

RESEARCH ON THE TRANSFORMATION OF NATURAL GAS ENERGY POLICIES AND SUSTAINABLE DEVELOPMENT IN UZBEKISTAN

Sun peng

JV Aias trans gas company , chief specialist

365857088@qq.com

Gaoyajun

TRANSLINK SERVICE company, sinior manager

1240409766@qq.com

Sunyuxin

China Tjianjin Experimental High School

2073730140@qq.com

ABSTRACT

This paper systematically analyzes the core content of Uzbekistan's energy strategy transformation from 2022 to 2026, focusing on its natural gas exploration and development, market liberalization, renewable energy synergistic development, and chemical industry upgrade policies. Research indicates that Uzbekistan promotes market-oriented reform of its energy system through the "Development Strategy for New Uzbekistan 2022-2026," gradually abolishes natural gas price subsidies, establishes an energy wholesale market, and attracts private investment in renewable energy through tax incentives. Simultaneously, the country actively develops its natural gas chemical industry and promotes the implementation of GTL projects to achieve resource value-added goals. However, winter supply-demand contradictions, insufficient infrastructure, and unauthorized gas usage remain significant challenges. This paper evaluates the effectiveness and limitations of Uzbekistan's energy transition by combining policy texts and statistical data, providing a case reference for understanding Central Asian energy policies.

Keywords: *Uzbekistan; Natural Gas Policy; Energy Transition; Renewable Energy; Market Reform*

1. Introduction

Uzbekistan, as an important energy producer and consumer in Central Asia, ranks among the world's top countries in natural gas reserves, with proven reserves reaching 1.84 trillion cubic meters in 2022. However, the country's energy system has long faced multiple challenges: aging infrastructure leading to transmission loss rates

as high as 18%, significantly above the international average; energy subsidies accounting for over 12% of fiscal expenditure, creating a heavy burden; and rapidly growing domestic demand conflicting with export commitments. The "Development Strategy for New Uzbekistan 2022-2026," released in January 2022, marks a fundamental shift in energy policy paradigm, transitioning from state monopoly to comprehensive marketization and greening. This strategy not only sets specific energy efficiency targets (20% improvement) but also defines renewable energy development pathways (25% share) and market liberalization timelines. This study adopts a combined methodology of policy text analysis, statistical data analysis, and case studies to deeply explore the dynamic mechanisms, implementation paths, and challenges of Uzbekistan's energy transition, providing important references for energy policy research in Central Asian countries.

2. Literature Analysis and Methods

Existing academic research on Uzbekistan's energy sector has primarily focused on historical resource management models and macro-level policy frameworks. For instance, studies by Eshchanov et al. (2023) and the World Bank (2023) have extensively documented the fiscal challenges of energy subsidies and issues of infrastructure inefficiency. However, significant gaps remain in these studies: there is a lack of systematic analysis of the implementation mechanisms of market liberalization policies under the "Development Strategy for New Uzbekistan 2022-2026," and insufficient exploration of the interaction between natural gas market reforms and renewable energy integration.

To address these gaps, this study adopts a mixed-methods research approach. Firstly, policy text analysis of presidential decrees, energy laws, and ministerial regulations (2022-2026) is conducted to identify policy instruments and implementation timelines. Simultaneously, quantitative statistical assessment is performed using energy balance data from the National Statistics Committee (2022-2023), cost indicators from Uzbekneftegaz, and investment data from the ADB/EBRD. Additionally, in-depth insights into implementation challenges and institutional adaptations are obtained through case studies of typical projects (such as the Kashkadarya GTL project and the Karakalpakstan wind farm) and semi-structured interviews with experts from Uzbekneftegaz and the Ministry of Energy. This approach enables triangulation between policy intentions, implemented actions, and measurable outcomes, thereby providing a comprehensive assessment of Uzbekistan's energy transition dynamics.

3. Discussion

3.1 Structural Reforms in Natural Gas Exploration and Development

In response to the 2022 presidential decree, Uzbekistan implemented profound structural reforms in its oil and gas sector. The government launched its first international bidding round, offering 25 exploration blocks primarily situated in the Bukhara-Khiva and Fergana Basins, which attracted significant interest from energy companies in China, Russia, and Europe. These blocks are estimated to hold additional proven reserves of 300 billion cubic meters. To bolster investor confidence, Uzbekistan revised its Mineral Resources Law, specifying production-sharing contracts (PSCs) that allow foreign investors to receive up to 70% of production shares and extend tax benefits for 15 years.

Technological modernization has been a critical focus, with Uzbekneftegaz collaborating with international firms such as Schlumberger and Halliburton to introduce advanced 3D seismic exploration and horizontal drilling technologies. These innovations increased the exploration success rate from 35% to 65%, culminating in the discovery of a major gas field in Kashkadarya Province in 2023 with recoverable reserves of 850 billion cubic meters—the largest natural gas find in Central Asia in the past decade.

Uzbekistan is also emphasizing comprehensive resource utilization. The 2023 Associated Helium Recovery Program aims to establish three helium refining plants within five years, with an expected annual output of 20 million cubic meters, positioning the country as a key global helium supplier. These initiatives collectively enhance national energy security and drive industrial development through value-added resource management.

3.2 Market Liberalization and Pricing Reforms

Uzbekistan's natural gas market reforms adopted a gradualist approach, balancing social protection with economic incentives. The 2022 pricing adjustment strategy maintained stable residential gas prices while significantly raising industrial rates, particularly for high-consumption sectors such as cement and chemicals, which experienced price increases of up to 100%. This differentiated pricing mechanism aimed to encourage energy efficiency among industrial users without immediately impacting households.

Based on Ministry of Energy data, the comprehensive cost of natural gas was 880 soum/m³ in 2022, whereas the industrial selling price remained at 660 soum/m³, necessitating government subsidies of 220 soum/m³. The new pricing framework seeks to eliminate subsidies gradually by 2026 to achieve full cost recovery. Accompanying this transition, the government introduced an energy-efficiency loan

program offering 50% interest subsidies to enterprises investing in energy-saving equipment.

To address winter supply security—a critical issue linked to social stability—the government established a multi-tiered safeguard system. This includes a 10-year take-or-pay import contract with Turkmenistan for 5 billion cubic meters annually, priced against the Japan Crude Cocktail index; a \$320 million investment in expanding underground gas storage capacity to 5 billion cubic meters; and interruptible supply contracts for industrial consumers to prioritize residential demand during shortages. Nevertheless, subsidy mechanisms continue to strain public finances, with Uzbekgas incurring losses of 5 trillion soum in 2022, equivalent to 4.3% of the national budget. In response, a cross-subsidy reform was initiated in 2023, offsetting gas subsidies through elevated electricity tariffs. Simultaneously, installation of 1.2 million smart gas meters reduced unauthorized consumption by 20%.

3.3 Renewable Energy Integration and Diversification Strategy

Uzbekistan has established a multifaceted incentive system to accelerate renewable energy adoption. This includes a ten-year tax exemption for renewable projects, covering corporate income, property, and land taxes, alongside exemptions from import duties and VAT on relevant equipment. A \$200 million green fund provides 70% financing guarantees for qualifying projects. The introduction of a renewable portfolio standard requires state-owned power generators to derive 20% of their capacity from renewables, with grid operators mandated to prioritize their procurement. A green certificate trading system further enables high-energy-consumption enterprises to meet emission targets through market mechanisms.

Notable progress has been made in solar energy through reverse auctions, which drove down photovoltaic electricity prices from 0.12/kWh in 2019 to 0.028/kWh in 2023. The Nuradabad solar plant utilizes bifacial modules and tracking systems to achieve 24.5% efficiency, supported by lithium iron phosphate storage for round-the-clock supply. In wind energy, the Karakalpakstan farm employs 6.2 MW turbines with 140-meter hubs, achieving over 3,800 utilization hours. The project's build-operate-transfer model ensures eventual public ownership after 20 years. Hydropower development focuses on run-of-river facilities in the Zeravshan Basin, with 47 planned stations totaling 480 MW. Modernization of existing plants with predictive maintenance has increased utilization rates from 65% to 85%. Nuclear energy collaboration with ROSATOM involves two VVER-1200 reactors, incorporating advanced safety features and a combined nuclear-desalination-agriculture model producing 18 million m³ of freshwater yearly.

International cooperation has been instrumental in financing this transition. In 2022, Uzbekistan secured a 480milliongreentransitionloanfromtheAsian DevelopmentBankanda250 million renewable energy loan from the World Bank, channeled through the National Development Bank at below-market rates. A partnership with Saudi ACWA Power exemplifies an innovative investment model: the Saudi side provides 70% of funding and operational expertise, while Uzbekistan contributes land and grid access for a 30% equity stake. This collaboration has expanded to include green hydrogen, with a planned facility targeting annual production of 500,000 tons.

3.4 Industrial Value Addition and Gas Chemical upgrading

Uzbekistan's natural gas chemical strategy prioritizes value addition and import substitution. The Kashkadarya GTL project, leveraging South African Sasol technology, converts natural gas into high-value oil products, multiplying output value by 3.2 times. Its Fischer-Tropsch synthesis process achieves 85% catalyst activity—20% higher than conventional methods. The Sultan Chemical Complex upgrade incorporates U.S. UOP methanol-to-olefins technology, achieving an ethylene yield of 32% and including a propane dehydrogenation unit with annual propylene capacity of 500,000 tons, meeting 80% of domestic demand. The complex integrates a chemical park, logistics hub, and R&D base, attracting 12 downstream enterprises.

A spatially optimized “one belt, three zones” industrial layout has emerged: the Bukhara zone focuses on basic feedstocks; Fergana produces high-end materials; and Tashkent drives innovation. This clustering has achieved 65% industrial density, cutting logistics costs by 30%. Circular economy models are gaining traction, exemplified by the Jizzakh Chemical Park's cascading “waste gas-steam-electricity” system (72% energy efficiency) and the Navoi Fertilizer Plant's annual CO₂ capture of 200,000 tons for enhanced oil recovery. These innovations have reduced the carbon intensity of Uzbekistan's chemical industry by 35% since 2018.

3.5 Challenges and Future Pathways

Uzbekistan's energy transition faces interrelated financial, technological, and social challenges. Subsidy reforms exert fiscal pressure equivalent to 4.3% of the budget, while annual infrastructure requirements exceed 3billion.Renewableintegrationdemandsmodernizedgridinfrastructure,withasmartgridi nvestmentgapof1.8 billion. Socially, energy price adjustments have contributed to 12.3% inflation, with household energy expenditures reaching 15% of disposable income.

Nevertheless, opportunities are substantial. Renewable energy costs are falling rapidly—solar power is already cheaper than fossil fuels and projected to decline another 40% by 2025. The EU's Carbon Border Adjustment Mechanism (CBAM) could save \$600 million annually in carbon tariffs if green transition goals are met. Demographic advantages, including a median age of 28, provide a skilled labor base for new energy industries.

Future priorities include establishing a Central Asia Energy Exchange to shape regional pricing, developing a green hydrogen export capacity of 1 million tons by 2040, and constructing transnational power corridors connecting Afghanistan and Pakistan. By 2030, the energy transition is expected to create 500,000 jobs and contribute 2.3 percentage points to GDP growth.

4. Conclusion

Uzbekistan's energy transformation under its 2022–2026 Development Strategy marks a decisive shift toward market liberalization, renewable integration, and industrial modernization. While significant progress has been made in gas exploration, pricing reforms, and international cooperation, challenges remain in financing, infrastructure, and social adaptation. The strategic focus on diversifying energy sources, advancing green technology, and enhancing regional connectivity will be crucial to achieving sustainable development, energy security, and economic resilience in the coming decades.

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