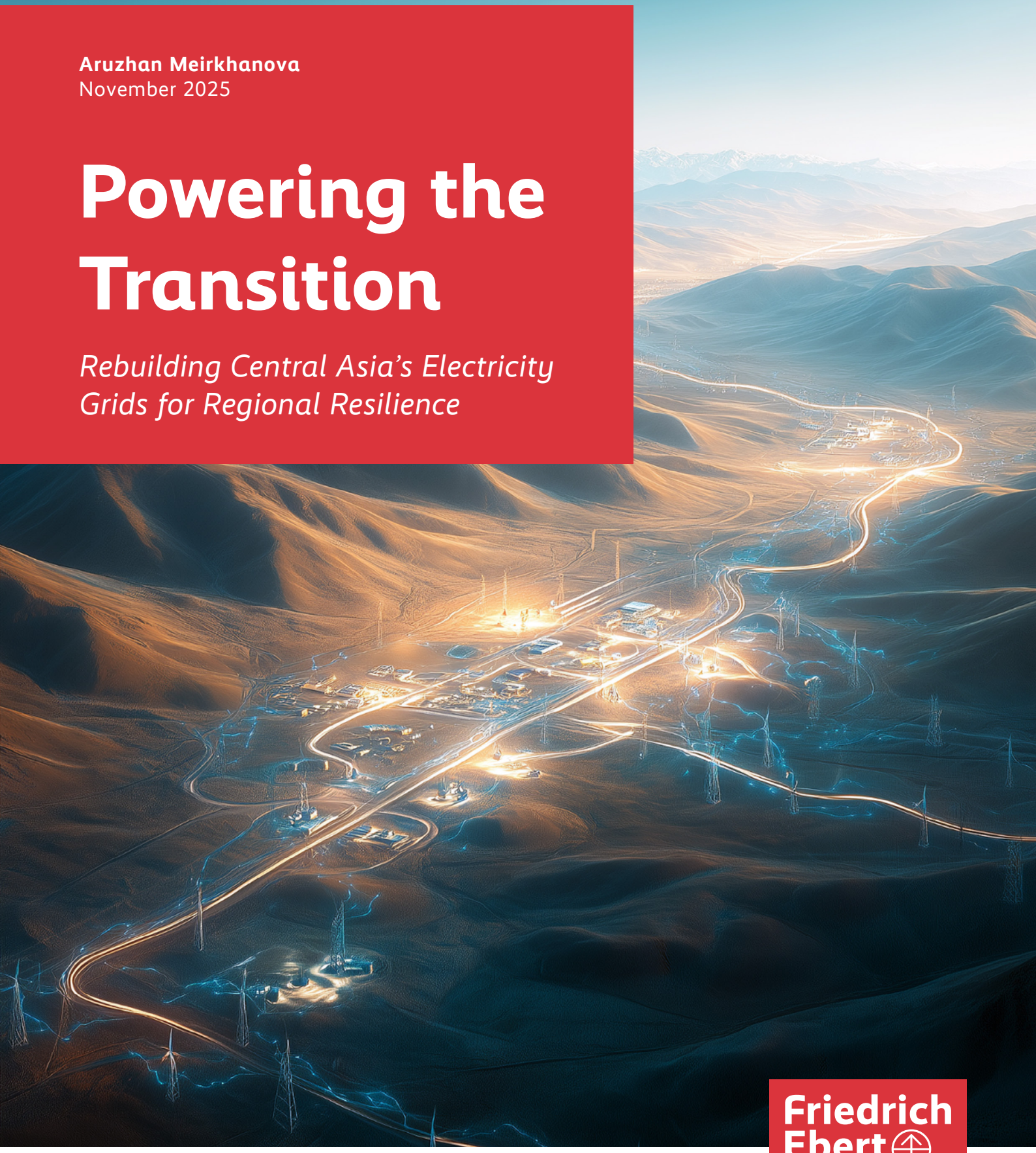
STUDY

Aruzhan Meirkhanova
November 2025

Powering the Transition

Rebuilding Central Asia's Electricity Grids for Regional Resilience



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Content

Executive summary

As Central Asia faces rising electricity demand, aging infrastructure, and growing decarbonization pressures, electricity grids are emerging as strategic assets at the intersection of national development, energy security, and cross-border cooperation. This paper examines grid infrastructure and governance in Kazakhstan, Uzbekistan, Kyrgyzstan, and Tajikistan, showing how differences in market models and institutional capacity shape reform outcomes. Rather than endorsing accelerated and across-the-board market liberalization or regulatory harmonization, the paper advocates for gradual and context-sensitive reforms that improve domestic systems while enabling the gradual development of interoperable "grid communities." It assesses where meaningful progress has been achieved and where structural constraints persist. By grounding recommendations in political economy realities, the paper highlights how focused EU support can help strengthen grids, enhance local capacity, and support regional links while aligning with domestic reform priorities.

Introduction: Why the Grid Matters in Central Asia's Energy Transition

As countries race to decarbonize their energy systems, global attention is turning to the infrastructure that underpins clean energy expansion: electricity grids. Transmission and distribution networks are central to energy security, affordability, and climate action. The International Energy Agency (IEA) warns that without a rapid scale-up of grid investments doubling to over USD 600 billion annually by 2030, countries will miss their climate goals.[1] In the IEA's "Grid Delay" scenario, outdated and underbuilt networks become a bottleneck, forcing systems to rely more heavily on coal and gas, more than doubling global carbon emissions relative to transition-aligned pathways.[2] As such, grids could be either active enablers or constraints on the path to net-zero.

This warning is highly relevant for Central Asia. Home to over 80 million people and projected to surpass 100 million by 2050,[3] the region faces a complex electricity trilemma: how to expand and decarbonize supply, maintain affordability, and ensure grid reliability amid aging infrastructure and rising demand. The 2022 large-scale power outage[4] across Kazakhstan, Kyrgyzstan, and Uzbekistan exposed the fragility of existing transmission systems. Grid bottlenecks hinder the deployment of renewables and weaken incentives for private investment. Yet, for Central Asia, the challenge is not just integrating wind and solar, but also rebuilding a legacy system that is crucial for the countries' energy security and positioning the region within emerging inter-regional energy trade corridors.

Despite different resource endowments and reform pathways, the region's countries face common constraints, albeit to varying degrees: electricity grids that are underfunded, under-digitized, and overstretched. While reform efforts and investment attraction are ongoing, they risk lagging behind without simultaneous upgrades in infrastructure, digitalization, and operational capacity. Moreover, Central Asia's power sectors differ substantially in their grid topologies, governance models, and reform readiness. Public ownership remains dominant, making rapid liberalization models impractical. Instead, locally owned and gradual reforms that are responsive to domestic realities could generate greater local buy-in.

Beyond their technical function, grids are also geopolitical. They reflect not only domestic policies but also shifting international alignments. For Central Asia, strategic grid development can both strengthen internal resilience and enable credible cross-border trade. Although the region is unlikely to pursue fully integrated "grid communities,"[5] targeted interoperable linkages could still deliver economic, security, and foreign policy benefits, if coupled with robust domestic systems.

This policy paper adopts a system-level perspective, arguing that one must understand electricity infrastructure, governance, and market arrangements as an integrated whole. The core argument is not for wholesale or accelerated market liberalization, but for pragmatic, country-specific reforms that improve system resilience and interoperability. In this light, infrastructure modernization should go in parallel with enhancements to regulatory capacity.

For international partners, and particularly the EU, this presents both a strategic challenge and an opportunity. On the one hand, geoeconomics competition in Central Asia is intense, while the EU remains geographically and politically distant. On the other hand, the EU has consistently supported regional cooperation and invested in both country-level and regional energy infrastructure. The sustainability of existing and future investments and the EU-Central Asia connectivity depends on the stability of grid infrastructure. **The momentum is ripe for strengthening this engagement: Central Asian heads of state are signaling political will for deeper cooperation, and governments are actively diversifying foreign partnerships.**

1 International Energy Agency. *Electricity Grids and Secure Energy Transitions.* 2023. https://iea.blob.core.windows.net/assets/ea2ff609-8180-4312-8de9-494bcf21696d/ElectricityGridsandSecureEnergyTransitions.pdf. Accessed July 21, 2025.

2 Ibid.

3 Makhanov, Kanat. "UN Population Prospects: Case of Central Asia." *Eurasian Research Institute*, n.d. https://www.eurasian-research.org/publication/un-population-prospects-case-of-central-asia/#:~:text=By%202050%2C%20the%20population%20of,benchmark%20of%20100%20million%20people. Accessed July 21, 2025.

4 Reuters. "Power Blackout Hits Kazakhstan, Kyrgyzstan, and Uzbekistan." *Reuters*, January 25, 2022. https://www.reuters.com/world/asia-pacific/power-blackout-hits-kazakhstan-kyrgyzstan-uzbekistan-2022-01-25/. Accessed July 21, 2025.

5 In Pepe, Jacopo Maria. "Europe and the Emerging Geopolitics of Electricity Grids." *Friedrich Ebert Stiftung*, 2024. https://library.fes.de/pdf-files/bueros/bruessel/21205.pdf. Accessed July 21, 2025, "Grid community" is defined as a synchronised electricity network, where both voltage and frequency work in unison so that all states share the same risks, chances, duties, and rights

For the EU engagement to be most effective, however, it must align with locally defined priorities and address concrete operational gaps. This means going beyond generation projects and investing in public sector capacity, digital tools, and distribution networks. Such a focus can help Central Asian governments preserve local ownership, reinforce domestic resilience, and gradually unlock the regional and inter-regional potential of their power sectors. The paper concludes with targeted policy recommendations based on the extensive analysis of structural and infrastructure gaps. These are intentionally designed as low-cost, high-impact measures that could fuel positive outcomes without imposing excessive fiscal or political strain.

Current State of Play: Central Asia's Grid Landscape

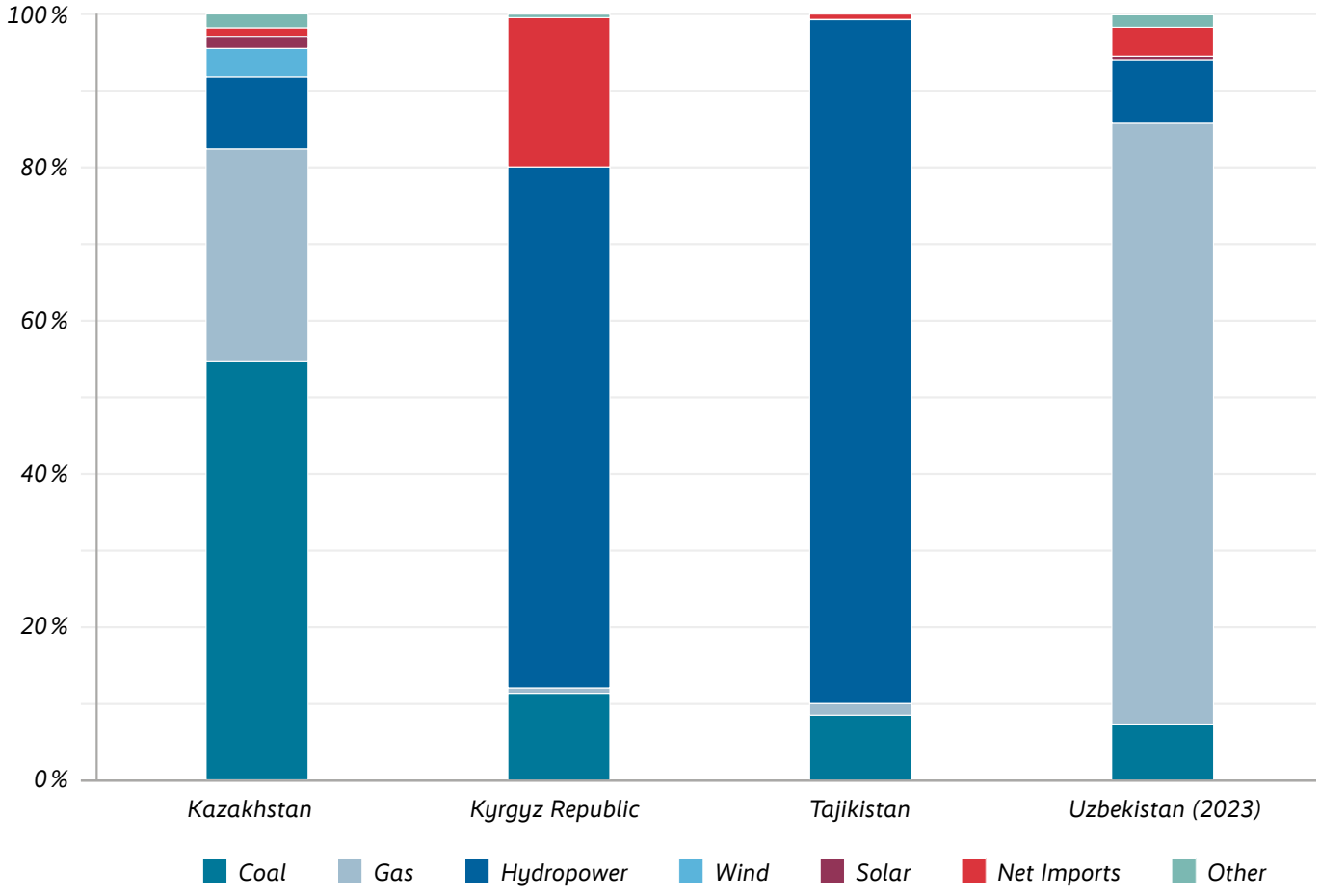
Electricity Consumption Mix and Generation Patterns

All five Central Asian countries inherited interconnected electricity systems from the Soviet era. Since independence, they have diverged significantly based on domestic resources, infrastructure priorities, and reform strategies. Kazakhstan is the largest producer and consumer of electricity, with a fossil-heavy mix: 55 % coal, 28 % gas, and over 5 % renewables (see Figure 1). Uzbekistan relies primarily on gas (78 %), with recent solar additions. In contrast, Kyrgyzstan and Tajikistan generate over two-thirds and nearly 90 % of their electricity from hydropower, which makes them vulnerable to seasonal and climatic variation. Kyrgyzstan, for instance, imported 20 % of its electricity in winter 2024.[6] Turkmenistan's electricity system remains isolated from the Central Asia Power System (CAPS), with generation predominantly gas-based and exports to neighbors conducted bilaterally.

6 Kwan, Sergey. "Kyrgyzstan Turns to Alternative Energy to Address Power Deficits." *Times of Central Asia*, 2025. https://timesca.com/kyrgyzstan-turns-to-alternative-energy-to-address-power-deficit/. Accessed July 21, 2025.

Figure 1

Electricity consumption mix in Central Asian countries (2024)



Source: Low Carbon Power. "Electricity Mix by Country." n.d. https://lowcarbonpower.org/, Accessed July 21, 2025.

Grid Topology

Grid layouts reflect both geographical constraints and legacy planning. Kazakhstan operates the region's largest system, comprising over 467,000 km of transmission and distribution lines.[7] Its National Electric Grid spans 27,800 km of 0,4 kV and above high voltage transmission lines, organized into three zones: North, South, and West.[8] The North-South 500 kV corridor moves primarily coal-fired power from the north to the energy-scarce southern regions. The previously isolated West zone is now being integrated with the Unified Energy System of Kazakhstan as part of the project, supported by the Development Bank of Kazakhstan and the European Bank for Reconstruction and Development (EBRD).[9]

Uzbekistan's flatter terrain allows for a more centralized grid architecture. Its transmission system operator (TSO), the National Electric Networks of Uzbekistan (NEGU) manages over 12,800 km of 220-500 kV lines and 91 high-voltage substations.[10] In addition, the country serves as a regional transit corridor, enabling electricity flows among Kazakhstan, Kyrgyzstan, and Tajikistan.

Kyrgyzstan and Tajikistan grapple with spatial mismatches. In Kyrgyzstan, the 110-500 kV transmission system operated by National Electric Grid of Kyrgyzstan (NEGK) totals 7,541 km, with hydropower concentrated in the center (Toktogul reservoir) and demand clustered in the north (Bishkek, Chuy Valley).[11] This requires long-distance transmission over mountainous terrain. In Tajikistan, more than 1,945 km of 220–500 kV lines connect central and southern generation zones with northern demand areas.[12] Chinese-financed infrastructure, including the 500 kV Dushanbe-Khujand (2009)[13] and Dushanbe-Obigarm (2018)[14] lines, helped unify previously segmented zones.

Infrastructural Challenges

Across the region, infrastructure quality remains a main constraint. Kazakhstan reports that 76 % of its grid assets are worn out.[15] In Uzbekistan, over 60 % of transmission lines, 74 % of substations, and more than half of transformers require modernization.[16] In Kyrgyzstan, 93 % of transformers and 79 % of hydro units are beyond their service life.[17] Tajikistan's utility operators estimate one-quarter of electricity is lost during generation, transmission, and distribution, although this might be a conservative estimate.[18] According to UNECE, average transmission losses in Central Asia exceed 12.8 %, exceeding global norms.[19]

The weakest link, however, is the distribution level, where infrastructure is typically older, less monitored, and more vulnerable to technical and commercial losses. In Uzbekistan, over 60 % of distribution assets are outdated, contributing to technical losses of up to 12 %.[20] Kazakhstan's twelve regional electricity companies report asset wear rates ranging from 65 % to 97 %.[21] Average distribution losses are 14 %, ranging from 6 % to 18 %, depending on region and grid size, which is substantially higher than average transmission losses of 5 %.[22] In Kyrgyzstan, 70 % of distribution assets have exceeded their life cycle,[23] with

7 Official Information Source of the Prime Minister of the Republic of Kazakhstan. 2022. "Electricity Generated by RES for 2021 Exceeded Planned Indicators – Bulat Aqchulaqov." https://primeminister.kz/en/news/reviews/2021-zhyly-zhek-ondirgen-elektr-energiyasynyn-kolemi-zhosparly-korsetkishterden-asty-b-aksholakov-282559. Accessed July 21, 2025.

8 KEGOC. "About Us." *Kegoc.kz*, n.d. https://www.kegoc.kz/en/about/. Accessed July 21, 2025.

9 KEGOC. "EBRD and Development Bank of Kazakhstan Invest in Kazakhstan Energy System Interconnection Project." *Kegoc.kz*, 2024. https://www.kegoc.kz/en/press-center/press-releases/164955/. Accessed July 21, 2025.

10 Joint-Stock Company 'National Electric Grid of Uzbekistan.' "About Company." *Uzbekistonmet.uz*, 2022. https://www.uzbekistonmet.uz/en/lists/view/79. Accessed July 21, 2025.

11 United Nations Economic Commission for Europe. *Energy Connectivity in Central Asia: An Inventory of Existing National Energy Systems*. 2023. https://unece.org/sites/default/files/2023-11/EN_Energy%20Connectivity%20in%20Central%20Asia_V2.pdf. Accessed July 21, 2025.

12 Ibid.

13 China and Central Asia Studies. "Tajikistan: 500 kV South-North Power Transmission Line." *China-CentralAsia.org*, n.d. https://china-centralasia.org/en/project/102#:~:text=Description%20of%20the%20project,Chinese%20architecture%20%22Luban%20prize%22 (accessed July 21, 2025).

14 Avesta Information Agency. "500 kV HV Transmission Line Dushanbe-Obi Garm Showed Its Effectiveness [LEP 500 kV Dushanbe-Obi Garm pokazala svoyu effektivnost']." *Avesta.tj*, September 19, 2019. https://avesta.tj/2019/09/19/lep-500-kv-dushanbe-obi-garm-pokazala-svoyu-effektivnost/. Accessed July 21, 2025.

15 Kaztag. "76 % Wear and Tear of Kazakhstan's Power Grids, Dependence on Imports and Other Problems – Results of the State Audit [76 % iznos electrosetey RK, zavisimost' ot importa i drugiye problem – itogi gosaudita]." *Kaztag.kz*, 2025. https://kaztag.kz/ru/news/76-iznos-elektrosetey-rk-zavisimost-ot-importa-i-drugie-problemy-itogi-gosaudita. Accessed July 22, 2025.

16 Eurasian Development Bank. "Uzbekistan and the EAEU: Perspectives and Potential Effects of Economic Integration" [In Russian]. *Reports and Working Documents*, 2021. https://eabr.org/upload/EDB_2021_Report_Uzbekistan_and_the_EAEU_rus.pdf. Accessed July 22, 2025.

17 Akhmatova, Ilona. "How Worn Out is the Equipment in Kyrgyzstan's Energy Sector? Disappointing Calculations." *Economist.kg*, May 15, 2023. https://economist.kg/novosti/2023/05/15/naskolko-iznosheny-oborudovaniya-v-energetike-kyrgyzstana-neuteshitelnye-podschety/. Accessed July 22, 2025.

18 Chorshanbiyev, Payrav. "In Tajikistan, Some Steal Electricity While Others Freeze." *Asia-Plus*, February 5, 2024. https://www.asiaplustj.info/ru/news/tajikistan/economic/20240205/v-tadzhikistane-odni-voruyut-drugie-myorznut. Accessed July 21, 2025.

19 United Nations Economic Commission for Europe. *Outline for a Roadmap for a Regionally Interconnected Energy System in Central Asia.* ECE/ENERGY/GE.5/2024/4. 2024. https://unece.org/sites/default/files/2024-08/ECE_ENERGY_GE.5_2024_4_e.pdf. Accessed July 22, 2025.

20 Eurasian Development Bank, "Uzbekistan and the EAEU," p. 40 – Ministry of energy of Uzbekistan as cited in

21 Petrocouncil.kz. "When Will Kazakhstan Be Able to Fully Provide Itself with Electricity?" *Petrocouncil.kz*, March 17, 2025. https://petrocouncil.kz/en/novost/kogda-kazahstan-smozhet-polnostyu-obespechivat-sebya-sobstvennoj-elektroenergiej. Accessed July 21, 2025.

22 KEGOC. "Analysis of Wholesale Market of Electric Energy and Capacity for 2023." *KEGOC*, 2024. https://www.kegoc.kz/upload/iblock/0d7/tgrsztaci3oypn9po5x1eoxnz448si2t.pdf. Accessed July 22, 2025: p. 8.

23 The World Bank. "The Electricity Sector in the Kyrgyz Republic to Improve Its Efficiency with World Bank Support." *The World Bank*, June 23, 2022. https://www.worldbank.org/en/news/press-release/2022/06/23/the-electricity-sector-in-the-kyrgyz-republic-to-improve-its-efficiency-with-world-bank-support. Accessed July 21, 2025.

losses reaching 11% in 2023.[24] In Tajikistan, distribution losses accounted for 21.6% in 2024, compared to 3.31% in the high-voltage network.[25] Commercial losses, including theft and tampering, also remain widespread. To deter tampering, Uzbekistan criminalized electricity theft in 2023,[26] and Tajikistan followed suit in 2025.[27]

Metering modernization is uneven across the region. Kazakhstan's KEGOC has achieved 100% Automated System for Commercial Electricity Metering (ASKUE) coverage across all 1150 kV, 500 kV, 220 kV, and 35 kV substations. However, more than half of metering points managed by electricity market subjects, including 59,1% of those managed by regional electricity companies, were not equipped with ASKUE as of 2023.[28] Uzbekistan has made significant progress in deploying smart meters, but 28% of wholesale consumers remained unconnected to ASKUE in 2023.[29] In Kyrgyzstan, with donor support, a national rollout of smart meters is underway, but ASKUE coverage stood at only 29%.[30] In Tajikistan, while no official figures were available on ASKUE coverage, the government is expanding smart metering in urban centers and integrating automated billing systems with donor support. Lack of universal access to automated metering infrastructure, which are crucial for smart grids, limits the ability of utilities to conduct real-time monitoring, forecasting, and control.

As countries expand metering and integrate higher shares of renewables, **grid resilience to both cyber and physical threats becomes critical**. Renewable energy generation and storage facilities are typically managed through Supervisory Control and Data Acquisition (SCADA) systems, which are vulnerable to cyber intrusion.[31] Weakly protected systems could be exploited to disrupt operations or cause equipment damage.[32] **Grid modernization must therefore be coupled with secure digital infrastructure, robust cybersecurity protocols, and coordinated incident-response planning.** Without these measures, investments in grid upgrades may increase exposure to cyberattacks, especially in a region where cross-border flows are expected to grow.

Across Central Asia, infrastructure degradation, uneven metering, and limited cybersecurity readiness are common constraints. Without urgent progress in these areas, countries risk domestic supply disruptions and missed opportunities for scalable regional power trade.

Electricity Market Governance and Reform

Reform progress across Central Asia remains uneven, shaped by divergent institutional legacies and levels of private sector participation (see Table 1). Kazakhstan leads in market liberalization, while Kyrgyzstan and Tajikistan retain highly centralized, hydro-dependent power sectors. Uzbekistan occupies a middle ground, undertaking ambitious reforms but facing implementation risks. Across the region, tariff reform, grid modernization, and renewable integration remain cross-cutting challenges, with regulatory capacity and pricing frameworks acting as major bottlenecks. While generation assets are diversified in ownership, grid infrastructure, particularly transmission networks, remains under public control, reflecting the critical role of the public sector in electricity infrastructure.

Kazakhstan

Kazakhstan's electricity sector is unbundled and governed through a hybrid model combining market mechanisms with centralized oversight. Generation is largely privatized, though state-owned Samruk-Energo retains major assets. Another SOE, KEGOC, oversees transmission, dispatch, and cross-border flows. Distribution is carried out by licensed regional electricity companies (RECs), both public and private. The 2023 reform[33] introduced a centralized Single Buyer model, operated by the Financial Settlement Center, and a balancing market,[34] moving away from a purely bilateral contracts-based system. These reforms have improved dispatch reliability. **Tariff reform aimed at cost recovery is underway, however, its pace is gradual, given the sensitivity of price increases.** Less than half of whole-

24 K-News. "In Kyrgyzstan in 2023 Electricity Losses Amounted to More Than 11%." *K-News*, January 16, 2024. https://knews.kg/2024/01/16/v-kyrgyzstane-v-2023-godu-poteri-elektroenergii-sostavili-bolee-11/. Accessed July 24, 2025.

25 Asia-Plus. "Head of Tajikistan's Ministry of Energy Expressed Dissatisfaction with How Distribution of Electricity Works."*Asia-Plus*, July 15, 2025. https://asiaplustj.info/ru/news/tajikistan/economic/20250715/glava-minenergo-tadzhikistana-virazil-nedovolstvo-rabotoi-po-raspredeleniyu-elektroenergii. Accessed July 27, 2025.

26 Republic of Uzbekistan. *Law of the Republic of Uzbekistan on Introducing Amendments and Additions to the Criminal Code, Criminal Procedure Code, and Administrative Responsibility Code in Connection with Strengthening Liability for the Illegal Use of Energy Resources*, No. 822, March 13, 2023. https://lex.uz/docs/6405976. Accessed July 27, 2025.

27 Asia-Plus. "Emomali Rahmon Signs Law Establishing Criminal Liability for Unlawful Manipulations with Electricity Meters." *Asia-Plus*, April 15, 2025. https://asiaplustj.info/ru/node/347849. Accessed July 25, 2025.

28 KEGOC. "Analysis of Wholesale Market," p. 50.

29 Gazeta.uz. "Over 100,000 Wholesale Consumers and 648,000 New Subscribers in Uzbekistan Are Not Connected to ASKUE." [In Russian]. *Gazeta.uz*, November 7, 2023. https://www.gazeta.uz/ru/2023/11/07/askue/. Accessed July 22, 2025.

30 Kaktus Media. "Smart Meters: Fight Against Electricity Theft and Customer Complaints." [In Russian]. *Kaktus Media*, March 27, 2025. https://kaktus.media/doc/520342_ymnye_schetchiki:_borba_s_vorovstvom_elektroenergii_i_jaloby_abonentov Accessed July 21, 2025.

31 O'Sullivan, Meghan, Indra Overland, and David Sandalow. *The Geopolitics of Renewable Energy*. Center on Global Energy Policy and the Geopolitics of Energy Project. Working Paper, 2017. https://www.belfercenter.org/sites/default/files/pantheon_files/files/publication/Geopolitics%20Renewables%20-%20final%20report%206.26.17.pdf. Accessed July 21, 2025.

32 Ibid.

33 Republic of Kazakhstan. *The Order of the Minister of Energy of Kazakhstan on Determining the Single Buyer of Electric Energy*, No. 212, June 6, 2023. https://online.zakon.kz/Document/?doc_id=37232863. Accessed July 22, 2025.

34 Republic of Kazakhstan. *On Amending the Order of the Minister of Energy of the Republic of Kazakhstan of February 20, 2015, No. 112 'On the Approval of the Rules for the Functioning of the Balancing Electricity Market.'*, No. 250, June 30, 2023. https://adilet.zan.kz/rus/docs/V2300032973#z8. Accessed July 27, 2025.

sale participants are integrated into the ASKUE metering system, limiting full market functionality.[35] The Tariff for Investment initiative[36] and the National Infrastructure Modernization Plan (through 2029) [37] aim to address these challenges, with KZT 3.3 trillion ($6.4 billion) in planned investments solely for the modernization of electricity infrastructure, not including new generation capacity.

Uzbekistan

Uzbekistan launched electricity sector reforms in 2019[38] by unbundling Uzbekenergo into generation (JSC Thermal Power Plants), transmission (NEGU), and distribution (Regional Electric Networks). NEGU initially held both TSO and single buyer roles, but the latter function was transferred in 2023 to Uzenergosotish.[39] A 2025 presidential decree[40] ended Uzenergosotish's monopoly, enabling licensed players to enter the market. A 2024 Electricity Law[41] and a separate regulator, the Agency for the Development and Regulation of the Energy Market, were established, though its tariff-setting authority only begins in 2026,[42] with a wholesale market launch planned for 2027.[43] Private participation is growing via public-private partnerships in regional grid management and planned investments of $4 billion in transmission[44] and $3 billion in distribution infrastructure.[45] Pricing reforms have introduced socially differentiated tariffs and indexation to inflation, but average supply costs still exceed revenue,[46] and subsidies persist.[47] Digitalization of energy system governance and the necessity to introduce SCADA systems will be critical for the growing integration of renewable energy sources. While reform targets are ambitious, the compressed timeline risks policy outpacing system readiness.

Kyrgyz Republic

Kyrgyzstan's power sector has undergone recent re-centralization. Though it was unbundled in the 2000s, weak finances and poor operational performance led to the 2022 re-merging[48] of transmission and distribution under the National Electric Grid of Kyrgyzstan (NEGK). State-owned enterprises (Electric Power Plants and Chakan HPPs) dominate generation. The absence of wholesale and balancing markets, coupled with administratively set tariffs, limits incentives for efficiency. The recently adopted Medium-Term Tariff Policy[49] seeks to address these gaps by gradually increasing tariffs. However, retail prices remain well below cost-recovery levels. Limited ASKUE coverage constrain real-time monitoring and load forecasting, while governmental agencies have limited enforcement capacity to mandate metering upgrades.[50]

Tajikistan

Tajikistan retains a centralized model dominated by Barqi Tojik, a state-owned utility responsible for generation, sectoral coordination, and cross-border trade. Between 2018 and 2021, the sector underwent unbundling, with Shabakahoi Intiqoli Barq (SIB) emerging as the transmission operator and Shabakahoi Taqsimoti Barq (STB) as the distribution company. All three companies are publicly owned and closely coordinated. While unbundling helped preserve operational continuity during transition, it has not resolved the sector's chronic financial and institutional fragility yet. Recent tariff increases reflect a policy shift toward cost recovery, but cross-subsidization, particularly in favor of stra-

35 KEGOC. "Analysis of Wholesale Market."

36 Ministry of National Economy of the Republic of Kazakhstan. "Implementation of the 'Tariff in Exchange for Investments' Program." November 6, 2023. https://www.gov.kz/memleket/entities/economy/press/news/details/647722?lang=ru. Accessed July 27, 2025.

37 Republic of Kazakhstan. *The Resolution of the Government of the Republic of Kazakhstan On the Approval of the National Project 'Modernization of the Energy and Utility Sectors,'* No. 1102, December 25, 2024. https://adilet.zan.kz/rus/docs/P2400001102. Accessed July 27, 2025.

38 Republic of Uzbekistan. *The Decree of the President of Republic of Uzbekistan on The Strategy for Further Development and Reform of the Electric Energy Sector of the Republic of Uzbekistan,* No. 4249, March 27, 2019. https://lex.uz/docs/4257085?ONDATE=04.06.2024%2000. Accessed July 23, 2025.

39 Republic of Uzbekistan. *The Decree of the President of Republic of Uzbekistan On measures to carry out the next stage of reforming the energy sector,* No. 166, September 28, 2023. https://lex.uz/ru/docs/6624460. Accessed July 23, 2025.

40 Republic of Uzbekistan. *The Decree of the President of Republic of Uzbekistan On Introducing Changes to Certain Acts of the President of Uzbekistan Linked to Further Acceleration of Market Reforms and Achieving Uzbekistan's Membership in the WTO,* No. 74, April 30, 2025. https://lex.uz/ru/pdfs/7508070. Accessed July 23, 2025.

41 Republic of Uzbekistan. *Law of the Republic of Uzbekistan About Electricity,* July 10, 2024. https://api-portal.gov.uz/uploads/14c629ca-71dd-41f7-459c-1738f8d1a0a3_media_.pdf. Accessed July 23, 2025.

42 Spot.uz. "Chronicles: How Uzbekistan Is Advancing Toward Electricity Market Liberalization." [In Russian]. *Spot.uz,* September 11, 2024. https://www.spot.uz/ru/2024/09/11/energy-history/. Accessed July 23, 2025.

43 Gazeta.uz. "Uzbekistan Plans to Complete Transition to the Wholesale Market of Electricity and Gas in 2027–2028 – Vice Prime-Minister." [In Russian]. *Gazeta.uz*, October 11, 2024. https://www.gazeta.uz/ru/2024/10/11/energy-gas-market/. Accessed July 23, 2025.

44 Gazeta.uz. "Uzbekistan to Build 7,000 km of Transmission Networks to Connect New Power Plants and Energy Storages." *Gazeta.uz,* January 29, 2025. https://www.gazeta.uz/en/2025/01/29/transmission-networks/. Accessed July 28, 2025.

45 World Bank. "Uzbekistan to Invest in Modernizing Electricity Distribution Networks with World Bank Support." *Press release*, May 15, 2025. https://www.worldbank.org/en/news/press-release/2025/05/15/uzbekistan-to-invest-in-modernizing-electricity-distribution-networks-with-world-bank-support. Accessed July 28, 2025.

46 Gazeta.uz. "Official Explains Reasons behind Gas and Electricity Tariffs Increase." *Gazeta.uz.* April 16, 2024. https://www.gazeta.uz/en/2024/04/16/new-tariffs/. Accessed July 28, 2025.

47 Gazeta.uz. "Uzbekistan Plans to Continue Subsidizing Gas and Electricity Prices Despite Tariff Increases." [In Russian]. *Gazeta.uz.* November 16, 2024. https://www.gazeta.uz/ru/2024/11/11/subsidy/. Accessed July 28, 2025.

48 Abdiyeva, Baktynur. "Distribution Companies Severelectro, Oshelectro and Others No Longer Exist—They Are All Included in NEGK." [In Russian]. *Economist.kg,* August 16, 2022. https://economist.kg/novosti/2022/08/16/raspredkompanij-severelektro-oshelektro-i-drugih-bolshe-net-vse-oni-vkljucheny-v-nesk/. Accessed July 28, 2025.

49 Kyrgyz Republic. Resolution of the Cabinet of Ministers of the Kyrgyz Republic 'On approval of the Medium-term tariff policy of the Kyrgyz Republic for electric energy for 2025–2030.' No. 227, April 24, 2025. https://www.gov.kg/ru/npa/s/4644. Accessed July 28, 2025.

50 Zhanybekov, B. R. "Implementation of ASKUE: Effective Management of Generated, Transmitted, and Distributed Electricity Volumes in the Power System of the Kyrgyz Republic." [In Russian]. *Kyrgyz Energy Settlement Center.* N.d. https://esep.energo.kg/. Accessed July 28, 2025.

tegic industries and state-owned enterprises, continues to undermine BT's finances.[51] BT's debt burden reportedly exceeds $3 billion.[52] While the country benefits from substantial hydropower capacity, ageing infrastructure and low collection rates have left the sector vulnerable to seasonal imbalances. Interest in establishing an independent regulator remains at an early stage. These structural challenges limit the sector's ability to attract greater investment.

Shared Challenges and Reform Priorities

Despite their differences, Central Asian power systems share structural vulnerabilities that constrain internal resilience and deeper regional cooperation:

- → **Tariff reform remains politically sensitive.** Governments face a fundamental tension between ensuring financial sustainability of power sectors and protecting consumers from price hikes. Legacy expectations of low-cost electricity, coupled with concerns over inflation and affordability, make it politically difficult to advance tariff increases at a quick pace. Tariff increases are advancing gradually given these challenges, and countries are implementing socially differentiated tariffs based on consumption and social protection programs to shield vulnerable groups.

- → **Distribution-level infrastructure is the weakest link in national electricity systems.** Across the region, distribution networks are underfunded, poorly maintained, and operationally fragile. Utilities struggle with outdated assets, high technical and commercial losses, and limited revenue collection. These conditions worsen supply quality and stall the integration of advanced technologies. Efforts to modernize distribution grids are underway, often with donor support, but are outpaced by rising demand and deteriorating infrastructure.

- → **Digital infrastructure is expanding, but coverage remains incomplete and uneven.** ASKUE and similar metering systems are being introduced at varying rates across the region, with Kazakhstan achieving near-complete coverage at the transmission level. However, progress is slower at the distribution level. Modern SCADA systems for real-time monitoring need scaling up, and cybersecurity protocols are nascent. Without these tools, utilities cannot reliably forecast demand, detect losses, or optimize dispatch, hindering daily operations and market development.

- → **Renewable energy integration risks outpacing the system's flexibility and planning capacity.** Kazakhstan and Uzbekistan are scaling up wind and solar generation, but grid flexibility has not kept pace. In 2024 alone, Kazakhstan generated 7.58 TWh from renewables but faced over 1 TWh of deviations from planned dispatch.[53] Limited maneuverable generation and the early-stage regulatory frameworks for storage systems might well increase balancing costs. Mandating co-located battery storage for large renewable projects might seem like a step forward, but high capital costs and regulatory uncertainty risk deterring investors. According to the IEA, the global average cost of utility-scale battery storage with four-hour duration stood at $290/kWh in 2022, and is expected to fall to $175/kWh by 2030, a 40 % decline.[54] Even at projected 2030 prices, co-locating 30 % battery storage with a 1 GW renewable energy plant, assuming four-hour duration, could cost more than $200 million.[55] While pilot battery energy storage systems (BESS) are underway, full-scale adoption requires clear market rules, revenue models, and system planning.

- → **Storage investment is becoming urgent, but regulation and financing tools are lagging behind.** Both Kazakhstan and Uzbekistan recognize the urgent need for grid-scale storage to manage growing shares of intermittent renewables. Uzbekistan has set ambitious targets: 20 GW of renewables and 4.2 GW of storage capacity by 2030,[56] including 300 MW BESS facilities in Fergana and Andijan[57] and a $1.1 billion commitment from ACWA Power.[58] Other developers like Masdar[59] and Voltalia[60] are also exploring storage options. Kazakhstan, meanwhile,

51 Chorshanbiyev, Payrav. "Turn the lights off! Why are Tajiks doomed to constant increases in electricity prices?" [In Russian]. *Asia-Plus*, April 8, 2025. https://asiaplustj.info/ru/news/tajikistan/economic/20250408/tushite-svet-pochemu-tadzhikistantsi-obrecheni-na-postoyannoe-podorozhanie-elektroenergii. Accessed July 28, 2025.

52 Chorshanbiyev, Payrav. "Barki Tojik Had Debts Written Off for $28 Million." [In Russian]. *Asia-Plus*, December 30, 2022. https://old.asiaplustj.info/ru/news/tajikistan/economic/20221230/barki-tochik-prostili-zadolzhennost-v-28-millionov (accessed July 21, 2025).

53 Serikov, Daniyar. "Green Energy Begins to Shake Prices in Kazakhstan." [In Russian]. *InBusiness.kz*, June 2, 2025. https://inbusiness.kz/ru/news/zelenaya-energetika-nachinaet-raskachivat-ceny-v-kazahstane. Accessed July 23, 2025.

54 International Energy Agency. "Batteries and Secure Energy Transitions." *IEA report*, 2024. https://iea.blob.core.windows.net/assets/cb39c1bf-d2b3-446d-8c35-aae6b1f3a4a0/BatteriesandSecureEnergyTransitions.pdf. Accessed July 28, 2025.

55 Author's calculations based on the IEA findings.

56 Qazaq Green. "Electricity Consumption in Uzbekistan Grows by 7-8 % Annually." *Qazaq Green*, October 1, 2024. https://qazaqgreen.com/en/news/central-asia/2298/. Accessed July 28, 2025.

57 The Government of Uzbekistan. "18 New Energy Facilities Have Been Commissioned, Construction of Other 6 Facilities Has Begun." [In Russian]. *Gov.uz*, December 14, 2024. https://gov.uz/ru/news/view/30313. Accessed July 28, 2025.

58 Kun.uz. "Saudi Arabia's ACWA Power to Build 2 GW Energy Storage Systems in Uzbekistan." *Kun.uz*, November 15, 2024. https://kun.uz/en/news/2024/11/15/saudi-arabias-acwa-power-to-build-2-gw-energy-storage-systems-in-uzbekistan. Accessed July 28, 2025.

59 UZDaily. "Masdar, GD Power - Powerchina and Voltalia Win Tender for the Construction of Three Solar Photovoltaic Stations in Uzbekistan." *UZDaily*, December 15, 2022. https://www.uzdaily.uz/en/masdar-gd-power-powerchina-and-voltalia-win-tender-for-the-construction-of-three-solar-photovoltaic-stations-in-uzbekistan/. Accessed July 29, 2025.

60 Voltalia. "Voltalia Signs a Power Sales Agreement for Its 526-Megawatt Hybrid Project in Uzbekistan." *News Release*, March 11, 2025. https://www.voltalia.com/news-releases/news-release-details/voltalia-signs-power-sales-agreement-its-526-megawatt-hybrid/. Accessed July 29, 2025.

projects the need for at least 3 GW of storage to balance a planned 19 GW of renewable capacity by 2030.[61] Major wind projects in Zhambyl[62] and Kostanay[63] (each around 1 GW) are already being designed with 30 % co-located storage. While both countries have established a legal basis for storage systems, the frameworks are at their incipient stage, and risk mitigation instruments need to be developed.

→ **Hydropower-dominated systems face seasonal vulnerabilities.** Kyrgyzstan and Tajikistan rely on hydropower for most of their electricity, which offers dispatch flexibility. However, amidst climate change and infrastructure constraints, they face seasonal generation imbalances and demand growth that outpaces capacity additions. The absence of balancing markets, weak metering, and continued use of cross-subsidies create further inefficiencies. As these countries seek to monetize hydropower through exports (e. g., CASA-1000), improved governance and grid modernization will be critical for competitiveness and resilience.

Together, these challenges call for reforms that are gradual, context-specific, and feasible. Tariff adjustment is widely acknowledged as essential for sector sustainability, yet in Central Asia it remains highly sensitive due to legacy expectations and the social functions of the state. A cautious, phased approach is therefore more realistic than rapid liberalization. **Governments should prioritize gradually moving tariffs closer to cost-recovery levels while**

61 Serikov, "Green Energy Begins to Shake Prices."

62 KazMunayGas. "Construction of a 1 GW Hybrid Wind Farm Project Using the 300 MW/600 MWh Energy Storage System (Mirny Project)." N.d. https://www.kmg.kz/en/company/projects/all/65456456/. Accessed July 28, 2025.

63 Universal Energy. "Universal Energy Wins Bid for 1GW Wind Power + 600MWh Energy Storage in Kazakhstan." N.d. https://www.universalenergy.com/en/news/1075. Accessed July 28, 2025.

Comparative analysis of electricity sector governance and markets in Central Asia **Table 1**

Country	Governance	Market Maturity	Strengths	Constraints and Needs
Kazakhstan	**Hybrid:** Unbundled, SOE TSO (KEGOC); privatized generation; partially privatized distribution	**Most advanced:** wholesale (with balancing market and a single buyer mechanism), retail markets	→ Strong reform progress (balancing market, digital TSO) → Near-complete ASKUE at transmission level → Priority grid investments embedded into national programs	→ Aging distribution assets → Tariffs do not fully cover costs → Need for full ASKUE deployment at distribution level and among wholesale market participants → Needs support with grid digitalization and enhanced cybersecurity protocols
Uzbekistan	**Transitional:** unbundled but high SOE dominance in generation, transmission and distribution	**In transition:** legal reforms enacted; wholesale market launch planned for 2027	→ Rapid legal and regulatory reforms → Growing private participation via PPPs → Ambitious RES and storage expansion targets	→ Outdated distribution networks → Tariffs do not fully cover costs → ASKUE coverage incomplete, including cross-border nodes → Compressed reform timeline risks outpacing system readiness → Needs technical assistance for market rules, digitalization, and cybersecurity
Kyrgyz Republic	**Recentralized:** transmission and distribution merged under NEGK; SOE-dominated generation	No competitive market; limited IPPs	→ Gradual tariff increases → Large hydropower base → Donor support for smart metering	→ High asset wear (transformers, hydro) → Tariffs do not fully cover costs → Low metering and digitalization → Lack of market mechanisms → Needs enhanced SOE capacity
Tajikistan	**Operational monopoly:** Barki Tojik dominates; recent unbundling of transmission and distribution	No competitive market; limited private sector participation	→ Large hydropower base → Gradual tariff reform	→ High losses, aging infrastructure → Tariffs do not fully cover costs → Chronic debt burden (> $3 bn) of Barki Tojik → Low metering and digitalization → Needs enhanced SOE capacity

safeguarding vulnerable consumers, ensuring reliable system operations, and strengthening the governance of public utilities. The political economy of electricity pricing, where subsidies and state ownership remain deeply embedded, makes sweeping liberalization risky**.** While accelerated reforms could, in principle, attract investment and stimulate innovation, they risk outpacing system readiness and undermining reliability. Conversely, excessive delays may preserve short-term stability but entrench inefficiencies and underinvestment. The optimal path lies in carefully sequenced reforms aligned with each country's grid topology, institutional capacity, and modernization needs.

From a regional perspective, institutional fragmentation, differences in governance models and tariff regimes, limits the feasibility of fully harmonized market integration. Instead of pursuing uniform rules, these differences need to be managed through **interoperable frameworks and targeted coordination** that enable real-time exchanges where feasible. Strengthening internal system resilience through digitalization, flexible capacity, and distribution upgrades, is a necessary prerequisite for deeper regional cooperation. External partners, particularly the EU, could facilitate this by de-risking investments, enhancing local capacity, and fostering regional learning. Such support is most effective when it reinforces domestic priorities and entails local ownership of reform.

Toward a Regional Grid: Challenges and Opportunities

The electricity systems of Central Asia have long been physically interconnected but remain institutionally fragmented and underutilized as a regional resource. During the Soviet period, the Central Asia Unified Power System (CAPS) functioned as a coordinated network. In the 1960s–1970s, large-scale hydropower plants in upstream Kyrgyzstan and Tajikistan were linked with thermal power plants in downstream Uzbekistan, Turkmenistan, and Kazakhstan. Power flows were centrally managed through the Integrated Dispatch Center in Tashkent, enabling seasonal balancing. After independence, this system fragmented as countries prioritized energy sovereignty. Turkmenistan exited CAPS in 2003 and now operates its grid in islanded mode. Tajikistan disconnected in 2009 but is gradually reintegrating with support from the Asian Development Bank.[64] Kazakhstan, Kyrgyzstan, and Uzbekistan continue to operate synchronously within CAPS, coordinated by the Electric Power Council and technically overseen by the Coordination Dispatch Center "Energia."

However, actual trade remains modest—averaging just 2.5% of regional demand and using only 40% of available interconnection capacity.[65] Several factors constrain deeper exchanges: outdated grid infrastructure, bottlenecks at interconnection nodes and metering systems, and the absence of a regional electricity trading platform. These limit the region's ability to accommodate rising power flows and integrate variable renewable energy.

That said, the synchronized operation among Kazakhstan, Kyrgyzstan, and Uzbekistan provides the foundations of a regional "grid community." Unlike ad hoc interconnectors, this arrangement already enables shared frequency control and seasonal load balancing. While it falls short of an EU-like electricity market, it offers potential for collective resilience. Recent reforms, such as upgrades to SCADA systems and early-stage dialogue on shared trading platforms, signal gradual progress. **To consolidate this emerging grid community, a pragmatic two-track strategy is needed: strengthening national grid resilience while deepening cross-border interoperability.** This includes deployment of interoperable metering (ASKUE), harmonized dispatch protocols, and standardized interconnection requirements, technical alignment that falls short of full market harmonization. Developing common investment frameworks and cost-sharing mechanisms for cross-border projects could further attract capital without requiring unified tariff regimes. If trade volumes increase, countries could benefit from efficiency gains such as reserve sharing and reduced dependence on costly gas peakers.

The geopolitical implications of enhanced connectivity are rather nuanced. A more interconnected grid increases system flexibility and can attract investment, particularly for smaller countries that benefit from proximity to larger balancing hubs such as Kazakhstan. But interdependence also introduces exposure: frequency disturbances, cyberattacks, or supply shocks in one country can ripple across borders. While grid linkages may encourage cooperation, they do not eliminate asymmetries and could reinforce them without careful institutional design.

Three scenarios illustrate the trade-offs between interdependence, sovereignty, and efficiency. In an "unlimited transmission" scenario, envisioned by UNECE, where interconnections within Central Asia and with global markets face no constraints, the region could theoretically save up to $1.4 billion annually in electricity production costs.[66] However, such integration would require converged market structures, harmonized regulations, and ceding elements of national control, which are neither feasible in the short to medium term nor desirable given the risks for individual countries. Conversely, if coordination stagnates amidst rising shares of renewables, countries risk overbuilding redundant capacity, facing higher balancing costs, and locking in inefficiencies. **Between these extremes lies a path of pragmatic regionalism: strengthening domestic grid resilience first, while incrementally enhancing cross-border interoperability. Under this scenario, digital trading platform, interoperable metering, and common investment frameworks could unlock efficiency gains without forcing market unification or undermining policy autonomy.**

64 Asian Development Bank. "Tajikistan: Reconnection to the Central Asian Power System Project – Additional Financing." https://www.adb.org/projects/52122-002/main. Accessed July 30, 2025.

65 The World Bank. *Regional Electricity Market Interconnectivity and Trade – Central Asia (P181214): Project Information Document (PID – Concept Stage)*. Report No: PID186. October 5, 2023. https://documents1.worldbank.org/curated/en/099100523132539287/pdf/P1812140c755ef090b30f0c40a9dc5720c.pdf. Accessed July 23, 2025.

66 United Nations Economic Commission for Europe (UNECE). *Modeling a Resilient and Integrated Energy System for Central Asia: A Roadmap for Regional Interconnectivity*. March 2025. https://unece.org/sites/default/files/2025-03/Report.pdf. Accessed July 23, 2025.

Expanding External Connectivity

Alongside intra-regional efforts, Central Asian countries are seeking to connect their electricity systems with external markets. CASA-1000, a $1.2 billion initiative[67] to export surplus hydropower from Kyrgyzstan and Tajikistan to Afghanistan and Pakistan during summer months, has faced delays but is regaining momentum. In 2024, Tajikistan and the Kyrgyz Republic inaugurated a 480 km, 500 kV line linking Datka and Sughd substations.[68] A new technical code for synchronized operations was also signed, laying the groundwork for parallel balancing. On the Afghan side, construction is 70 % complete, though an additional $100 million in financing is reportedly needed.[69]

Beyond CASA, Kazakhstan, Uzbekistan, and Azerbaijan signed a trilateral MoU in 2024 to develop a "Green Energy Corridor" linking Central Asia to Europe.[70] The project envisions a high-voltage submarine cable beneath the Caspian, overland lines through the South Caucasus, and a link to the EU via the Black Sea. In 2025, the three TSOs established a joint venture, Green Corridor Alliance, to coordinate this initiative.[71] Though still at the feasibility stage, it signals a strategic ambition to build a future Caspian-Black Sea "supergrid,"[72] connecting asynchronous systems via HVDC and advanced digital control.

Uzbekistan has recently proposed to connect the region to China's grid through new high-voltage lines and potential long-term synchronization.[73] Meanwhile, Kazakhstan operates in sync with Russia's Unified Power System via CAPS, providing emergency balancing and mutual trade.[74] Its approach exemplifies a dual-track strategy: maintain synchronized flows with Russia while building technical capacity for eastward and westward interconnections, consistent with its broader "multi-vector" foreign policy. These external linkages reflect the rising role of electricity as a geoeconomic vector. Cross-border flows can deliver economic benefits but also heighten institutional and security challenges. Their success will hinge on improved governance, cyber resilience, and credible domestic system upgrades.

The EU's Role in Central Asia's Power Transition: Strategic Gaps, System Support, and Long-Term Levers

The European Union has a clear strategic interest in supporting electricity sector infrastructure and reform in Central Asia. The region's importance as a source of clean power and an integral part of a future corridor for inter-regional electricity trade is increasing. As such, ensuring the interoperability and resilience of Central Asia's grids, aligns directly with the EU's long-term objectives. Reliable power systems underpin economic development, renewable energy integration, and regional cooperation - goals that mirror the EU's Global Gateway priorities, including climate action, sustainable connectivity, and geoeconomic diversification. At the pioneer EU-Central Asia Summit in April 2025, the European Commission President Ursula von der Leyen underscored this perspective. She highlighted transport corridors, critical raw materials, clean energy, and digital connectivity as the four pillars of future cooperation between the regions.[75] In this light, the effectiveness of the €12 billion investment package the Head of Commission pledged (over half of which will be directed to hydropower and climate)[76] at the Summit, will ultimately depend on the availability of robust electricity grids that are often the neglected yet critical enablers of all four pillars.

The EU's current engagement already reflects the emphasis on both the "hard" and "soft" dimensions of power systems. It spans multilateral coordination, bilateral partnerships, and financing through international financial institutions, particularly the EBRD and EIB. These efforts are guided by the 2019 EU Strategy for Central Asia, the 2023 Joint Roadmap, and the Team Europe Initiative on Water, Energy, and Climate. Over €700 million has been pledged for energy, water, and climate-related projects in the re-

67 CASA-1000. "Home." https://www.casa-1000.org/ru/home-ru/. Accessed July 23, 2025.

68 Abdrakhmanova, Gulmira. 2025. "Kyrgyz Republic and Tajikistan Launched HVDC 'Datka-Sugd'Line As Part of the CASA-1000." *Kazinform*, March 31, 2025. https://www.inform.kz/ru/kirgizstan-i-tadzhikistan-zapustili-lep-datkasugd-v-ramkah-proekta-casa-1000-de9e99. Accessed July 28, 2025.

69 BNE Intellinews. "Taliban Seek $100mn from World Bank to Restart Work on CASA-1000 Electricity Transmission Project." *BNE Intellinews*, April 2, 2025. https://www.intellinews.com/taliban-seek-100mn-from-world-bank-to-restart-work-on-casa-1000-electricity-transmission-project-374739/. Accessed July 23, 2025.

70 Abbasova, Vusala. "Azerbaijan, Kazakhstan, Uzbekistan Sign MoU to Merge Energy Systems." *Caspian News*, May 4, 2024. https://caspiannews.com/news-detail/azerbaijan-kazakhstan-uzbekistan-sign-mou-to-merge-energy-systems-2024-5-4-0/. Accessed July 23, 2025.

71 Jalolova, Sadokat. 2025. "Uzbekistan, Azerbaijan, and Kazakhstan Launch Joint Venture for Green Energy Corridor." *Times of Central Asia*, July 7, 2025. https://timesca.com/uzbekistan-azerbaijan-and-kazakhstan-launch-joint-venture-for-green-energy-corridor/. Accessed July 28, 2025.

72 In O'Sullivan, Overland, and Sandalow. *The Geopolitics of Renewable Energy*, "supergrids" are defined as multinational electricity grids designed for resource-sharing and economies of scale.

73 Mamadaminov, Umid. "China, Central Asian Countries Discuss Unified Power Grid Project — Deputy Energy Minister of Uzbekistan." *Gazeta.uz*, June 21, 2025. https://www.gazeta.uz/en/2025/06/21/ca-china-power-grid/. Accessed July 23, 2025.

74 Podkovalnikov, Sergey, and Lyudmila Chudinova. "Electric Power Partnership Between Russia and Central Asian Countries." [In Russian]. *Energeticheskaya Politika*, May 7, 2024. https://energypolicy.ru/elektroenergeticheskoe-partnerstvo-rossii-i-stran-czentralnoj-azii/regiony/2024/16/07/. Accessed July 21, 2025.

75 European Commission. *Speech by President von der Leyen at the Plenary Session of the First EU-Central Asia Summit.* Speech, April 4, 2025. https://ec.europa.eu/commission/presscorner/api/files/document/print/hu/speech_25_976/SPEECH_25_976_EN.pdf. Accessed September 1, 2025.

76 European Commission. *1st European Union Central Asia Summit.* Factsheet, April, 2025. https://ec.europa.eu/commission/presscorner/api/files/attachment/881028/EU-Central%20Asia_Factsheet_2025-04.pdf. Accessed September 1, 2025.

gion, including €200 million directly from the EU budget.[77] Regional platforms such as SECCA and CAWEP complement these initiatives by offering technical assistance for grid modernization and integration.

In Kazakhstan, the EBRD approved a €270 million loan in 2024 for the 500 kV West-UES interconnection,[78] supported by investments in KEGOC's local currency bond[79] and technical cooperation. A €6 million EU grant via the Mitigation Action Facility (with UNDP) supports transmission efficiency and loss reduction.[80] In Kyrgyzstan, EBRD programs have enabled digital metering, substation upgrades, and early work on the Kemin-Balykchy corridor,[81] supporting over 1 GW of renewable integration. In Uzbekistan, EU-backed sovereign loans have financed key high-voltage lines (Sarymay-Muruntau,[82] Sarymay-Djankeldy[83]), while off-taker guarantees and advisory support have de-risked utility-scale wind projects. In Tajikistan, the EIB provided a €70 million loan for a 500 kV interconnection with Kyrgyzstan,[84] while the EBRD is financing grid upgrades, advanced metering, and modernization.[85] EU co-financing also supports off-grid electrification in Gorno-Badakhshan through Pamir Energy.[86] A recent €20 million EBRD grant under the Global Gateway will further enhance Tajikistan's grid resilience.[87]

European corporate actors complements these efforts. Total Eren is developing gigawatt-scale wind power plant with storage in Kazakhstan,[88] Siemens and Eni are modernizing gas-fired[89] and hybrid plants,[90] whereas EDF is eyeing investments in distribution and transmission lines and renewables in Uzbekistan.[91] This combination of private innovation and public finance illustrates the EU's distinctive *modus operandi* in Central Asia.

The sustainability of these institutional and corporate investments, depends, however, on a robust policy and operational environment. The EU is operating in a competitive geoeconomic arena. Russia emphasizes system interoperability and regional market integration through the Eurasian Economic Union (EAEU). Kazakhstan operates synchronously with the Russian Unified Energy System (UES) and serves as a transit state for Kyrgyz imports of electricity and Uzbek imports of gas from the Russian Federation. Moscow has signaled interest in deeper coordination, including accession to the Coordination Electric Power Council of Central Asia[92] and the delayed but ongoing development of the EAEU common electricity market, now expected in 2027.[93] Russian firms such as Inter RAO and Rosatom remain active, particularly in generation and transmission infrastructure.

China's approach is more infrastructure-centric, focusing on physical interconnections, high-voltage lines, and projects delivered via EPC contracts, concessional finance, or equity stakes. In Kyrgyzstan, Chinese TBEA built the 500 kV Datka-Kemin line[94] and upgraded the Bishkek TPP. The company has signed memoranda to construct six hydro-

77 European Commission. *Global Gateway: Team Europe Launches Two Initiatives in Central Asia on Energy and on Digital Connectivity*. Press release, November 18, 2022. https://ec.europa.eu/commission/presscorner/api/files/document/print/pl/ip_22_6963/IP_22_6963_EN.pdf. Accessed July 23, 2025.

78 European Bank for Reconstruction and Development. "KEGOC: Integration of the West Zone." https://www.ebrd.com/home/work-with-us/projects/psd/55284.html. Accessed July 21, 2025.

79 Usov, Anton. "EBRD Invests KZT 6 Billion in KEGOC Bond." *European Bank for Reconstruction and Development*, April 3, 2023. https://www.ebrd.com/home/news-and-events/news/2023/ebrd-invests-kzt-6-billion-in-kegoc-bond.html. Accessed July 21, 2025.

80 UNDP Kazakhstan. "Kazakhstan Secures €6 Million for Grid Efficiency Modernization and Energy Loss Reduction." *UNDP*, December 13, 2024. https://www.undp.org/kazakhstan/press-releases/kazakhstan-secures-eu6-million-grid-efficiency-modernization-and-energy-loss-reduction. Accessed July 28, 2025.

81 Report.kg. "The EBRD Will Allocate €100 Million for the Construction of the Kemin-Balykchy Power Transmission Line, - Ibrayev." *Report.kg*, April 7, 2025. https://report.kg/exclusive/14863-ebrr-vydelit-na-stroitelstvo-ljep-kemin-balykchy-100-mln-ibraev.html. Accessed July 28, 2025.

82 European Bank for Reconstruction and Development. n.d. "Sarymay-Muruntau Transmission." https://www.ebrd.com/home/work-with-us/projects/psd/54421.html#project-description1. Accessed July 29, 2025.

83 European Bank for Reconstruction and Development. n.d. "Sarymay-Djankeldy Transmission." https://www.ebrd.com/home/work-with-us/projects/psd/52874.html#project-description1. Accessed July 29, 2025.

84 European Investment Bank (EIB). "EIB Supports Power Interconnection between Tajikistan and Kyrgyzstan." *European Investment Bank*, June 11, 2015. https://www.eib.org/en/press/all/2015-130-eib-supports-power-interconnection-between-tajikistan-and-kyrgyzstan. Accessed July 28, 2025.

85 Usov, Anton. "EBRD Helps Increase Reliability of Electrical Grid in Tajikistan." *European Bank for Reconstruction and Development*, February 28, 2024. https://www.ebrd.com/home/news-and-events/news/2024/ebrd-helps-increase-reliability-of-electrical-grid-in-tajikistan.html. Accessed July 30, 2025.

86 Delegation of the European Union to Tajikistan. "Sebzor Hydropower Plant – Improving the Energy Supply in the Province of Gorno-Badakhshan." *European External Action Service*, July 19, 2022. https://www.eeas.europa.eu/delegations/tajikistan/sebzor-hydropower-plant-improving-energy-supply-province-gorno-badakhshan_en. Accessed July 28, 2025.

87 Delegation of the European Union to Tajikistan. "EU Advances Global Gateway Strategy in Tajikistan." *European External Action Service*, March 15, 2025. https://www.eeas.europa.eu/delegations/tajikistan/eu-advances-global-gateway-strategy-tajikistan_en?s=228. Accessed July 21, 2025.

88 KazMunayGas. "Construction of a 1 GW Hybrid Wind Farm Project Using the 300 MW/600 MWh Energy Storage System (Mirny Project)." N.d. https://www.kmg.kz/en/company/projects/all/65456456/. Accessed July 28, 2025.

89 Qazaq Green. "Siemens Energy Intends to Get Involved in Significant Energy Projects Execution in Kazakhstan." *Qazaq Green News Kazakhstan*, September 29, 2023. https://qazaqgreen.com/en/news/kazakhstan/1465/. Accessed July 29, 2025.

90 Eni. "Eni and KazMunayGas Announce Commencement of Construction for 250 MW Hybrid Power Plant in Kazakhstan." *Press Release*, July 16, 2024. https://www.eni.com/en-IT/media/press-release/2024/07/eni-kmg-announce-commencement-construction-250mw-hybrid_power-plant-kazakhstan.html. Accessed July 29, 2025.

91 Antheunissens, Pierre-Paul. "EDF's General Director Outlines Vision for Uzbekistan's Energy Transition." *Kursiv.uz*, November 8, 2024. https://uz.kursiv.media/en/opinions/edfs-general-director-outlines-vision-for-uzbekistans-energy-transition/. Accessed July 30, 2025.

92 TASS News Agency. "Russia's Ministry of Energy and Uzbekistan Agree on Accession to the Central Asian Power Grid." [In Russian]. *TASS News Agency*, September 9, 2024. https://tass.ru/ekonomika/21819101. Accessed July 21, 2025.

93 Bolatbek, Fariza. "Unified Energy Market of the EAEU: Utopia or Reality of 2027?" [In Russian]. *Deutsche Welle (DW)*, November 20, 2024. https://www.dw.com/ru/edinyj-energorynok-eaes-utopia-ili-realnost-2027-goda/a-70825076. Accessed July 21, 2025.

94 China and Central Asia Studies. "Datka-Kemin Power Transmission Line – China Central Asia." n.d. https://china-centralasia.org/en/project/93. Accessed July 21, 2025.

power plants on the transboundary Sary-Jaz River and a new 500 kV Kemin-Torugart line,[95] envisioned as part of a future Kyrgyzstan-China corridor. In Tajikistan, TBEA unified the country's grid with the "South-North" line and built the Dushanbe-2 TPP.[96] In Uzbekistan, China Energy participated in national grid planning and pledged to co-develop a "green corridor" in Kazakhstan, alongside regional transmission infrastructure.[97] Since 2018, China's engagement has evolved from loans to equity, co-financing with IFIs, and participation in auctions (Kazakhstan) or direct negotiations (Uzbekistan).[98] Chinese firms now operate across the project lifecycle: as developers, EPCs, equipment suppliers, and joint manufacturers, shaping the region's grid through assets and technology.

Unlike Russia and China, the EU lacks synchronous ties or geographic proximity. **While the EU cannot leverage technical integration, it offers strategic complementarity**. **Its comparative value lies in addressing bottlenecks in planning, forecasting, digital metering, and governance via targeted infrastructure investments and capacity-building assistance**. Crucially, Central Asian leaders increasingly welcome grater EU engagement. Uzbek President Shavkat Mirziyoyev has stressed the growing need for close cooperation with Europe.[99] Kazakhstan's President Kassym-Jomart Tokayev has reaffirmed that the Enhanced Partnership and Cooperation Agreement remains the backbone of bilateral ties, identifying energy, major infrastructure and industrial projects, digital innovation, and artificial intelligence as priority areas.[100] Tajikistan's President Emomali Rahmon has called for elevating relations to a strategic level, with a strong emphasis on attracting European investment and technology.[101] Kyrgyz President Sadyr Japarov has expressed intention to deepen cooperation with the EU across multiple areas as well.[102]

At the elite level, rhetoric toward the EU is supportive, and perceptions of the EU are broadly positive. Yet, as a recent study by Mukasheva, Temirov, and Akhmedyanova shows,[103] Central Asian elites view the EU most positively when it comes to education, economic, and environmental cooperation. Authors suggest that the EU's effectiveness in fostering regional cooperation depends on prioritizing areas where its engagement resonates locally. Looking ahead, the EU could avoid sensitivities around rapid neoliberal reforms by supporting phased and locally owned approaches.

At the same time, engagement in flagship projects such as the planned Green Energy Corridor linking Central Asia to Europe via HVDC lines will demand sustained commitment. Success will depend not only on secure digital protocols and resilient governance frameworks, but also on careful alignment with domestic political economies. Importantly, such alignment has to remain consistent with the principles of transparency, good governance, and sustainability that underpin effective EU engagement. While large-scale infrastructure investments are inherently costly, their burden can be eased through co-financing with IFIs and concessional elements, which is particularly important for republics already under debt stress. Such an adaptive, system-level approach can help ensure that EU engagement remains both credible and constructive.

95 Akchabar. 2023. "China Will Build a 500 kV "Kemin-Torugart" Transmission Line." [In Russian]. *Akchabar*, August 17, 2023. https://www.akchabar.kg/news/kitaj-postroit-liniyu-elektroperedachi-500-kv-kemin-torugart-ahfzujwemxaeyeuz. Accessed July 28, 2025.

96 Asia-Plus. "Chinese TBEA Will Build the Cascade of HPP in Kyrgyzstan." Asia-Plus, August 17, 2023. https://asiaplustj.info/ru/news/centralasia/20230817/kirgizstan-privlek-kitaiskuyu-tvea-k-stroitelstvu-kaskada-ges-na-reke-sari-dzhaz. Accessed July 28, 2025.

97 Mamyshev, Zhanbolat. "China Will Help Central Asian Countries Balance Electricity Flows." [In Russian]. *Kursiv.kz*, June 16, 2025. https://kz.kursiv.media/2025-06-16/zhnb-china-energy-central-asia/. Accessed July 23, 2025.

98 Sharifli, Yunis. "Green New Wave: How China Adapts to Central Asia's Renewable Energy Landscape." *Carnegie Endowment for International Peace*, April 19, 2024. https://carnegieendowment.org/posts/2024/04/green-new-wave-how-china-adapts-to-central-asias-renewable-energy-landscape?lang=en. Accessed July 23, 2025.

99 European Council. *Joint Press Release Following the First EU-Central Asia Summit.* Speech, April 4, 2025. https://www.consilium.europa.eu/en/press/press-releases/2025/04/04/joint-press-release-following-the-first-eu-central-asia-summit/. Accessed September 1, 2025.

100 Official Website of the President of the Republic of Kazakhstan. "Kassym-Jomart Tokayev met with President of the European Commission Ursula von der Leyen." *Akorda.kz*, April 3, 2025. https://www.akorda.kz/en/1-333421. Accessed September 1, 2025.

101 Permanent Mission of the Republic of Tajikistan to the United Nations. "Meeting with the President of the European Commission Ms. Ursula von der Leyen." *MFA.TJ*, April 4, 2025. https://www.mfa.tj/en/newyork/view/16828/meeting-with-the-president-of-the-european-commission-ms-ursula-von-der-leyen. Accessed September 1, 2025.

102 The Caspian Post. "President Japarov Addresses First Central Asia-EU Summit in Samarkand." *The Caspian Post*, April 4, 2025. https://caspianpost.com/central-asia/president-japarov-addresses-first-central-asia-eu-summit-in-samarkand. Accessed September 1, 2025.

103 Mukasheva, Zarina. Anuar Temirov, and Dana Akhmedyanova. "Local Elite Perceptions on the EU's Agenda to Promote Regional Cooperation in Central Asia." *European Politics and Society* 26 (4), 2025. https://www.tandfonline.com/doi/full/10.1080/23745118.2025.2450650?scroll=top&needAccess=true. Accessed September 1, 2025.

Policy Recommendations

To support Central Asia's electricity grids effectively, donor community should pursue a staged and targeted approach, focusing on technical and institutional gaps. Given the legacy of state dominance, limited investor confidence, and uneven reform capacity, reforms must be tailored and politically feasible. The EU has a comparative advantage in combining technical cooperation with diverse financing instruments. Technical assistance and peer-to-peer exchanges can help ministries and regulators absorb new regulatory models, while grants can be deployed to de-risk early reforms and pilot projects. Concessional loans, particularly for distribution companies, can enable investments without overwhelming fiscal space. Importantly, sequencing reforms allows economic growth to accompany evolving market structures, minimizing the risk of price shocks for consumers with weaker purchasing power.

The recommendations below reflect the "low cost, high leverage" logic. Often, grants and technical cooperation can unlock significant flows of IFI and private capital, while avoiding debt stress for recipient countries. In an era of declining development assistance volumes, this efficiency is particularly important: every euro spent should demonstrate long-term value. The recommendations align with local developmental priorities and could well strengthen the credibility of EU and donor engagement; where relevant, they are also directed at national governments.

1. **Prioritize investments in distribution infrastructure and local grid resilience**.

→ ***Target audience:*** *EU institutions, national governments*

→ ***Political feasibility:*** *High in the short to medium term, as smart metering aligns with ongoing national modernization programs and EU donor priorities.*

Distribution-level bottlenecks remain the weakest link in Central Asia's electricity systems, accounting for the bulk of technical and commercial losses. EU actors can lead by co-financing distribution upgrades through concessional loans, grants, and technical assistance. These investments should go beyond hardware to include corporate governance reforms, improved revenue collection, and customer service modernization. Such interventions would stabilize power delivery at the most vulnerable layer of the grid and complement national plans.

2. **Support full deployment of smart metering and strengthen the digital security of energy infrastructure**

→ ***Target audience:*** *EU institutions, national governments*

→ ***Political feasibility:*** *High in the short to medium term. Widely supported by governments but may face cost and data-sharing resistance from some utilities.*

Automated metering infrastructure reduces losses and enables transparent trade, but deployment is uneven, especially in rural and border areas. The EU, drawing on its experience with digital energy markets, can co-finance metering rollouts while embedding standardized protocols, consumer-side communication infrastructure, and cybersecurity protections. Harmonized data architectures would enhance operational efficiency and reduce risks of disputes or cyber incidents. This is a prerequisite for any future interoperable market model in Central Asia.

3. **Enhance maneuverable capacity and develop a coherent regulatory framework for energy storage**

→ ***Target audience:*** *national governments, with EU support via technical assistance and blended finance*

→ ***Political feasibility:*** *Medium. Governments have a political will to pursue storage, but regulatory gaps and cost-recovery barriers limit private sector participation.*

While hydropower offers some flexibility, the region's growing share of variable renewables is straining grid stability. Investments in battery storage, pumped hydro, and gas-fired peakers are now essential, but remain unattractive to private developers due to high costs and policy uncertainty. The EU can add value by helping governments design **coherent regulations for storage and flexible generation,** offering technical assistance to integrate these assets into market operations, and providing **blended finance** to de-risk early-stage projects. Supporting pilot projects could demonstrate scalable models. Encouraging maneuverable generation also reduces curtailment risks and supports the long-term integration of renewables into national and regional grids.

4. **Facilitate AI integration and grid digitalization through peer learning and technical pilots**

→ ***Target audience:*** *EU institutions, national TSOs, and regional platforms*

→ ***Political feasibility:*** *High. AI pilots relate to technical upgrades rather than structural reforms, however, they also require robust cybersecurity frameworks.*

AI tools can improve forecasting, dispatch optimization, fault detection, and asset diagnostics. For instance, KEGOC's 2032 strategy[104] includes eight AI-based operational tools. EU-backed donors could co-fund pilot projects for AI deployment in forecasting or asset diagnostics, peer exchanges between Central Asian TSOs and European system operators, and supporting legal and cybersecurity frameworks for AI deployment.

5. **Expand support for human capital and institutional capacity in electricity governance**

→ ***Target audience:*** *EU institutions, national regulators, regional academic networks*

→ ***Political feasibility:*** *High but long-term. While stakeholders support capacity-building activities, they are usually effective in the long run and high cadre turnover might pose a risk.*

The EU can establish long-term training programs, regional fellowships, and secondments to European DSOs/TSOs. Supporting a Central Asian energy governance academy or center of excellence would build a pipeline of experts capable of sustaining reforms. By investing in local talent, the EU reduces reliance on short-term consultancies and strengthens national regulators' ability to implement complex reforms.

6. **Support the gradual development of a digital regional electricity trading platform**

→ ***Target audience:*** *regional institutions (e.g., Coordination Electric Power Council), with EU support*

→ ***Political feasibility:*** *Medium in the short term; higher in the medium to long term. Momentum for regional cooperation is increasing, but negotiations over technical details and cost-sharing could delay progress.*

The EU can help design a **voluntary** real-time balancing and reserve-sharing platform governed by standardized transit agreements and transparent settlement mechanisms. Rather than imposing full harmonization, this approach would enable gradual interoperability, efficiency gains, and renewable integration, while respecting national sovereignty. The EU's experience with cross-border energy platforms gives it a unique advantage in facilitating such a transition.

104 Zhazetova, Zhanel. "KEGOC Plans to Use AI to Forecast Electricity Demand and Control Substations." [In Russian]. *Kursiv.kz*, June 4, 2024. https://kz.kursiv.media/2024-06-04/zhzh-kegoc-ai/. Accessed July 23, 2025.

References

Abbasova, Vusala (2025). "Azerbaijan, Kazakhstan, Uzbekistan Sign MoU to Merge Energy Systems." *Caspian News*, May 4, 2024. https://caspiannews.com/news-detail/azerbaijan-kazakhstan-uzbekistan-sign-mou-to-merge-energy-systems-2024-5-4-0/. Accessed July 23, 2025.

Abdiyeva, Baktynur (2025). "Distribution Companies Severelectro, Oshelectro and Others No Longer Exist—They Are All Included in NEGK." [In Russian]. *Economist.kg*, August 16, 2022. https://economist.kg/novosti/2022/08/16/raspredkompanij-severelektro-oshelektro-i-drugih-bolshe-net-vse-oni-vkljucheny-v-nesk/. Accessed July 28, 2025.

Abdrakhmanova, Gulmira (2025). "Kyrgyz Republic and Tajikistan Launched HVDC 'Datka-Sugd'Line As Part of the CASA-1000." *Kazinform*, March 31, 2025. https://www.inform.kz/ru/kirgizstan-i-tadzhikistan-zapustili-lep-datkasugd-v-ramkah-proekta-casa-1000-de9e99. Accessed July 28, 2025.

Akchabar (2023). "China Will Build a 500 kV "Kemin-Torugart" Transmission Line." [In Russian]. *Akchabar*, August 17, 2023. https://www.akchabar.kg/news/kitaj-postroit-liniyu-elektroperedachi-500-kv-kemin-torugart-ahfzujwemxaeyeuz. Accessed July 28, 2025.

Akhmatova, Ilona (2023). "How Worn Out is the Equipment in Kyrgyzstan's Energy Sector? Disappointing Calculations." *Economist.kg*, May 15, 2023. https://economist.kg/novosti/2023/05/15/naskolko-iznosheny-oborudovaniya-v-energetike-kyrgyzstana-neuteshitelnye-podschety/. Accessed July 22, 2025.

Antheunissens, Pierre-Paul (2024). "EDF's General Director Outlines Vision for Uzbekistan's Energy Transition." *Kursiv.uz*, November 8, 2024. https://uz.kursiv.media/en/opinions/edfs-general-director-outlines-vision-for-uzbekistans-energy-transition/. Accessed July 30, 2025.

Asian Development Bank (n.d.). "Tajikistan: Reconnection to the Central Asian Power System Project – Additional Financing." https://www.adb.org/projects/52122-002/main. Accessed July 30, 2025.

Asia-Plus (2025). "Head of Tajikistan's Ministry of Energy Expressed Dissatisfaction with How Distribution of Electricity Works." *Asia-Plus*, July 15, 2025. https://asiaplustj.info/ru/news/tajikistan/economic/20250715/glava-minenergo-tadzhikistana-virazil-nedovolstvo-rabotoi-po-raspredeleniyu-elektroenergii. Accessed July 27, 2025.

Asia-Plus (2025). "Emomali Rahmon Signs Law Establishing Criminal Liability for Unlawful Manipulations with Electricity Meters." *Asia-Plus*, April 15, 2025. https://asiaplustj.info/ru/node/347849. Accessed July 25, 2025.

Asia-Plus (2023). "Chinese TBEA Will Build the Cascade of HPP in Kyrgyzstan." *Asia-Plus*, August 17, 2023. https://asiaplustj.info/ru/news/centralasia/20230817/kirgizstan-privlek-kitaiskuyu-tvea-k-stroitelstvu-kaskada-ges-na-reke-sari-dzhaz. Accessed July 28, 2025.

Avesta Information Agency (2019). "500 kV HV Transmission Line Dushanbe-Obi Garm Showed Its Effectiveness [LEP 500 kV Dushanbe-Obi Garm pokazala svoyu effektivnost']." *Avesta.tj*, September 19, 2019. https://avesta.tj/2019/09/19/lep-500-kv-dushanbe-obi-garm-pokazala-svoyu-effektivnost/. Accessed July 21, 2025.

Bolatbek, Fariza (2024). "Unified Energy Market of the EAEU: Utopia or Reality of 2027?" [In Russian]. *Deutsche Welle (DW)*, November 20, 2024. https://www.dw.com/ru/edinyj-energorynok-eaes-utopia-ili-realnost-2027-goda/a-70825076. Accessed July 21, 2025.

BNE Intellinews (2025). "Taliban Seek $100mn from World Bank to Restart Work on CASA-1000 Electricity Transmission Project." *BNE Intellinews*, April 2, 2025. https://www.intellinews.com/taliban-seek-100mn-from-world-bank-to-restart-work-on-casa-1000-electricity-transmission-project-374739/. Accessed July 23, 2025.

CASA-1000 (n.d.). "Home." https://www.casa-1000.org/ru/home-ru/. Accessed July 23, 2025.

China and Central Asia Studies (n.d.)."Datka-Kemin Power Transmission Line – China Central Asia." n.d. https://china-centralasia.org/en/project/93. Accessed July 21, 2025.

China and Central Asia Studies (n.d.). "Tajikistan: 500 kV South-North Power Transmission Line." *China-CentralAsia.org*, n.d. https://china-centralasia.org/en/project/102#:~:text=Description%20of%20the%20project,Chinese%20architecture%20%22Luban%20prize%22. Accessed July 21, 2025.

Chorshanbiyev, Payrav (2025). "Turn the lights off! Why are Tajiks doomed to constant increases in electricity prices?" [In Russian]. *Asia-Plus*, April 8, 2025. https://asiaplustj.info/ru/news/tajikistan/economic/20250408/tushite-svet-pochemu-tadzhikistantsi-obrecheni-na-postoyannoe-podorozhanie-elektroenergii. Accessed July 28, 2025.

Chorshanbiyev, Payrav (2024). "In Tajikistan, Some Steal Electricity While Others Freeze." [In Russian]. *Asia-Plus*, February 5, 2024. https://www.asiaplustj.info/ru/news/tajikistan/economic/20240205/v-tadzhikistane-odni-voruyut-drugie-myorznut. Accessed July 21, 2025.

Chorshanbiyev, Payrav (2022). "Barki Tojik Had Debts Written Off for $28 Million." [In Russian]. *Asia-Plus*, December 30, 2022. https://old.asiaplustj.info/ru/news/tajikistan/economic/20221230/barki-tochik-prostili-zadolzhennost-v-28-millionov. Accessed July 21, 2025.

Delegation of the European Union to Tajikistan (2025). "EU Advances Global Gateway Strategy in Tajikistan." *European External Action Service*, March 15, 2025. https://www.eeas.europa.eu/delegations/tajikistan/eu-advances-global-gateway-strategy-tajikistan_en?s=228. Accessed July 21, 2025.

Delegation of the European Union to Tajikistan (2022). "Sebzor Hydropower Plant – Improving the Energy Supply in the Province of Gorno-Badakhshan." *European External Action Service*, July 19, 2022. https://www.eeas.europa.eu/delegations/tajikistan/sebzor-hydropower-plant-improving-energy-supply-province-gorno-badakhshan_en. Accessed July 28, 2025.

Eni (2024). "Eni and KazMunayGas Announce Commencement of Construction for 250 MW Hybrid Power Plant in Kazakhstan." *Press Release*, July 16, 2024. https://www.eni.com/en-IT/media/press-release/2024/07/eni-kmg-announce-commencement-construction-250mw-hybrid_power-plant-kazakhstan.html. Accessed July 29, 2025.

Eurasian Development Bank (2021). "Uzbekistan and the EAEU: Perspectives and Potential Effects of Economic Integration" [In Russian]. *Reports and Working Documents*, 2021. https://eabr.org/upload/EDB_2021_Report_Uzbekistan_and_the_EAEU_rus.pdf. Accessed July 22, 2025.

European Bank for Reconstruction and Development (n.d.). "KEGOC: Integration of the West Zone." https://www.ebrd.com/home/work-with-us/projects/psd/55284.html. Accessed July 21, 2025.

European Bank for Reconstruction and Development (n.d.). "Sarymay-Djankeldy Transmission." https://www.ebrd.com/home/work-with-us/projects/psd/52874.html#project-description1. Accessed July 29, 2025.

European Bank for Reconstruction and Development (n.d.). "Sarymay-Muruntau Transmission." https://www.ebrd.com/home/work-with-us/projects/psd/54421.html#project-description1. Accessed July 29, 2025.

European Commission (2025). *Speech by President von der Leyen at the Plenary Session of the First EU-Central Asia Summit*. Speech, April 4, 2025. https://ec.europa.eu/commission/presscorner/api/files/document/print/hu/speech_25_976/SPEECH_25_976_EN.pdf. Accessed September 1, 2025.

European Commission (2025). *1st European Union Central Asia Summit*. Factsheet, April, 2025. https://ec.europa.eu/commission/presscorner/api/files/attachment/881028/EU-Central%20Asia_Factsheet_2025-04.pdf. Accessed September 1, 2025.

European Commission (2022). *Global Gateway: Team Europe Launches Two Initiatives in Central Asia on Energy and on Digital Connectivity*. Press release, November 18, 2022. https://ec.europa.eu/commission/presscorner/api/files/document/print/pl/ip_22_6963/IP_22_6963_EN.pdf. Accessed July 23, 2025.

European Council (2025). *Joint Press Release Following the First EU-Central Asia Summit*. Speech, April 4, 2025. https://www.consilium.europa.eu/en/press/press-releases/2025/04/04/joint-press-release-following-the-first-eu-central-asia-summit/. Accessed September 1, 2025.

European Investment Bank (EIB) (2015). "EIB Supports Power Interconnection between Tajikistan and Kyrgyzstan." *European Investment Bank*, June 11, 2015. https://www.eib.org/en/press/all/2015-130-eib-supports-power-interconnection-between-tajikistan-and-kyrgyzstan. Accessed July 28, 2025.

Gazeta.uz (2025). "Uzbekistan to Build 7,000 km of Transmission Networks to Connect New Power Plants and Energy Storages." *Gazeta.uz*, January 29, 2025. https://www.gazeta.uz/en/2025/01/29/transmission-networks/. Accessed July 28, 2025.

Gazeta.uz (2024). "Uzbekistan Plans to Continue Subsidizing Gas and Electricity Prices Despite Tariff Increases." [In Russian]. *Gazeta.uz*. November 16, 2024. https://www.gazeta.uz/ru/2024/11/11/subsidy/. Accessed July 28, 2025.

Gazeta.Uz (2024). "To Trade Electricity in Central Asia, [Countries] Plan to Launch the Unified Platform – Deputy Minister of Energy." [In Russian]. *Gazeta.uz*, November 7, 2024. https://www.gazeta.uz/ru/2024/11/07/electricity/. Accessed July 23, 2025.

Gazeta.uz (2024). "Uzbekistan Plans to Complete Transition to the Wholesale Market of Electricity and Gas in 2027–2028 – Vice Prime-Minister." [In Russian]. *Gazeta.uz*, October 11, 2024. https://www.gazeta.uz/ru/2024/10/11/energy-gas-market/. Accessed July 23, 2025.

Gazeta.uz (2024). "Official Explains Reasons behind Gas and Electricity Tariffs Increase." *Gazeta.uz.* April 16, 2024. https://www.gazeta.uz/en/2024/04/16/new-tariffs/. Accessed July 28, 2025.

Gazeta.uz (2023). "Over 100,000 Wholesale Consumers and 648,000 New Subscribers in Uzbekistan Are Not Connected to ASKUE." [In Russian]. *Gazeta.uz*, November 7, 2023. https://www.gazeta.uz/ru/2023/11/07/askue/. Accessed July 22, 2025.

International Energy Agency (2023). "Electricity Grids and Secure Energy Transitions." *IEA report*, 2023. https://iea.blob.core.windows.net/assets/ea2ff609-8180-4312-8de9-494bcf21696d/ElectricityGridsandSecureEnergyTransitions.pdf. Accessed July 21, 2025.

International Energy Agency (2024). "Batteries and Secure Energy Transitions." *IEA report*, 2024. https://iea.blob.core.windows.net/assets/cb39c1bf-d2b3-446d-8c35-aae6b1f3a4a0/BatteriesandSecureEnergyTransitions.pdf. Accessed July 28, 2025.

Joint-Stock Company 'National Electric Grid of Uzbekistan.' (2022). "About Company." *Uzbekistonmet.uz*, 2022. https://www.uzbekistonmet.uz/en/lists/view/79. Accessed July 21, 2025.

Jalolova, Sadokat (2025). "Uzbekistan, Azerbaijan, and Kazakhstan Launch Joint Venture for Green Energy Corridor." *Times of Central Asia*, July 7, 2025. https://timesca.com/uzbekistan-azerbaijan-and-kazakhstan-launch-joint-venture-for-green-energy-corridor/. Accessed July 28, 2025.

K-News (2024). "In Kyrgyzstan in 2023 Electricity Losses Amounted to More Than 11%." *K-News*, January 16, 2024. https://knews.kg/2024/01/16/v-kyrgyzstane-v-2023-godu-poteri-elektroenergii-sostavili-bolee-11/. Accessed July 24, 2025.

Kaktus Media (2025). "Smart Meters: Fight Against Electricity Theft and Customer Complaints." [In Russian]. *Kaktus Media*, March 27, 2025. https://kaktus.media/doc/520342_ymnye_schetchiki:_borba_s_vorovstvom_elektroenergii_i_jaloby_abonentov Accessed July 21, 2025.

KazMunayGas (n.d.). "Construction of a 1 GW Hybrid Wind Farm Project Using the 300 MW/600 MWh Energy Storage System (Mirny Project)." https://www.kmg.kz/en/company/projects/all/65456456/. Accessed July 28, 2025.

Kaztag (2025). "76% Wear and Tear of Kazakhstan's Power Grids, Dependence on Imports and Other Problems – Results of the State Audit [76% iznos electrosetey RK, zavisimost' ot importa i drugiye problem – itogi gosaudita]." *Kaztag.kz*, 2025. https://kaztag.kz/ru/news/76-iznos-elektrosetey-rk-zavisimost-ot-importa-i-drugie-problemy-itogi-gosaudita. Accessed July 22, 2025.

KEGOC (n.d.). "About Us." *Kegoc.kz*, n.d. https://www.kegoc.kz/en/about/. Accessed July 21, 2025.

KEGOC (2024). "Analysis of Wholesale Market of Electric Energy and Capacity for 2023." *KEGOC*, 2024. https://www.kegoc.kz/upload/iblock/0d7/tgrsztaci3oypn9po5x1eoxnz448si2t.pdf. Accessed July 22, 2025.

KEGOC (2024). "EBRD and Development Bank of Kazakhstan Invest in Kazakhstan Energy System Interconnection Project." *Kegoc.kz*, 2024. https://www.kegoc.kz/en/press-center/press-releases/164955/. Accessed July 21, 2025.

Kun.uz (2024). "Saudi Arabia's ACWA Power to Build 2 GW Energy Storage Systems in Uzbekistan." *Kun.uz*, November 15, 2024. https://kun.uz/en/news/2024/11/15/saudi-arabias-acwa-power-to-build-2-gw-energy-storage-systems-in-uzbekistan. Accessed July 28, 2025.

Kwan, Sergey (2025). "Kyrgyzstan Turns to Alternative Energy to Address Power Deficits." *Times of Central Asia*, 2025. https://timesca.com/kyrgyzstan-turns-to-alternative-energy-to-address-power-deficit/. Accessed July 21, 2025.

Kyrgyz Republic (2025). Resolution of the Cabinet of Ministers of the Kyrgyz Republic 'On approval of the Medium-term tariff policy of the Kyrgyz Republic for electric energy for 2025–2030.' No. 227, April 24, 2025. https://www.gov.kg/ru/npa/s/4644. Accessed July 28, 2025.

Low Carbon Power (n.d.). "Electricity Mix by Country". https://lowcarbonpower.org/ . Accessed July 21, 2025.

Makhanov, Kanat (n.d.). "UN Population Prospects: Case of Central Asia." *Eurasian Research Institute*, https://www.eurasian-research.org/publication/un-population-prospects-case-of-central-asia/#:~:text=By%202050%2C%20the%20population%20of,benchmark%20of%20100%20million%20people. Accessed July 21, 2025.

Mamadaminov, Umid (2025). "China, Central Asian Countries Discuss Unified Power Grid Project — Deputy Energy Minister of Uzbekistan." *Gazeta.uz*, June 21, 2025. https://www.gazeta.uz/en/2025/06/21/ca-china-power-grid/. Accessed July 23, 2025.

Mamyshev, Zhanbolat (2025). "China Will Help Central Asian Countries Balance Electricity Flows." [In Russian]. *Kursiv.kz*, June 16, 2025. https://kz.kursiv.media/2025-06-16/zhnb-china-energy-central-asia/. Accessed July 23, 2025.

Ministry of National Economy of the Republic of Kazakhstan (2023). "Implementation of the 'Tariff in Exchange for Investments' Program." November 6, 2023. https://www.gov.kz/memleket/entities/economy/press/news/details/647722?lang=ru. Accessed July 27, 2025.

Mukasheva, Zarina (2025). Anuar Temirov, and Dana Akhmedyanova. "Local Elite Perceptions on the EU's Agenda to Promote Regional Cooperation in Central Asia." *European Politics and Society* 26 (4), 2025. https://www.tandfonline.com/doi/full/10.1080/23745118.2025.2450650?scroll=top&needAccess=true. Accessed September 1, 2025.

O'Sullivan, Meghan, Indra Overland, and David Sandalow (2017). *The Geopolitics of Renewable Energy*. Center on Global Energy Policy and the Geopolitics of Energy Project. Working Paper, 2017. https://www.belfercenter.org/sites/default/files/pantheon_files/files/publication/Geopolitics%20Renewables%20-%20final%20report%206.26.17.pdf. Accessed July 21, 2025.

Official Information Source of the Prime Minister of the Republic of Kazakhstan (2022). "Electricity Generated by RES for 2021 Exceeded Planned Indicators – Bulat Aqchulaqov." *Primeminister.kz*, 2022. https://primeminister.kz/en/news/reviews/2021-zhyly-zhek-ondirgen-elektr-energiyasynyn-kolemi-zhosparly-korsetkishterden-asty-b-aksholakov-282559. Accessed July 21, 2025.

Official Website of the President of the Republic of Kazakhstan (2025). "Kassym-Jomart Tokayev met with President of the European Commission Ursula von der Leyen." *Akorda.kz,* April 3, 2025. https://www.akorda.kz/en/1-333421. Accessed September 1, 2025.

Pepe, Jacopo Maria (2024). "Europe and the Emerging Geopolitics of Electricity Grids." *Friedrich Ebert Stiftung*, 2024. https://library.fes.de/pdf-files/bueros/brueussel/21205.pdf. Accessed July 21, 2025.

Permanent Mission of the Republic of Tajikistan to the United Nations (2025). "Meeting with the President of the European Commission Ms. Ursula von der Leyen." *MFA.TJ,* April 4, 2025. https://www.mfa.tj/en/newyork/view/16828/meeting-with-the-president-of-the-european-commission-ms-ursula-von-der-leyen. Accessed September 1, 2025.

Petrocouncil.kz (2025). "When Will Kazakhstan Be Able to Fully Provide Itself with Electricity?" *Petrocouncil.kz*, March 17, 2025. https://petrocouncil.kz/en/novost/kogda-kazahstan-smozhet-polnostyu-obespechivat-sebya-sobstvennoj-elektroenergiej. Accessed July 21, 2025.

Podkovalnikov, Sergey, and Lyudmila Chudinova (2024). "Electric Power Partnership Between Russia and Central Asian Countries." [In Russian]. *Energeticheskaya Politika*, May 7, 2024. https://energypolicy.ru/elektroenergeticheskoe-partnerstvo-rossii-i-stranczentralnoj-azii/regiony/2024/16/07/. Accessed July 21, 2025.

Qazaq Green (2024). "Electricity Consumption in Uzbekistan Grows by 7-8% Annually." *Qazaq Green,* October 1, 2024. https://qazaqgreen.com/en/news/central-asia/2298/. Accessed July 28, 2025.

Qazaq Green (2023). "Siemens Energy Intends to Get Involved in Significant Energy Projects Execution in Kazakhstan." *Qazaq Green News Kazakhstan*, September 29, 2023. https://qazaqgreen.com/en/news/kazakhstan/1465/. Accessed July 29, 2025.

Republic of Kazakhstan (2024). *The Resolution of the Government of the Republic of Kazakhstan On the Approval of the National Project 'Modernization of the Energy and Utility Sectors,'* No. 1102, December 25, 2024. https://adilet.zan.kz/rus/docs/P2400001102. Accessed July 27, 2025.

Republic of Kazakhstan (2023). *On Amending the Order of the Minister of Energy of the Republic of Kazakhstan of February 20, 2015, No. 112 'On the Approval of the Rules for the Functioning of the Balancing Electricity Market.',* No. 250, June 30, 2023. https://adilet.zan.kz/rus/docs/V2300032973#z8. Accessed July 27, 2025.

Republic of Kazakhstan (2023). *The Order of the Minister of Energy of Kazakhstan on Determining the Single Buyer of Electric Energy*, No. 212, June 6, 2023. https://online.zakon.kz/Document/?doc_id=37232863. Accessed July 22, 2025.

Republic of Uzbekistan (2025). *The Decree of the President of Republic of Uzbekistan on Introducing Changes to Certain Acts of the President of Uzbekistan Linked to Further Acceleration of Market Reforms and Achieving Uzbekistan's Membership in the WTO*, No. 74, April 30, 2025. https://lex.uz/ru/pdfs/7508070. Accessed July 23, 2025.

Republic of Uzbekistan (2024). *Law of the Republic of Uzbekistan About Electricity*, July 10, 2024. https://api-portal.gov.uz/uploads/14c629ca-71dd-41f7-459c-1738f8d1a0a3_media_.pdf. Accessed July 23, 2025.

Republic of Uzbekistan (2023). *The Decree of the President of Republic of Uzbekistan on Measures to Carry Out the Next Stage of Reforming the Energy Sector*, No. 166, September 28, 2023. https://lex.uz/ru/docs/6624460. Accessed July 23, 2025.

Republic of Uzbekistan (2023). *Law of the Republic of Uzbekistan on Introducing Amendments and Additions to the Criminal Code, Criminal Procedure Code, and Administrative Responsibility Code in Connection with Strengthening Liability for the Illegal Use of Energy Resources*, No. 822, March 13, 2023. https://lex.uz/docs/6405976. Accessed July 27, 2025.

Republic of Uzbekistan (2019). *The Decree of the President of Republic of Uzbekistan on the Strategy for Further Development and Reform of the Electric Energy Sector*, No. 4249, March 27, 2019. https://lex.uz/docs/4257085?ONDATE=04.06.2024%2000 (accessed July 23, 2025).

Report.kg (2025). "The EBRD Will Allocate €100 Million for the Construction of the Kemin-Balykchy Power Transmission Line, - Ibrayev." *Report.kg*, April 7, 2025. https://report.kg/exclusive/14863-ebrr-vydelit-na-stroitelstvo-ljep-kemin-balykchy-100-mln-ibraev.html. Accessed July 28, 2025.

Reuters (2022). "Power Blackout Hits Kazakhstan, Kyrgyzstan, and Uzbekistan." *Reuters*, January 25, 2022. https://www.reuters.com/world/asia-pacific/power-blackout-hits-kazakhstan-kyrgyzstan-uzbekistan-2022-01-25/. Accessed July 21, 2025.

Serikov, Daniyar (2025). "Green Energy Begins to Shake Prices in Kazakhstan." [In Russian]. *InBusiness.kz*, June 2, 2025. https://inbusiness.kz/ru/news/zelenaya-energetika-nachinaet-raskachivat-ceny-v-kazahstane. Accessed July 23, 2025.

Sharifli, Yunis (2024). "Green New Wave: How China Adapts to Central Asia's Renewable Energy Landscape." *Carnegie Endowment for International Peace*, April 19, 2024. https://carnegieendowment.org/posts/2024/04/green-new-wave-how-china-adapts-to-central-asias-renewable-energy-landscape?lang=en. Accessed July 23, 2025.

Spot.uz (2024). "Chronicles: How Uzbekistan Is Advancing Toward Electricity Market Liberalization." [In Russian]. *Spot.uz*, September 11, 2024. https://www.spot.uz/ru/2024/09/11/energy-history/. Accessed July 23, 2025.

TASS News Agency (2024). "Russia's Ministry of Energy and Uzbekistan Agree on Accession to the Central Asian Power Grid." [In Russian]. *TASS News Agency*, September 9, 2024. https://tass.ru/ekonomika/21819101. Accessed July 21, 2025.

The Caspian Post (2025). "President Japarov Addresses First Central Asia-EU Summit in Samarkand." *The Caspian Post*, April 4, 2025. https://caspianpost.com/central-asia/president-japarov-addresses-first-central-asia-eu-summit-in-samarkand. Accessed September 1, 2025.

The Government of Uzbekistan (2024). "18 New Energy Facilities Have Been Commissioned, Construction of Other 6 Facilities Has Begun." [In Russian]. *Gov.uz*, December 14, 2024. https://gov.uz/ru/news/view/30313. Accessed July 28, 2025.

The World Bank (2023). *Regional Electricity Market Interconnectivity and Trade – Central Asia (P181214): Project Information Document (PID – Concept Stage)*. Report No: PID186. October 5, 2023. https://documents1.worldbank.org/curated/en/099100523132539287/pdf/P1812140c755ef090b30f0c40a9dc5720c.pdf. Accessed July 23, 2025.

The World Bank (2022). "The Electricity Sector in the Kyrgyz Republic to Improve Its Efficiency with World Bank Support." *The World Bank*, June 23, 2022. https://www.worldbank.org/en/news/press-release/2022/06/23/the-electricity-sector-in-the-kyrgyz-republic-to-improve-its-efficiency-with-world-bank-support. Accessed July 21, 2025.

UNDP Kazakhstan (2024). "Kazakhstan Secures €6 Million for Grid Efficiency Modernization and Energy Loss Reduction." *UNDP*, December 13, 2024. https://www.undp.org/kazakhstan/press-releases/kazakhstan-secures-eu6-million-grid-efficiency-modernization-and-energy-loss-reduction. Accessed July 28, 2025.

United Nations Economic Commission for Europe (UNECE) (2025). *Modeling a Resilient and Integrated Energy System for Central Asia: A Roadmap for Regional Interconnectivity*. March 2025. https://unece.org/sites/default/files/2025-03/Report.pdf. Accessed July 23, 2025.

United Nations Economic Commission for Europe (2024). *Outline for a Roadmap for a Regionally Interconnected Energy System in Central Asia*. ECE/ENERGY/GE.5/2024/4. https://unece.org/sites/default/files/2024-08/ECE_ENERGY_GE.5_2024_4_e.pdf. Accessed July 22, 2025.

United Nations Economic Commission for Europe (2023). *Energy Connectivity in Central Asia: An Inventory of Existing National Energy Systems*. 2023. https://unece.org/sites/default/files/2023-11/EN_Energy%20Connectivity%20in%20Central%20Asia_V2.pdf. Accessed July 21, 2025.

Universal Energy (n.d.). "Universal Energy Wins Bid for 1GW Wind Power + 600MWh Energy Storage in Kazakhstan". https://www.universalenergy.com/en/news/1075. Accessed July 28, 2025.

Usov, Anton (2023). "EBRD Invests KZT 6 Billion in KEGOC Bond." *European Bank for Reconstruction and Development*, April 3, 2023. https://www.ebrd.com/home/news-and-events/news/2023/ebrd-invests-kzt-6-billion-in-kegoc-bond.html. Accessed July 21, 2025.

Usov, Anton (2024). "EBRD Helps Increase Reliability of Electrical Grid in Tajikistan." *European Bank for Reconstruction and Development*, February 28, 2024. https://www.ebrd.com/home/news-and-events/news/2024/ebrd-helps-increase-reliability-of-electrical-grid-in-tajikistan.html. Accessed July 30, 2025.

UZDaily (2022). "Masdar, GD Power - Powerchina and Voltalia Win Tender for the Construction of Three Solar Photovoltaic Stations in Uzbekistan." *UZDaily*, December 15, 2022. https://www.uzdaily.uz/en/masdar-gd-power-powerchina-and-voltalia-win-tender-for-the-construction-of-three-solar-photovoltaic-stations-in-uzbekistan/. Accessed July 29, 2025.

Voltalia (2025). "Voltalia Signs a Power Sales Agreement for Its 526-Megawatt Hybrid Project in Uzbekistan." *News Release*, March 11, 2025. https://www.voltalia.com/news-releases/news-release-details/voltalia-signs-power-sales-agreement-its-526-megawatt-hybrid/. Accessed July 29, 2025.

World Bank (2025). "Uzbekistan to Invest in Modernizing Electricity Distribution Networks with World Bank Support." *Press release*, May 15, 2025. https://www.worldbank.org/en/news/press-release/2025/05/15/uzbekistan-to-invest-in-modernizing-electricity-distribution-networks-with-world-bank-support. Accessed July 28, 2025.

Zhanybekov, B. R. (n.d.). "Implementation of ASKUE: Effective Management of Generated, Transmitted, and Distributed Electricity Volumes in the Power System of the Kyrgyz Republic." [In Russian]. *Kyrgyz Energy Settlement Center*. https://esep.energo.kg/. Accessed July 28, 2025.

Zhazetova, Zhanel (2024). "KEGOC Plans to Use AI to Forecast Electricity Demand and Control Substations." [In Russian]. *Kursiv.kz*, June 4, 2024. https://kz.kursiv.media/2024-06-04/zhzh-kegoc-ai/. Accessed July 23, 2025.

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Powering the Transition: Rebuilding Central Asia's Electricity Grids for Regional Resilience

This study exemines the challenges and opportunities of strengthening Central Asia's electricity grids - a vital step toward energy security, green transition, and economic development. Kazakhstan, the Kyrgyz Republic, Uzbekistan, and Tajikistan are modernizing their grids, but face common structural constraints. These include ageing physical infrastructure, particularly at the distribution level, and the political sensitivity of tariff reforms needed to ensure sector sustainability. Other challenges involve incomplete metering coverage, a growing share of renewables amid a shortage of storage and flexible generation capacity in downstream republics, and seasonal vulnerabilities linked to water availability.

Drawing on both primary and secondary sources, the paper situates these issues within the wider context of regional and interregional grid connectivity. It argues that, rather than pursuing swift and uniform electricity market liberalization or regulatory harmonization, reforms should be phased, context-sensitive, and locally owned.

Advancing this pragmatic approach, the paper concludes with recommendations for regional policymakers and international partners, including the European Union. These focus on modernizing distribution networks, expanding smart metering and cybersecurity, developing coherent storage policies, building institutional capacities, and fostering a real-time intra-regional electricity trading platform.

Further information on the topic can be found here:
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