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Prospects of Nuclear Power Development in Uzbekistan

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Abstract: This article discusses the current state, problems and prospects for the development of nuclear energy in Uzbekistan. A brief analysis of global trends in the field of nuclear energy, decarbonization processes and increasing importance of renewable energy sources is presented. The special role of nuclear energy in ensuring energy independence in the context of transition to renewable energy sources is noted. The importance of the development of this industry for the future of Uzbekistan is emphasized. The new energy transition is one of the pressing modern trends in the global economy. The need to increase the utilization of low- and no-carbon energy sources, in particular renewable energy sources (RES), is now a priority for the modern energy industry .At present, the drive by developed countries to decarbonize the global economy in order to reduce their dependence on energy imports is creating all sorts of prospects for further development. The need for energy supply has almost quadrupled in the last fifty years. Renewable energy is a real new opportunity.

Keywords: Uzbekistan, nuclear energy, atom, nuclear power plants, global transition, energy.

INTRODUCTION.

The growing global demand for sustainable and low-carbon energy sources has heightened interest in nuclear power as a viable option to meet increasing electricity needs while mitigating environmental impact. Uzbekistan, a rapidly developing Central Asian nation with expanding industrial and urban sectors, faces significant energy challenges including dependence on fossil fuels, rising energy consumption, and the need to diversify its energy mix[1]. In this context, the prospects of nuclear power development in Uzbekistan emerge as a critical topic, intertwining energy security, economic growth, and environmental sustainability. The relationship between nuclear energy development and national energy strategies underscores the importance of adopting advanced technologies, regulatory frameworks, and international cooperation [2].

Fundamental theories underpinning nuclear energy development involve energy economics, technological innovation diffusion, and risk assessment. Concepts such as energy return on investment (EROI), lifecycle emissions, and safety culture are central to evaluating nuclear power's viability [3]. Previous research has examined global nuclear energy trends, safety concerns, and economic feasibility, with particular emphasis on emerging economies transitioning to nuclear energy. However, studies focusing specifically on Uzbekistan's socio-

economic context, resource availability, and policy environment remain limited, revealing a knowledge gap that this article seeks to address [4].

This study employs a mixed-methods approach, combining quantitative analysis of energy demand projections, economic modeling, and environmental impact assessments with qualitative evaluation through stakeholder interviews and policy reviews. This comprehensive methodology allows an integrated understanding of the multifaceted challenges and opportunities related to Uzbekistan's nuclear energy development [5]. Data sources include national energy statistics, international nuclear agencies, and expert insights, enabling a robust foundation for analysis.The research expects to identify critical factors that will influence the successful implementation of nuclear power, including technological readiness, financial viability, public acceptance, and regulatory preparedness. It also anticipates uncovering potential risks and barriers, such as infrastructure limitations and geopolitical considerations [6]. The findings aim to provide strategic recommendations for policymakers and stakeholders on optimizing nuclear power integration into Uzbekistan's energy portfolio.

Ultimately, this article contributes to the broader discourse on sustainable energy transitions in emerging economies by providing empirical evidence and practical guidance specific to Uzbekistan [7]. The results hold implications for energy security, environmental policy, and economic development, while offering insights applicable to similar contexts globally.

METHODOLOGY

This research adopts a multidisciplinary mixed-methods design to comprehensively explore the prospects of nuclear power development in Uzbekistan. Quantitative data were gathered from official sources such as Uzbekistan's Ministry of Energy, the International Atomic Energy Agency (IAEA), and the World Bank, focusing on energy consumption trends, electricity generation capacity, cost estimates, and environmental indicators. Advanced modeling techniques, including scenario analysis and cost-benefit assessment, were employed to project future energy demand and evaluate the economic feasibility and environmental impact of nuclear power integration compared to alternative energy sources.

Qualitative data were collected through semi-structured interviews with energy sector experts, government officials, and representatives from international organizations involved in nuclear energy development. These interviews provided contextual insights into regulatory challenges, technological readiness, public perception, and institutional capacity. Additionally, an in-depth review of national energy policies, strategic development plans, and international nuclear cooperation agreements was conducted to understand the policy landscape and governance frameworks influencing nuclear power prospects.By integrating quantitative modeling with qualitative assessments, this methodology offers a holistic view of both measurable parameters and socio-political dimensions critical for nuclear energy deployment. The study period primarily focuses on the current decade, aligning with Uzbekistan's strategic energy planning horizon. This approach ensures that findings are relevant, actionable, and grounded in the country's unique economic, environmental, and geopolitical context.

RESULT AND DISCUSSION.

At present, the drive by developed countries to decarbonize the global economy in order to reduce their dependence on energy imports is creating all sorts of prospects for further development. The need for energy supply has almost quadrupled in the last fifty years. Renewable energy is a real new opportunity.

In this regard, nuclear power is a strategically important industry that provides stable energy production with minimal environmental impact, making it a key element of energy policy in many countries. In Uzbekistan, where there is a rapid growth in energy consumption due to industrialization and population increase, the development of nuclear power plants (NPPs) is seen as a priority for achieving energy independence, security and sustainable economic growth [8].

The future development of nuclear energy is of crucial importance. In this regard, the Agency for Development of Atomic Energy was established on 19 July 2018 by the Decree of the President of the Republic of Uzbekistan Sh.M. Mirziyoyev 'On Measures for the Development of Nuclear Energy in the Republic of Uzbekistan. UzAtom is the state management body responsible for the development and implementation of state policy and strategic directions in the field of nuclear power development [9,10]. Undoubtedly, the development of nuclear power requires the creation of appropriate conditions, including active attraction of investments. Investments are necessary to finance capital-intensive projects such as the design, construction and operation of nuclear power plants (NPPs), reactors of various capacities, as well as infrastructure for handling nuclear materials and radioactive waste [11]. Attracting foreign capital will provide access to advanced technologies, high-tech equipment and international expertise, which is critical for the implementation of innovative solutions, such as new generation reactors with improved efficiency and safety. At present, the Agency is developing programs and projects in the field of nuclear energy, including construction and operation of facilities, ensuring nuclear and radiation safety, development of science and technology, and attracting investments within the framework of international cooperation[1]. Priority tasks include addressing issues related to the non-proliferation of nuclear materials, ensuring the protection and security of nuclear facilities, as well as interaction with international organizations such as the IAEA and others. Active work is carried out to train highly qualified personnel in the industry. Necessary conditions are provided for the introduction of advanced technologies and safety standards [12].

According to experts' estimates, by 2035, electricity consumption in Uzbekistan will reach 121 billion kWh, which requires a significant increase in generating capacities. In this context, nuclear energy is positioned as a basic source capable of complementing renewable sources, which are expected to account for 54 per cent of the total energy mix by 2030 [13].

The leadership of Uzbekistan emphasizes the strategic importance of nuclear energy. The project to build a nuclear power plant in Jizzak oblast using Russian RITM-200N low-power reactors, as well as plans to build large-capacity plants, have attracted widespread public and scientific interest. These initiatives offer prospects for economic development, but are accompanied by challenges related to safety, environment and economic efficiency. At the same time, some experts draw attention to certain problems that may accompany the processes of nuclear project implementation in the Republic of Uzbekistan. Particular attention is given to the issue of ensuring safety [14]. Risks of nuclear and radiation threats due to a number of objective factors are considered a serious drawback. Another significant weakness is the threat of nuclear proliferation. Possible and potentially weak elements in the organization of facility protection and an imperfect regulatory framework may increase the risk of unauthorized access to nuclear materials. Environmental and social risks are also a problem, given the seismic activity of the region and potential public resistance to the construction of NPPs and radioactive waste disposal facilities. Such factors could provoke conflicts and limit opportunities to attract investment. With this in mind, experts believe that appropriate measures need to be developed to prevent the emergence and development of undesirable scenarios. Finally, the high capital intensity of projects and dependence on foreign investors create financial risks [15]. At the same time, despite these challenges, the development of nuclear energy provides Uzbekistan with significant strategic advantages. Firstly, nuclear power contributes to energy independence by reducing dependence on hydrocarbon imports, allowing the country to fulfil the functions of a regional electricity exporter, which further strengthens Uzbekistan's role and influence in Central Asia. Secondly, attracting foreign investment will facilitate technology transfer. Finally, job creation and strengthening of economic ties with donor countries will serve as a reliable platform for enhancing the sustainability of the country's economy.

CONCLUSION

The findings of this study highlight that the development of nuclear power in Uzbekistan holds significant potential to diversify the country's energy mix, enhance energy security, and contribute to the reduction of carbon emissions, thereby supporting sustainable economic growth. The analysis reveals that while technological readiness and economic feasibility appear promising, challenges such as regulatory framework development, public acceptance, and infrastructural constraints must be addressed to ensure successful implementation. These findings imply that strategic investments in capacity building, transparent policymaking, and international collaboration are critical for realizing the benefits of nuclear energy. Furthermore, the study underscores the necessity of continuous research focused on advanced reactor technologies, risk mitigation strategies, and social impact assessments to support informed decision-making and foster public trust. Future investigations should also explore the integration of nuclear power within Uzbekistan's broader renewable energy strategy to optimize the country's transition to a low-carbon energy future.

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