Economic Benefits of Renewable Energy Adoption in Developing Countries: A Case Study of Central Asia

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Abstract. Renewable energy adoption offers substantial economic advantages for developing countries, including cost savings, job creation, enhanced energy security, and GDP growth, while mitigating fossil fuel dependency and environmental degradation. This article examines these benefits through a general framework for developing economies and a focused case study on Central Asia, a region rich in solar, wind, and hydropower potential yet heavily reliant on hydrocarbons. Drawing on data from the International Renewable Energy Agency (IRENA, 2025) and the International Energy Agency (IEA, 2025), the analysis highlights how renewables can drive sustainable development amid geopolitical and climatic challenges. In Central Asia, adoption has accelerated, with installed capacity reaching 17.3 GW by 2023—a 26.6% increase over five years—yielding benefits like reduced import costs and regional power trade savings estimated at USD 1.5 billion annually (World Bank, 2023; updated projections for 2025). However, barriers such as infrastructure deficits and policy gaps persist. The study employs a qualitative synthesis of economic models and empirical data, advocating for targeted investments to maximize returns. Findings underscore renewables' role in fostering inclusive growth, with implications for policy in resource-constrained regions.

Keywords: renewable energy, economic benefits, developing countries, Central Asia, energy security, job creation, sustainable development.

Introduction. Developing countries face a dual energy challenge: meeting rising demand amid limited access while transitioning from fossil fuels to mitigate climate risks. Renewable energy sources—solar, wind, hydro, and biomass—present a viable pathway, offering not only environmental sustainability but also profound economic gains. Globally, renewables accounted for 71% of new capacity additions in 2024, driven by Asia, with costs plummeting: solar PV now the cheapest electricity source, saving USD 467 billion in fossil fuel expenditures (IRENA, 2025). For developing nations, adoption promises energy independence, reduced import bills, and diversified economies, aligning with UN Sustainable Development Goal 7 (affordable and clean energy).

Central Asia exemplifies this potential: home to five landlocked nations (Kazakhstan, Uzbekistan, Turkmenistan, Kyrgyzstan, Tajikistan) with abundant renewables resources—solar irradiation exceeding 2,000 kWh/m² annually in southern regions and vast wind corridors—yet 80–90% energy mix fossil-based (ADB, 2023). Geopolitical tensions, including Russia's invasion of Ukraine, have spiked energy prices, underscoring the need for diversification. This case study analyzes economic benefits in Central Asia, building on IRENA's 2025 data showing a 26.6% capacity surge to 17.3 GW by 2023. Through literature synthesis and economic modeling insights, the article elucidates benefits like job creation (potentially 1–2 million regionally by 2030) and GDP uplift (1–3% annually), while

addressing implementation hurdles. Ultimately, it posits renewables as a catalyst for resilient, equitable growth in vulnerable economies.

Literature Review. Scholarship on renewables' economic impacts in developing countries emphasizes multifaceted returns. IRENA (2025) reports that renewables generated 13.7 million jobs globally in 2024, with 70% in emerging markets, through manufacturing, installation, and maintenance. Cost dynamics are pivotal: levelized cost of energy (LCOE) for solar fell 89% since 2010, enabling savings of USD 520 billion annually in fuel imports for oil-dependent nations (IRENA, 2025). Macroeconomic models, like those from the IEA (2025), project that clean energy investments—USD 2.2 trillion globally in 2025—could boost GDP by 0.5–1% in developing Asia by 2030 via supply chain localization and reduced volatility.

In Central Asia, studies highlight region-specific dynamics. The Asian Development Bank (ADB, 2023) underscores renewables' role in curbing energy insecurity, with hydropower dominating in Kyrgyzstan and Tajikistan (60–90% of supply) and solar/wind emerging in Kazakhstan and Uzbekistan. A systematic review by Sulaimanova et al. (2023) identifies economic drivers: renewables could cut import costs by 20–30% and foster intra-regional trade, potentially saving USD 1.5 billion yearly (World Bank, 2023). Kazakhstan's shift, analyzed by Smagulova et al. (2025), links renewables to GDP growth (via STIRPAT modeling, 2000–2022 data) and environmental gains, though quantitative job figures remain sparse. Challenges noted include intermittency and grid constraints, per EBRD (2025) lender perspectives.

Gaps persist in integrated case studies; this article addresses them by synthesizing 2025 data, focusing on quantifiable benefits and policy levers.

Economic Benefits of Renewable Energy Adoption in Developing Countries

Renewables yield diverse economic advantages, scalable to developing contexts where energy access affects 759 million people (IEA, 2025).

Cost Savings and Energy Affordability

Renewables' declining costs—solar LCOE at USD 0.049/kWh globally—outpace fossil fuels, saving developing countries billions. In sub-Saharan Africa and South Asia, off-grid solar reduced household energy expenditures by 50–70% (IRENA, 2025). Import-dependent nations like Pakistan (19 GW solar imports in 2024) averted USD 10–15 billion in fuel costs (IEA, 2025). These savings free fiscal space for health and education, with multipliers of 1.5–2.0 per USD invested (World Bank, 2024).

Job Creation and Human Capital Development

Renewables are labor-intensive: IRENA (2025) estimates 5–10 jobs per MW installed, versus 1–2 for coal. In developing Asia, solar manufacturing and O&M created 4.5 million jobs in 2024, with women comprising 32% in assembly roles. Skill transfer enhances productivity; India's solar push added 300,000 jobs by 2023, boosting rural incomes by 20% (IRENA, 2025).

GDP Growth and Economic Diversification

Investments stimulate growth: IEA (2025) models show USD 1.5 trillion in electricity sector spending (50% renewables) yielding 0.8% global GDP uplift by 2025, higher (1.2–1.5%) in emerging markets via backward linkages (e.g., local PV production). Diversification reduces oil price shocks; Brazil's bioenergy sector contributes 1.5% to GDP (IEA, 2025).

Energy Security and Trade Balance

Renewables mitigate import risks: developing countries spent USD 1.2 trillion on fossil imports in 2024, 10% of GDP in some (IRENA, 2025). Domestic deployment enhances security; Indonesia's geothermal expansion saved USD 2 billion annually in LNG imports (ADB, 2024).

Renewable Energy in Central Asia

Central Asia's renewables trajectory illustrates these benefits, with capacity tripling since 2015 amid post-Soviet fossil reliance (IRENA, 2025).

Regional Overview and Adoption Trends

By 2023, renewables reached 17.3 GW (26.6% growth), led by Kazakhstan (4 GW solar/wind) and Uzbekistan (2 GW hydro/solar) (IRENA, 2025). Kazakhstan's 2025 target: 15% renewables by 2030, up from 3% in 2020, via 500 MW auctions (Smagulova et al., 2025). Uzbekistan's 1 GW solar park (2024) exemplifies FDI attraction, with Chinese investments exceeding USD 1 billion (IEA, 2025). Kyrgyzstan and Tajikistan leverage hydro (90% of supply), exporting to neighbors.

Economic Impacts

Cost Savings: Renewables cut LCOE by 40% regionally; Kazakhstan's solar projects yield USD 0.04/kWh, saving USD 500 million annually in coal imports (ADB, 2023). Regional trade via CASA-1000 could save USD 1.5 billion in fuel by 2030 (World Bank, 2023).

Job Creation: IRENA (2025) projects 500,000 jobs by 2030; Kazakhstan's wind farms created 5,000 direct roles in 2024, with 20,000 indirect in supply chains. Uzbekistan's solar initiatives employ 10,000, prioritizing youth and women (EBRD, 2025).

GDP and Diversification: Modeling shows 1–2% GDP boost by 2030; Kazakhstan's renewables added 0.5% growth in 2024 via exports (Smagulova et al., 2025). Uzbekistan's green corridor reduced oil dependency, enhancing resilience (ADB, 2023).

Energy Security: Renewables diversify from Russian gas; Tajikistan's hydro exports to Afghanistan/Pakistan secure USD 200 million yearly (IRENA, 2025).

Country	Installed Renewables (GW, 2023)	Projected Jobs (2030)	Annual Savings (USD Million)	GDP Impact (%)
Kazakhstan	4.0	200,000	500	1.2
Uzbekistan	2.5	150,000	300	0.8
Kyrgyzstan	3.5 (hydro)	50,000	100	1.0
Tajikistan	5.0 (hydro)	60,000	150	1.5
Turkmenistan	2.0	40,000	200	0.5

Table 1: Key Economic Metrics of Renewables in Central Asia (Sources: IRENA, 2025; ADB, 2023; projections to 2030).

Challenges and Mitigation

Despite benefits, hurdles include grid intermittency (EBRD, 2025), financing gaps (Africa-like underinvestment at 2% global share), and policy silos (Sulaimanova et al., 2023). Mitigation: IRENA's 2025 Central Asia platform mobilizes USD 10 million for projects; regional grids enhance trade (World Bank, 2023).

Discussion. The findings of this study affirm the significant economic potential of renewable energy adoption for developing countries, with Central Asia serving as an illustrative case. The evidence demonstrates that renewables not only reduce costs and enhance energy security but also generate long-term macroeconomic benefits such as GDP growth and labor market expansion. These outcomes are consistent with prior global studies (IRENA, 2025; IEA, 2025), which highlight the role of clean energy in diversifying economies and mitigating vulnerability to fossil fuel price shocks.

Central Asia's experience illustrates both convergence and divergence with broader global trends. On one hand, the region replicates the positive impacts seen elsewhere—lower electricity costs, large-scale job creation, and reduced fossil fuel imports. For instance, Kazakhstan's solar and wind investments show clear savings on coal imports, while Uzbekistan's solar parks have mobilized foreign direct investment and generated youth employment. On the other hand, structural constraints

unique to Central Asia, including Soviet-era grid systems, limited financing mechanisms, and policy fragmentation, slow down the pace of transformation (ADB, 2023; EBRD, 2025).

A key theme emerging is the interplay between renewable energy adoption and regional cooperation. Initiatives like CASA-1000 reveal how cross-border trade in electricity could unlock an additional USD 1.5 billion in annual savings (World Bank, 2023), demonstrating the economic multiplier of collective action. At the same time, renewables introduce new governance challenges: balancing hydropower dependence in Kyrgyzstan and Tajikistan with solar and wind expansion in Kazakhstan and Uzbekistan requires coordinated policy approaches.

Another noteworthy finding is the employment dimension. While global projections (IRENA, 2025) estimate 5–10 jobs per MW of renewable capacity, Central Asia's labor markets face mismatches in technical skills. Without targeted training programs and vocational education reforms, the region risks underutilizing its human capital potential. Similarly, gender gaps persist, with women's participation concentrated in low-skill assembly jobs, highlighting the need for inclusive workforce policies.

Finally, the economic benefits should be weighed against persisting risks. Intermittency, financing bottlenecks, and uneven rural electrification may constrain long-term impact if unaddressed. Policy stability, transparent regulatory frameworks, and innovative financing instruments (e.g., green bonds, blended finance) emerge as critical enablers. Thus, while the economic case for renewables is robust, the translation of potential into realized outcomes depends heavily on governance, institutional reform, and investment climates.

Conclusion. This study underscores the economic benefits of renewable energy adoption in developing countries, with Central Asia exemplifying both opportunities and challenges. Empirical evidence demonstrates that renewables deliver measurable cost savings, stimulate job creation, bolster GDP growth, and enhance energy security while reducing reliance on fossil fuels. In a region long dependent on hydrocarbons, the transition to renewables represents not only an environmental necessity but also a strategic economic choice.

Central Asia's progress—marked by a 26.6% increase in renewable capacity to 17.3 GW by 2023—indicates that momentum is building. Yet, realizing the full spectrum of benefits requires addressing systemic barriers: outdated infrastructure, limited financing, and fragmented policies. Regional power trade initiatives and foreign investment inflows offer promising avenues, but inclusive human capital development and skill-building programs must complement technical progress.

Ultimately, renewable energy adoption is more than a decarbonization strategy—it is an engine of sustainable economic transformation. For developing countries, and Central Asia in particular, renewables can reduce fiscal vulnerabilities, diversify economies, and promote equitable growth. Policymakers should therefore prioritize enabling frameworks, regional cooperation, and targeted investments to unlock the long-term prosperity that renewable energy offers.

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