sigma}_{\alpha=30^{o}}$, *MJ / m2*
North republics (Republic of Karakalpakstan, Khorezm areas , andnorth Navoi region)	6840-7560	2900-3000	**700-7250**
South of the republic (Kashkadara andSurkhandara region)	6840-7056	2950-3050	**7600-7700**
Fergana sky valley (Fergana, Andijan And Namangan region)	5400-5580	2650-2700	**6600-6650**
Zaravshan valley (Jizzakh, the Bukhara region, Samarkand, and South Navoi region)	6876-7128	2930-3000	**7200-7300**
Tashkent	**6995**	**2852**	**6700**



Over the last ten years, from 2007 (8 GW) to 2017 (402 GW), the global growth rate of solar power plants has been 48%. (2018, 110 GW). In the Republic of Uzbekistan less than 10 MW

From 2014 onward, the subsequent solar photovoltaic facilities have been laun ched across the Republic of Uzbekistan.

Place location	Power	Year
Experienced photovoltaic station in Papal region (Namangan region)	130 kW	**2014 G.**
Almalyk mining and metallurgical plant(Almalyk area Tashkent region)	112 kW	**2015 G.**
observatory of the Republic of Uzbekistan's Maidanak Institute Astronomy Academy of Sciences (Kashkadarya region)	27 kW	**2016 G.**
Kandymsky gas processing complex (Karakul area Bukhara region)	1.2 MW	**2016 G.**
Tashkent State Technical Institute's Faculty of Energy (Tashkent)	20 kW	**2016 G.**
International Solar Energy Institute (Tashkent)	28 kW	**2017 G.**

The role of solar energy in Uzbekistan's energy system. The modern e conomic progress of nations is closely intertwined with transformations in the energy sector. The capability of the economic framework to provide inexpensive and depend able energy is an essential factor for the stability and resilience of economic advance ment.

Harnessing solar energy to produce electricity began in the late 1950s. At that t ime, semiconductor solar cells were developed specifically for application in spacecra ft [1].

RESULT

These days, solar energy can supply electricity for both spaceships and the expanding human population. In order to provide electricity to humanity, it is necessary to actively develop solar energy. In developed countries, great attention is paid to the development of systems based on renewable energy sources (RES), including solar energy.

Considering the climate characteristics of the various areas within the Republic of Uzbekistan, assessments regarding the impact of temperature on the performance of photoconverters were conducted. Based on these assessments, photovoltaic panels were designed to function optimally in extreme continental climate conditions [2].

One of the urgent tasks of modern energy is the development and creation of low-cost and environmentally friendly renewable energy sources. The climatic and natural conditions of Uzbekistan provide excellent opportunities for solar energy (SE) [3].

Thus, while exploring the possibilities, many states were interested in building and investing in the construction of photovoltaic power plants. One of the key pacts involves the execution of loan and warranty agreements aimed a t financing the nation's inaugural 100megawatt solar photovoltaic power facility, bols tering its initiatives for clean energy generation, enhancing supply resilience, and figh ting climate change. PJSC 'Abu Dhabi Future Energy Company' (Masdar), the Asian Development Bank (ADB), and the Government of Uzbekistan were involved in this accord.

The Asian Development Bank and the International Finance Corporation (IFC) Bank (ADB) are pledging up to $60 million to support the initiative, marking the inaugural large-scale, privately owned and managed renewable energy facility in Uzbekistan. The European Bank for Reconstruction and Development (EBRD) is extending a bridge loan to Masdar to cover the project's funding requirements. In the meanwhile, the World Bank is offering a payment guarantee of US$5.1 million to the Government of Uzbekistan to ensure compliance with project payment obligations, while providing assistance in establishing a favorable climate for the use of renewable energy sources in Uzbekistan.

It is expected that the facility's 300,000 solar panels, which span 268 hectares and are situated 35 kilometers east of Navoi city, would begin supplying electricity straight to the national power grid in 2021. With enough solar energy to power more than 31,000 homes, it is anticipated to produce 270 gigawatt-hours of electricity yearly and reduce the annual emissions of 156,000 metric tons of greenhouse gases.

Through this initiative, Uzbekistan will be able to reduce its dependency on coal and natural gas, as the country now generates 85% of its electricity from thermal power plants. This initiative will also promote the utilization of renewable energy sources and aid in the generation of electricity, which is anticipated to rise from 65,000 Gigawatt-hours (GWh) in 2019 to 103,000 GWh by 2030 to satisfy the swiftly increasing demand nationwide.

The IFC Europe and Central Asia Director stated, "The project will have a huge impact by serving as an example of best practice in Uzbekistan, opening new markets for private investment, and helping to achieve the country's goal of increasing the use of renewable energy." Wiebke Shlemer .

DISCUSSION

The financial arrangement for the initiative encompasses as much as $20 million in senior loans sourced from IFC's own resources, along with up to $20 million from the Canada-IFC Blended Climate Finance Program, and an additional $20 million contribution from ADB. IFC will also extend up to $1 million in interest rate swaps. Moreover, the World Bank will provide a payment guarantee amounting to $5.1 million. This assurance will be used to make sure that the National Electricity Grid of Uzbekistan (NEG) can meet its commitments stemming from the electricity purchase agreement established with Masdar while also covering the risk of non-payment for the electricity delivered.

A foreign entity, Nur Navoi Solar, will construct and manage the plant. This li mited liability company (project company) is owned by Masdar, the UAE's renewabl e energy company. The first nation outside of Africa to take part in this program is Uzbekistan. Masdar has promised to supply power for just 2.679 for the next 25 years.

The lowest solar rate in Central Asia to date is US cents per kilowatt-hour. Electricity will be sold to the Distribution Zone by the project business at this set price until 2046.

In light of the agreement, it should be mentioned that this project's execution will present a chance to advance Uzbekistan's energy system and implement renewable energy sources, as well as increase independence from traditional energy sources.

Solar power plant power 130 kW (area Pap, Namangan)

Solar power plant with capacity 1.2 MW (area Karakul, Bukhara)

Sfes power 27 kW (Ltd. "International institute solar energy")

CONCLUSION

Energy has indeed played a transformative and crucial role in shaping human civilization, enabling advancements in various fields and improving the quality of life for individuals and societies. The availability and utilization of energy have driven progress, from basic necessities like food, water, and shelter to technological innovations and economic growth. Throughout history, the shift from one primary energy source to another - such as wood to coal, coal to oil, and oil to renewable sources - has correspondingly influenced societal development and opened up new possibilities for human progress.

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