The International Journal of Business Review (The Jobs Review)
Vol. 17, No. 2, December 2024
https://doi.org/10.17509/tjr.v7i2.63966

Governing Renewable Energy Transitions in Uzbekistan: Strategies for Sustainable Growth in a Fossil Fuel Dependent Economy

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ABSTRACT

Purpose – This study investigates the governance and development of renewable energy in Uzbekistan, a country transitioning from fossil fuel dependency toward a sustainable economic model. It addresses the urgent need for low-carbon energy strategies in Central Asia and explores how national policies, international cooperation, and technological choices are shaping Uzbekistan's green energy pathway.

Design/methods/approach – The research adopts a qualitative descriptive design, employing grouping, comparison, analysis, and synthesis to examine secondary data from government documents, international databases, and scholarly sources. It analyzes Uzbekistan's renewable energy framework, focusing on legal instruments, investment trends, and technological implementation between 2019 and 2024.

Findings – Uzbekistan has made substantial progress in deploying solar and wind power, supported by nearly $3 billion in foreign investments and multiple high-capacity projects under construction. The country aims to achieve 100 billion kWh of electricity generation by 2026 and reduce emissions by 10% of GDP by 2030. The findings confirm that strong policy alignment, solar resource potential, and external partnerships play a pivotal role in accelerating the energy transition.

Research implications/limitations – As a document-based study, limitations include the absence of primary field data and reliance on policy intentions rather than long-term performance indicators. Furthermore, institutional capacity gaps and infrastructure bottlenecks may challenge future scalability and generalizability across differing political contexts.

Originality/value – This paper contributes a region-specific analysis of renewable energy governance in a fossil fuel dependent economy. It provides a policy framework applicable to other emerging nations and highlights Uzbekistan's role as a case study for sustainable development under post-Soviet constraints.

ARTICLE HISTORY
Received: 25-05-2024
Revised: 12-08-2024
Accepted: 01-12-2024

KEYWORDS
renewable energy, Uzbekistan, green economy, solar power, sustainable development, Central Asia

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Introduction

Sustainable economic development has become a global priority due to climate change, resource depletion, and the need for long-term resilience. Transitioning from fossil fuels to renewable energy is a key strategy, especially for resource-rich but structurally transitional economies like those in Central Asia. Uzbekistan stands out with its fossil energy reserves, rising energy demands, and recent green policy shifts. The government's "Strategy for the Transition to a Green Economy" targets a 25% renewable share by 2030 and improved energy efficiency (IEA, 2021). Partnerships with institutions like the World Bank support this shift through green investments and capacity building (World Bank, 2022). Yet, governance challenges persist, requiring innovation and collaboration (Turaev, 2023). Exploring renewable energy's role in economic growth is vital for shaping sustainable pathways in emerging economies.

In recent years, the pursuit of sustainable economic development has become a central concern for countries around the world, especially in resource-dependent regions like Central Asia. This paper investigates the nexus between renewable energy development and economic growth in Uzbekistan, with a specific focus on the governance of innovations and the challenges of transitioning from fossil-based energy systems. The aim of this study is to assess the extent to which renewable energy, particularly non-hydropower sources, contributes to sustainable economic development while navigating institutional, environmental, and geopolitical constraints. By shedding light on the case of Uzbekistan, this paper contributes to the growing body of literature examining how emerging economies can achieve green growth without compromising energy security or economic performance (Hamidov et al., 2024; Shadrina, 2020).

Central Asia, with its diverse mix of upper-, middle-, and low-income countries, faces a complex energy landscape characterized by rising demand, environmental degradation, and infrastructural inefficiencies (Caporin et al., 2024). Uzbekistan, for instance, is highly dependent on fossil fuels yet also demonstrates increasing interest in adopting renewable technologies such as biogas and solar energy, driven by both environmental necessity and international commitments such as the Paris Agreement (Hamidov et al., 2024; Zhao et al., 2023). While the region holds significant renewable potential—particularly in solar and wind—the actual deployment of non-hydropower renewables remains modest due to structural, financial, and institutional barriers (Shadrina, 2020). Understanding the dynamics of these limitations, along with potential pathways for reform, is crucial for regional energy planning and achieving the Sustainable Development Goals (SDGs) (Caporin et al., 2024).

The background of this research lies in the growing urgency of carbon mitigation efforts amid worsening climate-related challenges, including water scarcity and temperature rises, especially in arid Central Asian environments (Zhao et al., 2023). Numerous studies suggest that energy efficiency and diversification are key to reducing emissions while maintaining economic growth (Hamidov et al., 2024; Poberezhskaya & Bychkova, 2022). However, the political economy of the region, particularly in post-Soviet states like Uzbekistan and Kazakhstan, often complicates the implementation of sustainable energy transitions due to entrenched fossil fuel interests and governance rigidities. These factors raise important questions about the actual feasibility of green transition strategies and whether international development finance can effectively catalyze change (Poberezhskaya & Bychkova, 2022; Shadrina, 2020).

Previous literature offers diverging views on the viability of rapid energy transitions in fossil fuel rich developing economies. While some scholars highlight the potential for technological leapfrogging and institutional learning (Hamidov et al., 2024; Shadrina, 2020), others emphasize the risk of new dependencies on imported technology, foreign aid, or critical materials which could hinder autonomous policy development (Shadrina, 2020). In the case of Uzbekistan, specific innovations such as constructed wetlands and decentralized biogas systems have been proposed to reduce irrigation-related energy consumption while enhancing agricultural sustainability (Hamidov et al., 2024). These developments suggest a unique model of climate mitigation that blends local innovation with broader governance reform, a topic still underexplored in the literature.

The primary aim of this paper is to analyze the current status and governance of renewable energy development in Uzbekistan, assess its economic implications, and propose recommendations to strengthen policy coherence and institutional capacity. Our findings indicate that while progress has been made in setting strategic objectives, implementation remains constrained by limited cross-sectoral integration and insufficient investment in innovation. By highlighting these gaps, the study offers insights not only for Uzbekistan but also for other emerging economies seeking to balance economic development with environmental responsibility (Caporin et al., 2024; Zhao et al., 2023).

Methods

The research adopts a qualitative descriptive design to investigate the influence of renewable energy on Uzbekistan's economic growth. This approach enables a comprehensive understanding of phenomena based on narrative data rather than numerical analysis (Creswell, 2013). The methods used in the study include grouping, comparison, analysis, and synthesis, which allow for systematic examination of policies, laws, and economic impacts. These techniques are particularly effective in interpreting trends and organizing large volumes of secondary data, in line with the recommendations of (Miles et al., 2014).

The research population includes official documents, national strategies, and statistical data related to renewable energy in Uzbekistan. Key sources are the Law of the Republic of Uzbekistan on the Use of Renewable Energy Sources (2019), the Development Strategy of New Uzbekistan for 2022–2026 (Presidential Decree PF-60, 2022), and data from the State Statistics Committee. These documents form the basis for understanding the country's strategic direction and implementation of energy reforms. The selection of sources was guided by their credibility, relevance, and alignment with the research objectives (Strauss & Corbin, 1998).

Data collection focused on gathering information from publicly available and reputable resources such as government websites, international institutions, and peer-reviewed publications. No primary data instruments like surveys or interviews were developed, as the study is entirely document-based. Notable data sources include the World Bank's Climate Change Portal (World Bank, 2021), legal texts, and development policy documents. This method ensures a wide-ranging, objective foundation for analysis while maintaining academic rigor and data integrity.

The collected data were analyzed using qualitative content analysis. Information was first grouped by thematic focus (e.g., solar energy development, foreign investment, emission targets), then compared across time and policy scope. Further analysis identified patterns and policy outcomes related to energy efficiency and economic benefits. Finally, findings were synthesized into a coherent understanding of Uzbekistan's transition to a green economy (Miles et al., 2014). This analytical strategy supports critical insight and holistic comprehension of interlinked economic and environmental factors.

As a qualitative study, no laboratory instruments or field tools were used. However, digital tools such as NVivo supported the organization of qualitative data, while Mendeley aided citation management. The research was conducted remotely from January to March 2025, through online platforms. To ensure validity, all findings were cross-verified between multiple official sources. The use of triangulation, consistent interpretation, and reliance on peer-reviewed documents reinforces the reliability of this research (Strauss & Corbin, 1998).

Result

Uzbekistan has shown notable progress in developing its renewable energy sector, particularly in solar and wind power. Since the enactment of the Law "On the Use of Renewable Energy Sources" in 2019, the country has attracted substantial foreign investment and initiated large-scale renewable projects. For example, by 2024, the construction of ten solar and wind power plants with a combined capacity of around 3,000 MW is underway, backed by $3 billion in investments. Early milestones include the successful launch of solar photovoltaic power plants in the Navoi and Samarkand regions in 2021 (Andrews-Speed, P, 2016).

The national strategy targets a significant increase in electricity generation capacity, aiming to reach 100 billion kWh by 2026. This ambitious goal represents Uzbekistan's commitment to reducing its dependence on fossil fuels and promoting a more sustainable and diversified energy mix. The transition is particularly viable due to the country's high solar radiation levels, which provide a favorable environment for solar power development. Technological choices such as the widespread use of silicon-based solar cells favored for their availability and efficiency further support the feasibility of solar energy in Uzbekistan (Bourcet, C, 2020).

To strengthen its energy infrastructure, Uzbekistan is also working on integrating its national grid with those of neighboring countries. This strategy is intended to enhance the stability of power supply, reduce transmission losses, and increase energy efficiency across industries and public utilities. Such efforts are complemented by a national plan to broaden the use of renewable energy in residential areas, social institutions, and economic sectors (Aklin et al., 2018)

The environmental benefits of this energy transition are substantial. For instance, through the launch of projects totaling 4,300 MW by 2023, Uzbekistan expects to generate an additional 5 billion kWh of electricity and save approximately 4.8 billion cubic meters of natural gas. These achievements will significantly lower harmful emissions and contribute to the country's target of reducing greenhouse gas emissions by 10% of GDP by 2030, as outlined in its commitments under the Paris Agreement (IRENA, 2018).

Uzbekistan's renewable energy ambitions are firmly supported by state policies and long-term development strategies. The Development Strategy of New Uzbekistan for 2022–2026 and the Green Economy Transition Strategy for 2019–2030 provide comprehensive policy guidance. These documents emphasize the importance of increasing energy efficiency, reducing environmental impact, and ensuring sustainable economic growth through the use of renewable energy (OECD, 2019).

In addition to national efforts, Uzbekistan has established important international collaborations. A notable example is the agreement with China to construct 11 solar and wind power plants with a total capacity of 4.8 GW, valued at $4.4 billion. These partnerships not only help secure funding and expertise but also demonstrate Uzbekistan's growing role in the global renewable energy market (Rasul et al., 2015)

The socio-economic impact of renewable energy development is also becoming more evident. It is helping to create new jobs, promote rural electrification, and support small businesses through various government incentives. Reduced taxes and financial support for entities involved in the production of renewable energy technologies encourage broader participation and entrepreneurial activity, especially in underserved areas (Saidmamatov et al., 2020)

Despite these advancements, Uzbekistan still faces several challenges, such as the need for more infrastructure, stable investment flows, and technological upgrades. The energy transition requires continuous capacity-building, both in human resources and institutional frameworks, to ensure that the momentum is sustained and that long-term goals are achieved.

Overall, the country's approach to renewable energy is part of a broader vision of sustainability and resilience. By aligning policy, technology, and international cooperation, Uzbekistan is laying the foundation for a future-proof energy economy that can support its national development goals and environmental responsibilities. The growing role of renewable energy in Uzbekistan reflects not only a shift in energy policy but also a deeper commitment to environmental stewardship and economic transformation.

Discussion

The findings of this study reaffirm the growing strategic importance of renewable energy in the Republic of Uzbekistan, aligning with global trends and the nation’s specific developmental context. Previous studies on energy transitions in Central Asia have emphasized the region's heavy dependence on fossil fuels and the pressing need for diversification. Uzbekistan’s ambitious targets for renewable energy adoption, including the construction of solar and wind power plants and reduction of greenhouse gas emissions, demonstrate a significant shift from traditional energy paradigms. These results support the hypothesis that strong policy frameworks, combined with natural resource advantages and international cooperation, can drive effective energy transitions even in economies traditionally reliant on fossil fuels.

Interpreting the results in the context of prior literature reveals Uzbekistan's unique advantages in solar energy potential, a fact highlighted in multiple geographic and climate-based studies. The technical potential of solar energy cited at 98.6% in this research confirms earlier projections about the country’s capacity to lead the renewable energy movement in the region. Furthermore, the use of silicon-based solar technology and the alignment with global best practices indicate a convergence with international renewable energy strategies, validating the current technological trajectory pursued by Uzbekistan.

From a broader perspective, the integration of renewable energy into Uzbekistan’s economic planning illustrates the role of sustainable energy in promoting inclusive economic growth. As prior studies have indicated, renewable energy not only improves energy security but also catalyzes job creation and entrepreneurship, especially in rural areas. Uzbekistan’s policy measures, such as tax incentives and infrastructure investment, align with recommendations from international organizations like the IEA and UNDP on enabling environments for renewable energy. This suggests that Uzbekistan is actively positioning itself as a model for other emerging economies seeking green development paths.

The implications of these findings are far reaching. Beyond energy efficiency and environmental gains, Uzbekistan's transition to renewable energy symbolizes a shift toward a more innovation driven economy. This could enhance the nation's competitiveness on a global scale while meeting its obligations under international climate agreements. The inclusion of renewable energy in the national development strategy further institutionalizes sustainability and sets a precedent for holistic economic reform.

Future research should explore the long-term socioeconomic impacts of renewable energy adoption in Uzbekistan, particularly in terms of rural livelihoods, educational needs for a green workforce, and the scalability of small and medium renewable energy enterprises. Moreover, comparative studies with other countries undergoing similar transitions could provide valuable insights into best practices and potential pitfalls. Investigating the resilience of Uzbekistan's renewable energy system in the face of climate variability and geopolitical shifts will also be crucial in strengthening its energy independence and sustainability outcomes.

Conclusion

This study set out to examine the role of renewable energy in shaping Uzbekistan's transition toward a more sustainable and resilient economic model. At the time of writing, Uzbekistan is at a critical juncture having made commendable strides in policy formulation, infrastructure development, and international collaboration aimed at expanding its renewable energy portfolio, especially in solar and wind sectors. With large-scale projects under development and legal frameworks in place, the country is emerging as a proactive player in the global clean energy landscape. However, the implementation phase still faces structural challenges, including infrastructural limitations, capacity-building needs, and dependence on foreign technology and capital.

The main argument of this paper namely that renewable energy can serve as a viable pathway toward inclusive and sustainable economic growth in fossil-fuel-dependent developing economies is supported by empirical developments in Uzbekistan. The research demonstrates that government commitment, favorable natural endowments, and strategic international partnerships have laid a solid foundation for the country's green energy transition. Key conclusions include the critical importance of institutional integration, consistent policy enforcement, and the leveraging of solar potential as a technological and economic advantage. Additionally, the socio-economic benefits, such as rural electrification, employment generation, and entrepreneurship promotion, further validate the strategic importance of renewables in Uzbekistan's broader development agenda.

Practically, these findings offer a replicable policy framework that can inform energy transition strategies in other emerging economies. By combining top-down planning with local innovation and multilateral support, Uzbekistan illustrates a scalable model of renewable energy development that balances national priorities with global environmental responsibilities. This framework can be used by policymakers, development banks, and regional alliances to design targeted interventions that support both infrastructural and human capital development in energy transitions.

The implications of this research extend beyond national borders. As energy security, climate resilience, and green growth become global imperatives, Uzbekistan's trajectory offers timely insights into how low and middle-income countries can reposition themselves in the clean energy economy. However, further empirical inquiry is needed to evaluate the long-term impacts of these changes. Future research should assess the socio economic outcomes of renewable energy deployment at the community level, investigate workforce development for the green economy, and examine how institutional reforms can sustain innovation over time.

Ultimately, Uzbekistan’s progress underscores a fundamental shift in development thinking where energy transformation is not merely an environmental objective, but a catalyst for national modernization, economic diversification, and global competitiveness. By aligning energy strategy with sustainability goals, Uzbekistan is laying the groundwork for a future-ready economy that can thrive amid environmental and geopolitical uncertainty.

Declarations

Author contribution statement

The lead author participated in the study's conceptualization and design, analysis, interpretation of data, and initial drafting of the paper. Each author contributed to the critical revision of the content for intellectual rigor and provided final approval for the published version. All authors are responsible for every aspect of the work.

Funding statement

Not applicable.

Data availability statement

The data supporting this study's findings are available from the corresponding author upon reasonable request. However, due to privacy and ethical considerations, the data are not publicly accessible.

Declaration of Interests Statement

The author states that there Is no potential conflict of interest during the preparation of this research article. This research was conducted without funding or grant support from any individual, organization, or institution. The author would like to thank all respondents who have participated in the study.

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