



## Article

# Oil and Gas Economics in Central Asia: from Resource Dependence to Diversified and Sustainable Growth

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**Abstract:** Central Asia's oil and gas sector stands at a pivotal crossroads: abundant hydrocarbon reserves have historically underpinned economic growth, yet over-reliance on resource revenues exposes governments to price volatility, constrains institutional development, and impedes the structural transformation needed for long-term prosperity. This article examines the economic dynamics, policy landscape, and strategic transition pathways of the oil and gas sector across Central Asia, with particular focus on Uzbekistan as a representative transition economy. The study employs a mixed-methods approach combining quantitative indicator analysis (2019–2024), systematic policy document review, and structured stakeholder consultation with 21 organisations. Findings reveal measurable progress in reducing fiscal hydrocarbon dependence, attracting foreign direct investment, and improving energy efficiency, yet significant structural barriers including ageing Soviet-era infrastructure, insufficient downstream processing depth, and underdeveloped carbon governance mechanisms require coordinated policy intervention. The paper proposes a five-pillar strategic framework for sector modernisation, encompassing regulatory reform, downstream capacity investment, energy efficiency acceleration, digital resource management, and international financing partnerships. The conclusions provide actionable guidance for policymakers, multilateral development banks, and private sector actors engaged in Central Asia's energy transition.

**Keywords:** Oil and Gas Economics, Central Asia, Uzbekistan, Resource Curse, Energy Transition, Hydrocarbon Governance, Economic Diversification, Sustainable Development.

**JEL Classification:** Q32, Q41, Q48, O13, P28, F63

## 1. Introduction

Hydrocarbon resources have long served as the primary engine of economic growth for resource-rich developing nations. Yet the relationship between oil and gas wealth and national prosperity is far from straightforward. The so-called 'resource curse' a paradox whereby abundant natural resource endowments correlate with weaker economic institutions, lower diversification, and greater exposure to commodity price cycles has been extensively documented in the academic literature [1], [2]. Central Asia presents a particularly instructive case: the region hosts some of the world's most significant hydrocarbon reserves, yet the translation of this geological wealth into sustained human development remains uneven and contested.

Uzbekistan occupies a distinctive position within this regional picture. Ranked eleventh globally by natural gas extraction volume, the country's oil and gas sector contributes approximately 12 percent of GDP and 20 percent of export revenues. Since 2016, President Shavkat Mirziyoyev's reform agenda has introduced sweeping

liberalisation measures that have materially altered the operating environment for international energy investors [3]. GDP growth reached 5.7 percent in 2023, driven partly by energy sector investment inflows and partly by the diversification of services, manufacturing, and information technology.

The global energy transition adds further urgency to this analysis. The International Energy Agency projects that global oil demand will plateau before 2030 under current policy trajectories, while natural gas retains a bridge-fuel role through mid-century [4]. For hydrocarbon-dependent economies in Central Asia, this transition horizon demands proactive structural adjustment not merely passive adaptation. The fiscal, institutional, and environmental dimensions of such adjustment have received growing scholarly attention, yet rigorous country-level empirical analysis remains limited, particularly for Uzbekistan.

This article makes three principal contributions to the literature. First, it provides a comprehensive empirical mapping of oil and gas sector performance, policy instruments, and institutional actors in Uzbekistan over the period 2019–2024. Second, it situates Uzbekistan's hydrocarbon governance trajectory within the broader Central Asian and post-Soviet regional context, drawing comparative lessons from Kazakhstan, Azerbaijan, and Turkmenistan. Third, it develops a strategic framework grounded in international best practice and adapted to Uzbekistan's specific institutional realities for accelerating the transition toward a modernised, lower-carbon, and more diversified energy sector.

### **Literature Review: Theoretical Foundations of Oil and Gas Economics**

Resource economics theory encompasses several competing analytical frameworks for understanding the impact of oil and gas wealth on national development outcomes. The resource curse hypothesis, initially articulated by Auty and empirically extended by Sachs and Warner [5], posits that hydrocarbon-rich states tend to exhibit lower long-run economic growth rates than their resource-poor counterparts. Subsequent scholarship has significantly qualified this thesis: contemporary research isolates institutional quality rather than resource abundance per se as the decisive mediating variable [6], [7]. Countries with strong pre-existing governance frameworks, Norway being the canonical example, have successfully converted resource wealth into sustained prosperity, while those with weaker institutions have more commonly experienced the pathologies associated with the curse.

Dutch disease theory provides a complementary explanatory mechanism. First formalised by Corden and Neary [8], the model describes how hydrocarbon export booms generate real exchange rate appreciation, crowding out the tradeable manufacturing sector and entrenching structural dependence on primary commodities. Empirical evidence for Dutch disease effects has been identified in multiple Central Asian contexts, including episodes of som exchange rate pressure in Uzbekistan following natural gas price upswings [9].

From a sustainable development perspective, modern frameworks for hydrocarbon resource management emphasise three interrelated dimensions: fiscal governance comprising sovereign wealth fund design, inter-generational savings rules, and revenue smoothing mechanisms; environmental stewardship encompassing methane emissions reduction, carbon pricing, and the regulatory facilitation of low-carbon technology adoption; and structural transformation leveraging hydrocarbon revenues to finance the diversification of productive capacity. Van der Ploeg and Venables [10] develop optimal savings and investment ratios for resource-rich developing economies, providing a theoretically grounded benchmark for evaluating Uzbekistan's fiscal positioning.

The emerging literature on energy transitions in fossil fuel-dependent states further informs this analysis. Haggerty demonstrates that just transition frameworks, which address the employment, community, and fiscal dimensions of declining fossil fuel production, are increasingly adopted by resource-rich governments seeking to manage the

social costs of decarbonization [11]. For Central Asian economies still in earlier phases of hydrocarbon development, this literature highlights the importance of sequencing: building institutional capacity and diversifying revenue bases before, rather than after, the inevitable long-run decline in hydrocarbon demand.

## 2. Research Methodology

This study adopts a mixed-methods research design, integrating quantitative secondary data analysis with qualitative policy document review and structured stakeholder consultation. The methodological approach is structured around three sequential phases, designed to triangulate findings across complementary data sources and thereby enhance the robustness of both the empirical assessment and the strategic recommendations.

### Data Collection

Quantitative data were obtained from official national and international statistical sources covering the period 2019–2024. Primary national data sources include the State Committee of Statistics of the Republic of Uzbekistan [12]; the Ministry of Energy of the Republic of Uzbekistan [13]; and the Ministry of Economy and Finance of the Republic of Uzbekistan [14]. International supplementary data were drawn from the World Bank, IMF, EBRD, ADB, BP Statistical Review of World Energy, and the International Energy Agency. All monetary figures are reported in constant 2023 USD unless otherwise specified.

Qualitative data were gathered through structured stakeholder consultations conducted between September and December 2024. A total of 21 organisations participated across Tashkent, Bukhara, and Kashkadarya oblasts, encompassing representatives from national ministries, state-owned and privately operated oil and gas companies, multilateral development bank project teams, and academic energy policy experts. Consultations followed a semi-structured interview format, permitting open-ended responses while ensuring systematic coverage of key thematic areas across participants.

### Analytical Framework

Quantitative analysis employs descriptive statistics and trend analysis to evaluate trajectory and gap relative to 2030 targets across five key oil and gas sector indicators: natural gas extraction volume, hydrocarbon export revenues, energy intensity, foreign direct investment in the energy sector, and the hydrocarbon share of the national budget. Energy intensity is calculated as megajoules of primary energy consumption per unit of GDP (constant USD), following the IEA's standard energy accounting methodology [4]. Comparative benchmarking uses EU-28 and OECD averages as reference points for energy efficiency and fiscal hydrocarbon dependence ratios.

Policy analysis applies an adapted OECD policy instrument typology to classify and evaluate the legislative, economic, and informational instruments governing Uzbekistan's oil and gas sector [15]. Implementation effectiveness is assessed against stated statutory targets and cross-validated through triangulation with primary stakeholder testimony and published audit findings from the Ministry of Finance.

Sectoral analysis covers three priority sub-sectors downstream refining, gas transmission infrastructure, and the renewable energy integration interface selected on the basis of their combined contribution to sector GDP (approximately 28 percent), employment intensity (approximately 15 percent of the energy workforce), and documented transition potential. The sectoral selection was validated through expert elicitation and alignment with the priority investment corridors identified in the Uzbekistan Energy Roadmap 2030.

### Analytical Tools

The SWOT analysis presented in Section 5.1 was constructed through iterative expert elicitation, synthesising outputs from stakeholder consultations with findings from the quantitative and policy analyses. Findings were validated through a two-stage peer review: an internal consistency check conducted by the research team, followed by external expert review by three academics specialising in energy economics in transition economies.

The strategic framework proposed in Section 5.2 was developed using a multi-pillar logic model approach, mapping identified barriers and opportunities to specific intervention types. International comparator cases were drawn from documented energy sector transitions in Kazakhstan, Norway, and Azerbaijan, selected for their institutional comparability and the quality of available longitudinal data. The framework was presented to a validation panel of eight energy policy practitioners in November 2024 and revised to incorporate panel feedback before finalisation.

### **3. Results**

#### **3.1 Economic Context and Sector Overview**

##### **3.1.1 Macroeconomic Positioning**

Uzbekistan's GDP reached approximately USD 90.9 billion in 2023, placing it among the three largest economies in Central Asia alongside Kazakhstan and Turkmenistan. The oil and gas sector remains structurally significant: natural gas extraction stood at approximately 50.7 billion cubic metres in 2023, while crude oil production of roughly 1.1 million tonnes reflects the country's comparatively modest liquid hydrocarbon endowment relative to its gas reserves. A population of 36.1 million growing at approximately 1.5 percent annually generates substantial and rising domestic energy demand, progressively constraining the volumes available for export.

The state-owned Uzbekneftegaz holding company continues to serve as the primary vehicle for hydrocarbon operations, though its governance structure has been subject to sustained reform pressure since 2019. Insufficient financial transparency and complex intra-group transfer pricing arrangements have historically deterred foreign direct investment in the upstream segment [16]. The reform measures introduced between 2019 and 2024 represent the most substantive governance restructuring since independence, and their implementation trajectory is examined in detail in Section 4.2.

##### **3.1.2 Reserve Base and Production Trends**

Uzbekistan's proven natural gas reserves are estimated at approximately 1.1 trillion cubic metres, with ongoing geophysical exploration campaigns in the Kashkadarya, Surkhandarya, and Ustyurt regions targeting material reserve additions. Crude oil reserves are comparatively limited at approximately 594 million barrels, concentrated in the Ferghana Valley and the Ustyurt Plateau [17]. Extraction volumes have trended downward since the mid-2010s across both commodities, reflecting the maturation of legacy Soviet-era fields and insufficient investment in enhanced recovery technologies.

International oil companies including Lukoil, CNPC, and Total Energies are active participants in Uzbekistan's upstream exploration and production activities. Their presence signals improving investor confidence in the post-2016 contractual environment, yet the pace of new field development remains below the investment levels necessary to arrest production decline in the near term. Accelerating the licensing and permitting of new production sharing agreements is accordingly identified as a priority in the Uzbekistan Energy Roadmap 2030 [18].

#### **3.2 Policy and Legislative Framework**

Uzbekistan's oil and gas policy architecture has undergone significant reform since 2019, driven by the twin imperatives of attracting foreign capital and improving sector

governance. Table 2 summarises the principal policy instruments adopted over the study period and their current implementation status.

**Table 1.** Policy and Legislative Framework for the Oil and Gas Sector in Uzbekistan (2019–2024).

Policy / Initiative	Year	Key Objective	Status
Uzbekneftegaz Reform Programme	2019	Improve governance and financial transparency	Active
Gas Market Liberalisation Policy	2020	Introduce market pricing mechanisms and competition	Active
Hydrocarbons Legislation Reform	2021	Create an investor-friendly PSA contractual framework	Active
National Energy Efficiency Programme	2022	Reduce energy intensity by 30% by 2030	In progress
Oil and Gas Sector Digitalisation Programme	2023	Deploy digital monitoring and SCADA systems	Pilot phase
Energy Roadmap 2030	2024	Comprehensive integrated energy transition plan	Adopted

*Source: Ministry of Energy of the Republic of Uzbekistan; author's compilation.*

The Uzbekistan Energy Roadmap 2030, adopted in 2024, constitutes the most comprehensive integrated policy document to date. It establishes sector-specific targets across oil and gas production, downstream processing, energy efficiency, and renewable integration, and introduces for the first time a formal monitoring and evaluation framework with mandatory annual reporting obligations to the Cabinet of Ministers. The Roadmap is explicitly aligned with the Paris Agreement commitments and the UN SDG 7 (Affordable and Clean Energy), signalling Uzbekistan's intent to position its energy sector within the evolving international green investment landscape [19].

Gas market liberalisation the gradual introduction of cost-reflective pricing and third-party pipeline access is of particular structural significance. Administratively suppressed gas prices have historically distorted consumption incentives, discouraged private sector investment in efficiency, and created fiscal transfer burdens on the state budget. International experience demonstrates that well-sequenced price reform, accompanied by targeted social protection for vulnerable household consumers, can mobilise private capital while improving resource allocation efficiency.

### 3.3 Key Sector Indicators and Progress Assessment

Table 1 presents selected quantitative indicators tracking Uzbekistan's oil and gas sector performance over the period 2019–2023, with reference to the 2030 targets established in the Energy Roadmap.

**Table 2.** Key Oil and Gas Sector Indicators: Uzbekistan (2019–2023).

Indicator	2019	2021	2023	Target 2030
Natural gas extraction (bn m <sup>3</sup> )	56.3	53.1	50.7	55.0
Hydrocarbon export revenue (USD mn)	3,240	2,810	3,490	4,200
Energy intensity (MJ / USD GDP)	8.4	7.8	7.1	5.9
Hydrocarbons share of budget revenue (%)	22.1	19.8	18.4	14.0
FDI into energy sector (USD mn)	610	780	1,120	2,500

*Source: State Committee of Statistics of the Republic of Uzbekistan; Ministry of Energy; author's calculations.*

The data reveal a broadly encouraging trajectory across most monitored indicators. Energy intensity has declined by 0.7 MJ/USD units over four years, consistent with the 30 percent efficiency improvement target, though the pace of reduction will need to accelerate to reach 5.9 MJ/USD by 2030. Foreign direct investment into the energy sector has grown by 84 percent between 2019 and 2023 the strongest performance among the five indicators reflecting the positive investor response to the governance and legislative reforms introduced under the 2019–2021 reform programme. The hydrocarbon share of budget revenue has declined from 22.1 to 18.4 percent, signalling gradual fiscal diversification. However, the absolute level of gas extraction has trended downward rather than recovering toward the 55.0 bn m<sup>3</sup> target, underscoring the urgency of accelerating upstream investment and field development licencing.

### **3.4 Sectoral Analysis**

#### **3.4.1 Downstream Refining**

Uzbekistan's oil refining industry is concentrated at the Ferghana and Altiariq refineries, with combined nameplate capacity exceeding 10 million tonnes of crude throughput per annum. However, both facilities operate predominantly with Soviet-vintage equipment characterised by shallow conversion depth the proportion of crude converted into high-value light products such as gasoline and diesel remains well below the 90 percent conversion rates achieved by modern European and Asian refineries. A EUR 1.2 billion modernisation programme planned for the Ferghana refinery is projected to raise conversion depth from 65 to 92 percent by 2030, materially reducing dependence on fuel imports and capturing significant downstream value added domestically. Mobilising private co-investment and completing the regulatory approvals for this programme are identified as near-term policy priorities.

#### **3.4.2 Gas Transmission Infrastructure**

Uzbekistan operates an extensive gas pipeline network with a total length exceeding 13,000 kilometres of trunk and distribution lines, providing nationwide coverage. However, the ageing condition of this infrastructure is a persistent concern: technical losses during gas transmission and distribution are estimated at 2–3 billion cubic metres annually a volume sufficient to supply approximately 1.5 million households. Pipeline rehabilitation and digitalisation programmes are underway, supported in part by concessional financing from the ADB and EBRD, but the investment rate remains below what is required to arrest infrastructure deterioration at the current pace of system ageing.

#### **3.4.3 Renewable Energy Integration**

The interface between the oil and gas sector and renewable energy development is increasingly significant in Uzbekistan's energy strategy. The 2030 target of a 25 percent renewable energy share in electricity generation implies a substantial reallocation of capital and institutional capacity away from gas-fired power generation. The 1 GW of solar capacity commissioned at the Nukus and Samarkand facilities in 2023 represents the largest renewable energy deployment in Uzbekistan's history and demonstrates the technical feasibility of utility-scale solar in the country's high-irradiance climate. From a gas sector perspective, successful renewable deployment gradually frees domestic gas volumes for higher-value export or industrial uses, improving the overall economics of the gas production chain.

## **4. Discussion**

### **4.1 SWOT Analysis of the Oil and Gas Sector Transition**

Figure 1 presents a comprehensive SWOT analysis synthesising the structural factors shaping Uzbekistan's oil and gas transition potential. The analysis draws on primary data

collection and stakeholder consultations conducted by the author between September and December 2024, validated through external expert review.

STRENGTHS	WEAKNESSES
Substantial natural gas reserve base (1.1 trillion m <sup>3</sup> ), Government commitment to reform and investor engagement, Extensive nationwide pipeline network infrastructure, Established partnerships with major international oil companies	Ageing Soviet-era production and refining assets. Insufficient financial transparency of Uzbekneftegaz. High energy intensity relative to OECD benchmarks, Shallow downstream refining conversion depth
OPPORTUNITIES	THREATS
Growing international green and blended finance flows, ADB, EBRD, and World Bank concessional financing, Digital transformation enabling real-time resource monitoring, Renewable energy integration freeing gas volumes for export	Global oil and gas demand peak risk before 2030. Hydrocarbon price volatility is compressing fiscal revenues, brain drain of technical and engineering talent Slow pace of institutional and regulatory reform

**Figure 1.** SWOT Analysis: Oil and Gas Sector Transition in Uzbekistan.

*Source: Author's own analysis based on stakeholder consultations and policy review.*

The SWOT synthesis highlights a sector at an inflection point. The combination of a substantial reserve base and an improving regulatory environment provides a credible foundation for upstream investment recovery. However, the structural weaknesses associated with Soviet-era infrastructure legacy both in production assets and in institutional practice require concerted and sustained policy effort that goes beyond incremental reform. On the external dimension, the opportunity window presented by current international green finance flows and multilateral development bank engagement is real but time-limited: investor appetite for emerging market energy projects is sensitive to both global interest rate conditions and geopolitical risk perceptions.

#### 4.2 Strategic framework for sector modernisation

Building on the foregoing analysis, this section proposes a multi-pillar strategic framework for accelerating oil and gas sector modernisation in Uzbekistan. The framework is structured around five mutually reinforcing intervention domains, each addressing a distinct cluster of identified barriers.

##### 4.2.1 Regulatory Strengthening and Price Reform

The legal and regulatory environment must be further developed to embed transparent, rules-based governance across the oil and gas value chain. Priority actions include: completing the unbundling of Uzbekneftegaz's transmission and commercial operations to eliminate cross-subsidisation; accelerating the transition to cost-reflective gas tariffs accompanied by means-tested household support mechanisms to protect vulnerable consumers; aligning environmental reporting standards with international frameworks including the Task Force on Climate-related Financial Disclosures (TCFD); and establishing a fully independent petroleum sector regulator with statutory authority to enforce contract compliance and environmental obligations.

##### 4.2.2 Downstream Capacity Modernisation

Refinery modernisation represents the single highest-return investment in Uzbekistan's near-term oil and gas agenda. Beyond the Ferghana refinery programme, investment in petrochemical complex development converting natural gas liquids into

higher-value chemical feedstocks offers a pathway to substantially increase domestic value capture from the hydrocarbon resource base. International experience from Kazakhstan's Tengizchevroil and Azerbaijan's SOCAR demonstrates that well-structured public-private partnership frameworks can successfully mobilise the scale of capital required for such transformational investments [20].

#### **4.2.3 Energy Efficiency Acceleration**

Uzbekistan's energy intensity of 7.1 MJ/USD GDP remains nearly three times the OECD average. Closing this gap through industrial process improvement, pipeline loss reduction, and building envelope standards presents a substantial economic opportunity: the IEA estimates that a one-unit reduction in energy intensity is equivalent in its demand impact to bringing a new mid-sized gas field into production. Dedicated energy efficiency credit lines, co-financed by the ADB and EBRD, provide a proven financing instrument for industrial energy audits and capital equipment replacement in the oil and gas sector supply chain.

#### **4.2.4 Digital Resource Management**

Digital technologies encompassing IoT subsurface sensors, AI-driven reservoir modelling, blockchain-based hydrocarbon tracking, and cloud-based SCADA integration can materially improve field production efficiency, reduce unplanned downtime, and enhance environmental compliance monitoring. A national digital hydrocarbon management platform, integrating data streams from wellheads, compressor stations, and export metering points, would reduce information asymmetries between the regulator and operators while enabling evidence-based policy monitoring. The pilot digitalisation programme launched in 2023 provides a viable entry point from which to scale these capabilities sector-wide [21].

#### **4.2.5 International Financing and Knowledge Transfer**

Uzbekistan has established productive relationships with multilateral development banks notably the ADB, the EBRD and the World Bank that provide both concessional financing and technical assistance for energy sector modernisation. Deepening these partnerships through dedicated upstream development facilities, blended finance instruments for downstream investment, and knowledge transfer programmes focused on petroleum engineering and regulatory capacity will be essential to mobilising the estimated USD 5.2 billion in investment required to meet the 2030 Energy Roadmap targets. The issuance of sovereign green and transition bonds, linked to verified emissions reductions in the oil and gas sector, represents an additional avenue for tapping international capital markets at competitive costs.

### **5. Conclusions**

This article has examined the current state and strategic trajectory of the oil and gas sector in Uzbekistan, demonstrating that the country has established meaningful reform foundations for sector modernisation while confronting substantial structural and institutional challenges that require sustained and coordinated policy attention. The evidence supports four principal conclusions. First, Uzbekistan's oil and gas policy architecture has strengthened considerably since 2019, with the Energy Roadmap 2030 providing a coherent integrated direction across production, processing, efficiency, and renewable integration. Second, quantitative indicators reveal genuine progress in reducing fiscal hydrocarbon dependence, attracting foreign direct investment, and improving energy intensity, though the pace of change requires significant acceleration across all dimensions to meet 2030 targets. Third, structural barriers including ageing Soviet-era infrastructure, shallow downstream conversion depth, and insufficient regulatory independence necessitate targeted investment, institutional reform, and pricing

adjustment that together constitute a substantial policy agenda. Fourth, Uzbekistan's combination of a large reserve base, an improving regulatory environment, and growing multilateral development bank engagement provides a conducive foundation for the ambitious modernisation programme that the Energy Roadmap envisions. For policymakers, the overarching priority is to maintain the momentum of governance and pricing reforms while expanding the institutional capacity of the petroleum regulator and the Ministry of Energy to manage increasingly complex foreign investment relationships. For development finance institutions, the opportunity lies in designing blended finance instruments calibrated to the specific risk profiles of downstream and infrastructure investments in an emerging economy context. For private sector actors, Uzbekistan's oil and gas sector offers a combination of geological prospectivity, improving contract security, and government willingness to engage that compares favourably with alternatives in the post-Soviet space.

Future research should focus on firm-level econometric analysis of the productivity gains associated with post-reform foreign direct investment in the upstream segment; comparative assessment of energy efficiency programme outcomes across Central Asian economies; and longitudinal evaluation of the fiscal and social welfare effects of gas tariff liberalisation on urban and rural household groups.

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