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Kazakhstan's Green Energy Journey: From Coal Giant to Renewable Frontier

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ABSTRACT

Kazakhstan stands at a pivotal crossroads between its fossil-fuel-dependent past and an increasingly renewable-powered future. This article examines Kazakhstan's ongoing energy transition, tracing the country's development from a coal-dominated power system — where coal still supplies over 70% of electricity — toward an emerging renewable energy sector underpinned by ambitious policy reforms, international investment, and exceptional natural endowments. Drawing on legislative milestones, capacity data, and investment flows, the article analyses the site-specific auction mechanism introduced in 2019, the growth of installed renewable capacity to 3.5 GW across 162 facilities by 2024, and the geopolitical dimension of the proposed Green Corridor linking Central Asia to European energy markets. The article argues that Kazakhstan's experience offers a replicable model for resource-rich, coal-dependent economies undertaking large-scale energy transitions, while acknowledging the significant challenges that remain in grid integration, just transition planning, and capital mobilization.

1. Introduction

Kazakhstan sits on a paradox. For much of its post-Soviet history, the vast Central Asian nation was defined by fossil fuels — coal powering over 70% of its electricity, oil revenues filling state coffers, and hydrocarbons shaping its entire economic identity. Yet today, the same country is emerging as one of the region's most ambitious players in renewable energy, drawing investment from global giants, signing climate pledges, and quietly transforming a landscape once synonymous with industrial-era emissions.

2. A Nation Built on Coal — and Trying to Move Beyond It

To understand Kazakhstan's green energy story, you have to first appreciate what it's up against. The country still relies on coal for over 70% of its electricity generation — a dependency baked into infrastructure, employment, and political economy over decades. Entire cities and regions are tied to coal mines and thermal power plants. Shifting away from that is not merely an engineering challenge; it is a social and economic transformation.

But the pressure to change is real. Climate change is no longer a distant threat for Kazakhstan. The devastating floods of 2024 and the region's worsening water shortages have forced the country to rethink its energy future. Central Asia has become one of the world's most climate-vulnerable regions — glaciers are retreating at an alarming rate, feeding rivers that now struggle to sustain growing populations, while farmers face challenges as once-reliable water sources dwindle. For Kazakhstan, clean energy has shifted from aspiration to necessity.

3. Exceptional Natural Endowment

What makes Kazakhstan's renewable potential so striking is sheer geography. The country possesses extraordinary renewable resources: 920 billion kWh from wind annually, more than 3,000 hours of sunshine per year, and some 62 billion kWh of hydropower potential. The vast steppes that stretch across its territory are among the windiest environments on earth. Its southern regions receive solar radiation comparable to parts of the Middle East. This natural endowment means Kazakhstan is not betting on an unlikely energy transition — it is, in many ways, making use of what it already has in abundance.

4. Building the Foundation: Policy and Legislation

Kazakhstan's modern renewable energy framework traces back to the early 2010s, when the government began laying down the legislative foundations needed to attract investment. A key innovation came in 2019, when Kazakhstan introduced a site-specific renewable energy auction mechanism that provided investors with pre-assessed project locations to streamline investment and reduce costs. This was a significant step: rather than leaving developers to navigate land rights and grid connection on their own, the state took on preliminary work to de-risk projects.

The approach worked. Site-specific auctions have attracted an additional $150–200 million in private investments, boosting the country's renewable energy capacity. The government has since expanded the auction model — for the 2024–2027 period, auctions covering 6.7 GW have been approved, of which more than 3.1 GW has already been allocated. In a notable first, Kazakhstan held its first-ever auctions for large-scale wind power projects with energy storage systems in April 2025.

Support measures also include guaranteed electricity purchase prices, annual price indexation, and exemption from grid fees — a package designed to give investors the certainty they need to commit capital to long-horizon infrastructure projects. In 2024,

Kazakhstan went further still, enacting a new law to promote the adoption of renewable energy technologies at the household level, simplifying the process for installing solar panels and other energy-efficient systems.

5. Numbers on the Ground

The policy push is translating into concrete capacity. Kazakhstan now operates 162 renewable energy facilities with a combined installed capacity of 3.5 GW, including 67 wind farms, 49 solar power plants, 43 hydropower plants, and three biogas facilities.

Progress has been steady year on year. The share of electricity generated from renewables reached 6.43% by the end of 2024, and renewable energy production grew by 14% compared to 2023. By the close of 2025, renewables accounted for 7% of total electricity generation, with nine new projects totaling 503 MW commissioned during the year — including five wind farms, three solar plants, and one hydropower facility.

The targets ahead are considerably more ambitious. Kazakhstan aspires for renewable energy to contribute 15% of its power by 2030 and half of its electricity by 2050, with an overarching goal of achieving carbon neutrality by 2060.

6. International Investment Arrives

One of the clearest signals of Kazakhstan's emerging credibility in the green energy space is the quality of investors it is attracting. A standout achievement was the signing of an investment agreement with Masdar to construct a 1 GW wind farm in the Zhambyl region, incorporating advanced energy storage systems. Other major international players now involved include TotalEnergies, China Power International Holding, and China Energy.

Multilateral development banks have also been pivotal. The Asian Infrastructure Investment Bank financed two flagship wind projects in southern Kazakhstan — the Zhanatas Wind Farm and the Shokpar Wind Power Plant, each with 100 MW capacity. Together they help abate roughly 250,000 tonnes of CO_2 annually.

At COP29 in Baku, Kazakhstan secured approximately $3.7 billion in agreements with international companies and development institutions to advance green energy projects. The country also formalized a Strategic Partnership with the European Union on raw materials, batteries, and renewable hydrogen, signaling that Kazakhstan sees itself not merely as an energy producer but as a node in the global clean energy supply chain.

7. The Regional Dimension: A Green Corridor to Europe

Perhaps the most geopolitically ambitious aspect of Kazakhstan's green energy push is the proposed 'Green Corridor' — an energy export route linking Central Asia to Europe. Kazakhstan, Uzbekistan, and Azerbaijan signed a founding agreement in December 2024, with the national grid operators of all three countries uniting around a common goal. The Green Corridor Alliance LLC was formally established in Baku in July 2025, with the Italian engineering firm CESI conducting a feasibility study due to be presented by early 2027.

The concept is straightforward but transformative in its implications: Central Asia's abundant solar and wind resources could flow westward across the Caspian and through Azerbaijan to European markets hungry for clean power. For Kazakhstan, this would turn its renewable resource wealth into an export industry — adding a new dimension to an economy that has long relied on exporting hydrocarbons.

8. Challenges That Remain

Kazakhstan's green energy story is genuinely encouraging, but the challenges are equally real. The 7% renewables share, while growing, is still modest against the scale of the coal infrastructure that dominates the grid. Integrating variable renewable energy into an aging Soviet-era power system requires significant grid investment. And the social dimension of the transition — what happens to coal miners and the communities that depend on thermal power — remains an unresolved question that any government must take seriously.

There is also the question of financing. UNDP has helped Kazakhstan introduce innovative financial instruments, including green bonds and blended finance approaches, to address funding gaps. But mobilizing the capital needed to hit 2030 and 2050 targets will require sustained effort on a scale that dwarfs what has been achieved so far.

9. A Work in Progress Worth Watching

Kazakhstan's green energy experience is not a finished success story — it is a work in progress, and an instructive one. A country with one of the world's most coal-dependent grids has built a functioning renewables sector in roughly a decade, attracted billions in foreign investment, developed an auction market that others in the region are now studying, and set itself targets that would have seemed implausible twenty years ago.

North Macedonia has already begun exploring Kazakhstan's renewable energy experience as a model for its own transition. That a landlocked Central Asian country, historically defined by extractive industries, is being looked to for lessons in clean energy development says something meaningful about how far and how fast things can change — when geography, policy, and political will align.

Whether Kazakhstan fully delivers on its carbon neutrality pledge by 2060 remains to be seen. But the direction of travel is clear, and the momentum is real.

Sources: *QazaqGreen, AIIB, UNDP Kazakhstan, The Diplomat, renewables.az*