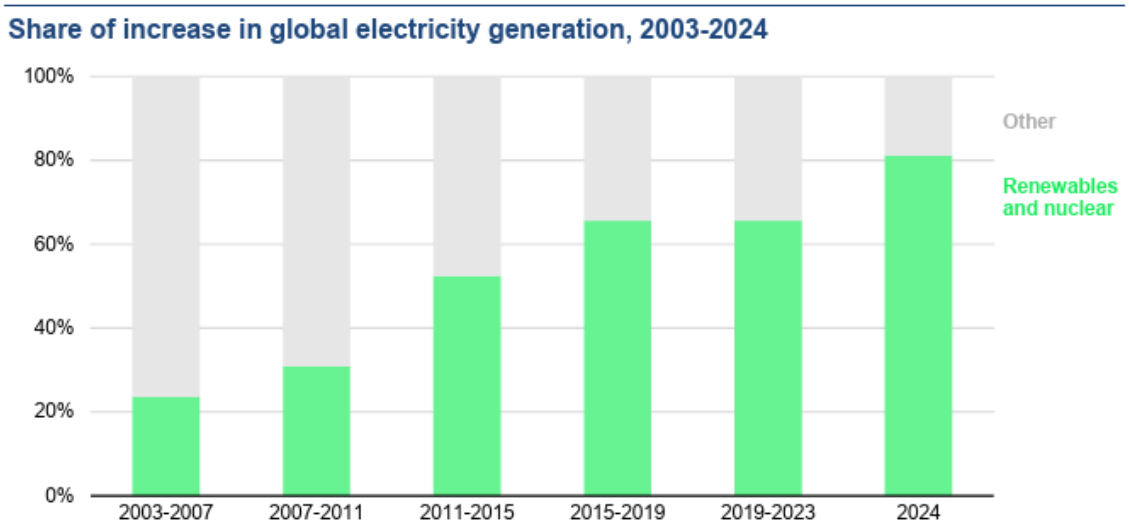
Sun and Wind - Renewable Energy Trends and Opportunities

Introduction

The global renewable energy landscape is experiencing a transformative era, with solar and wind power at the forefront of this rapid evolution. In 2025, the solar sector alone is set to achieve record-breaking capacity additions, driven by dramatic cost reductions, technological innovation, and robust policy support. Major economies such as China, the United States, and India are leading the charge, while emerging markets like Kazakhstan are making significant strides in diversifying their energy portfolios. Our new analysis explores the latest trends in global renewable energy, with a particular focus on the remarkable progress and ongoing challenges in Kazakhstan's transition from a fossil fuel-dependent economy to a more sustainable, low-carbon future.

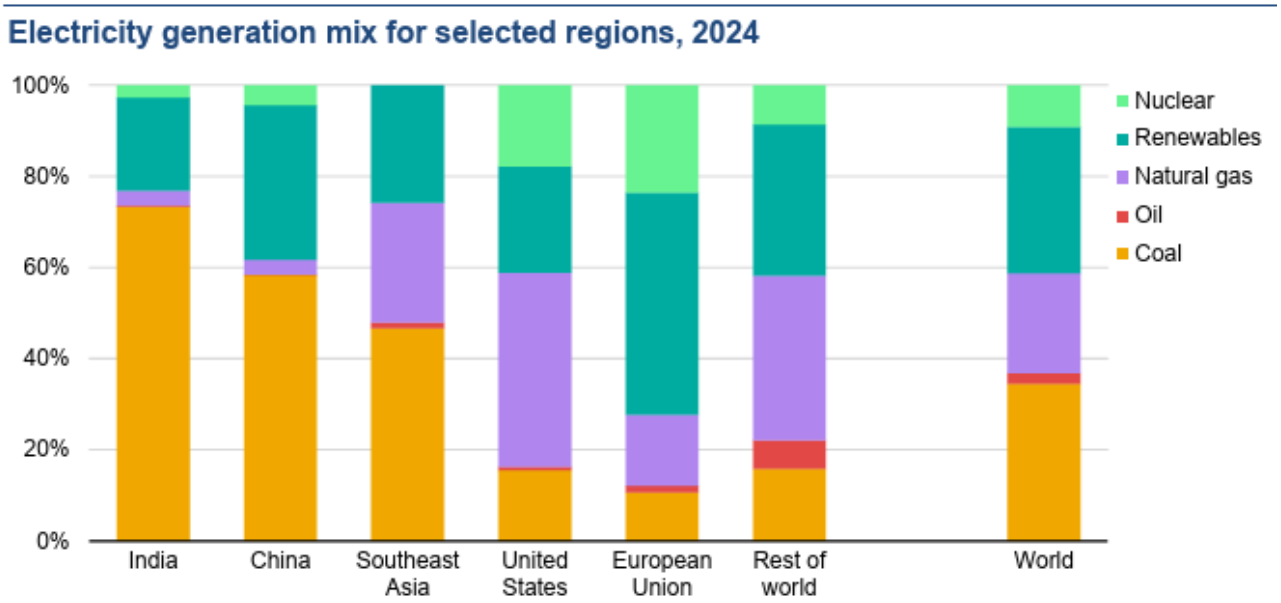
Expanding Role of Renewable Energy in Global Mix

According to the Global Energy Review 2025 by the International Energy Agency [IEA], global energy demand grew by 2.2% in 2024, outpacing the previous decade's average. Electricity demand surged by 4.3%, driven by increased cooling needs, industrial consumption, transport electrification, and the growth of data centers and artificial intelligence.



Source: IEA, Global Energy Review 2025 [March 2025]

Renewables, mainly solar and wind, grew by nearly 6% in 2024, providing 80% of the increase in global electricity demand. Around 700 gigawatts [GW] of new renewable power capacity were installed worldwide in 2024, setting a new annual record for the 22nd consecutive year. For the first time, renewables and nuclear power covered 40% of total global generation in 2024. Solar photovoltaics accounted for 7% and wind for 8% of global electricity generation.



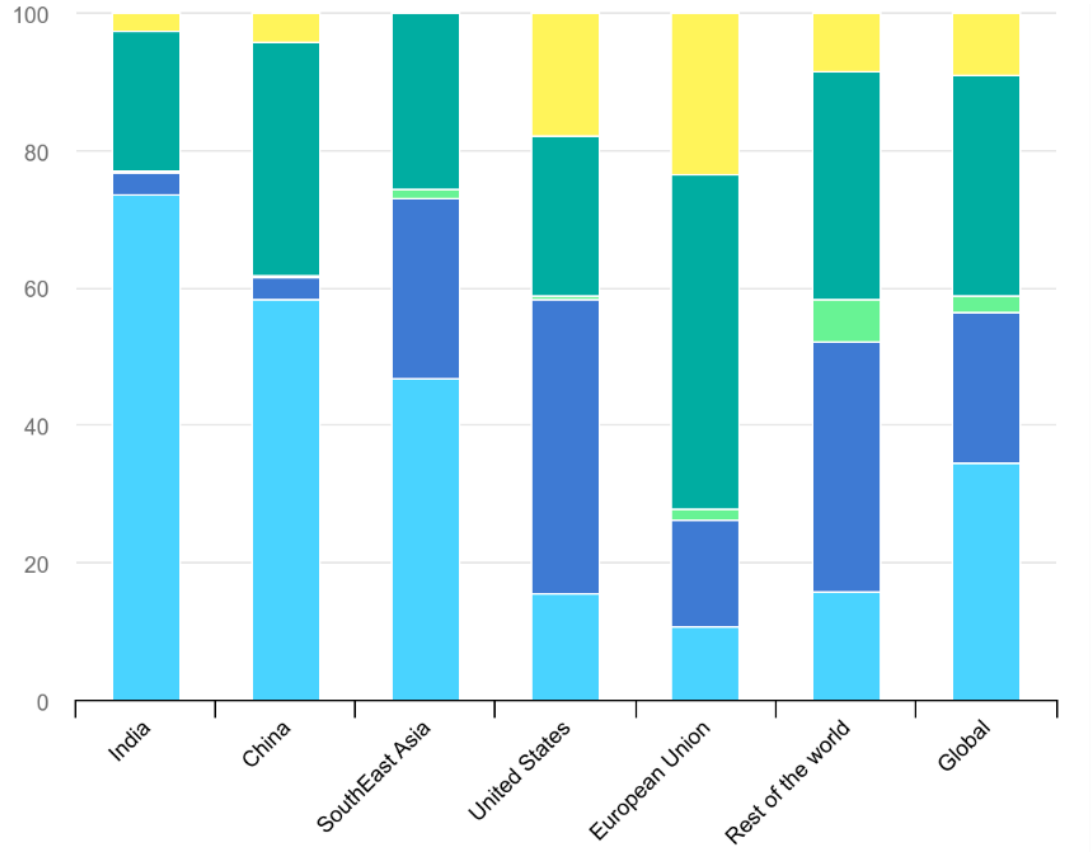
Source: IEA, Global Energy Review 2025 [March 2025]

Despite the rapid growth of renewables, fossil fuels still cover the lion's portion [circa 60%] of the global electricity demand. In addition, electricity generation for coal, oil, and gas increased in 2024. Coal remains the largest source of electricity [35%], followed by natural gas [20%] and oil [a few percent]. Energy-related CO_2 emissions reached a record 37.8 billion tons in 2024, but the growth rate was lower than global GDP growth, indicating some decoupling.

Trends in Global Renewable Energy

The European Union is the primary driver of the global shift toward cleaner energy, with a combination of renewables and nuclear power already accounting for over 70% of its electricity generation. China, despite still relying heavily on coal [over 58% of its electricity mix], is also making significant investments in renewables, which now generate roughly one-third of the country's electricity. Meanwhile, the world's largest economy, the United States, lags in the adoption of renewables and nuclear energy, instead pursuing a different strategy that emphasizes natural gas. This is a sound and logical approach given its position as the

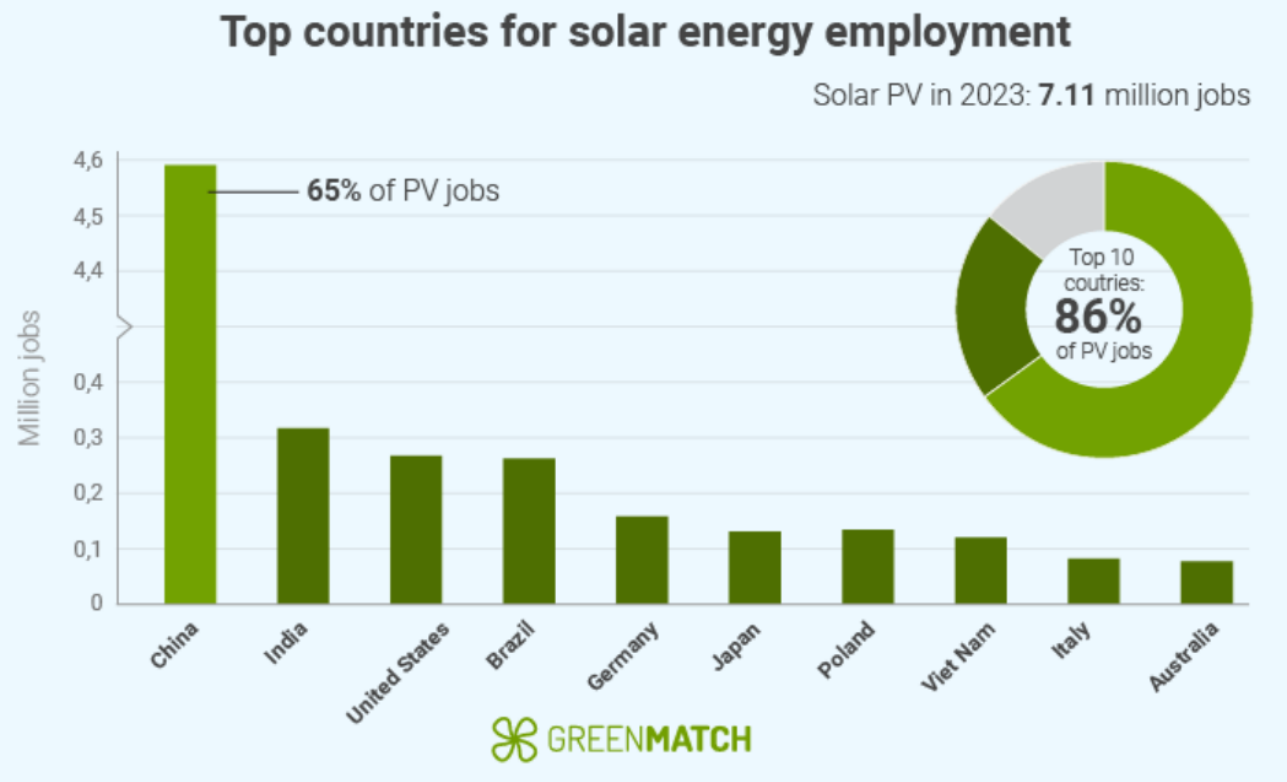
world's largest natural gas producer. India, the world's most populous country and a major emerging economy, remains decades behind in clean energy development, with coal making up about three-quarters of its electricity generation. This highlights that developing countries still face a long road ahead on their paths to decarbonization.



Source: IEA, Electricity generation mix for selected regions 2024, % [March 2025]

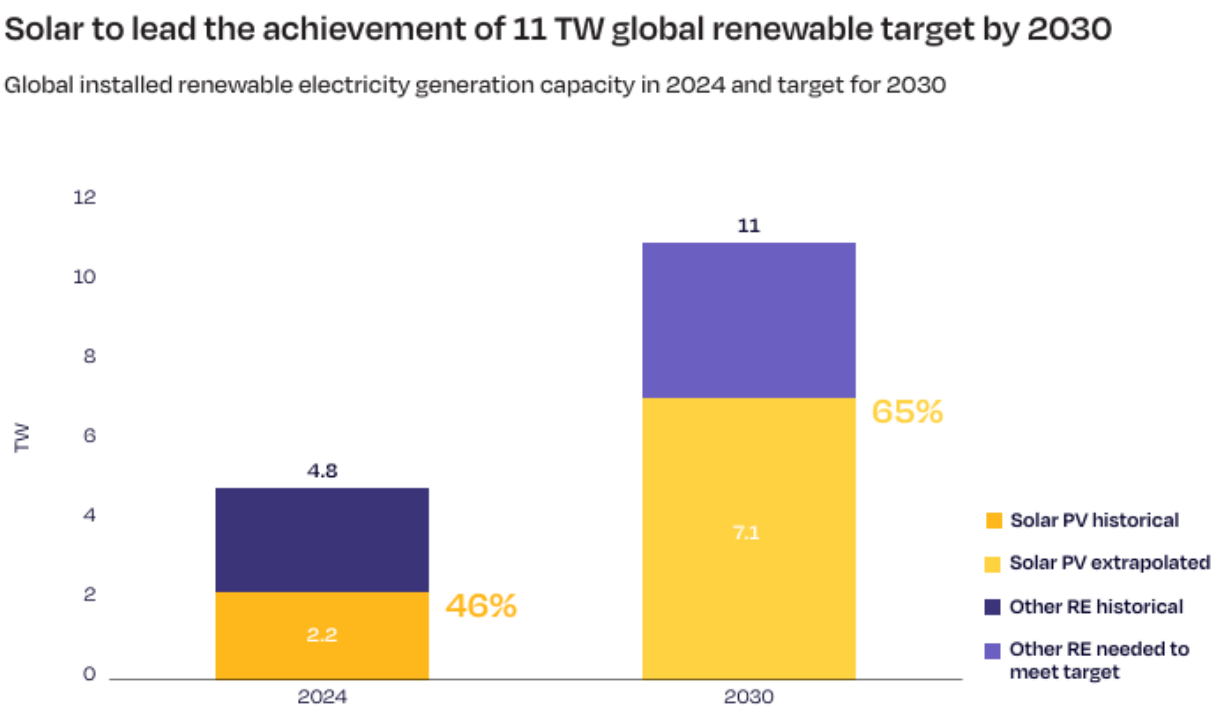
Nevertheless, the transition to cleaner energy is accelerating rapidly, with the industry attracting significantly more investment than ever before. According to the IEA, global energy investment in 2025 is projected to reach a record $3.3 trillion. Of this total, approximately $2.2 trillion is expected to flow into clean energy technologies including renewables, nuclear, and energy storage. This means that investment in clean energy is forecast to be nearly double the amount allocated to fossil fuels.

Out of the vast global investment in clean energy, solar energy appears to be the most attractive domain for investors with investment forecast expected to reach almost half-a-trillion USD in 2025 alone, solar photovoltaic capacity is projected to increase by a remarkable 698 GW compared to the previous year, representing nearly 90% of all global power expansion. This extraordinary growth is fueled by dramatic cost reductions as solar panel prices have plummeted by 99% over the last four decades, thanks to relentless technological innovation, economies of scale, and intense market competition.



Source: Green Match

As a result, global solar generation is expected to reach 1.39 trillion kilowatt-hours [kWh] in 2025, with China, the United States, Japan, Germany, and India leading the world in installed capacity and output. According to the IEA, solar will account for nearly half of the global increase in electricity demand through 2025, firmly establishing itself as the primary engine of new renewable capacity additions. The value of the global solar energy industry is forecast to reach $282 billion in 2025, with projections rising to $334 billion by 2029, reflecting a CAGR of 4.3%. Looking further ahead, the Boston Consulting Group and the International Solar Alliance anticipate even more transformative impacts by 2050, including a 60% reduction in generation costs and the creation of over 27 million green jobs worldwide.

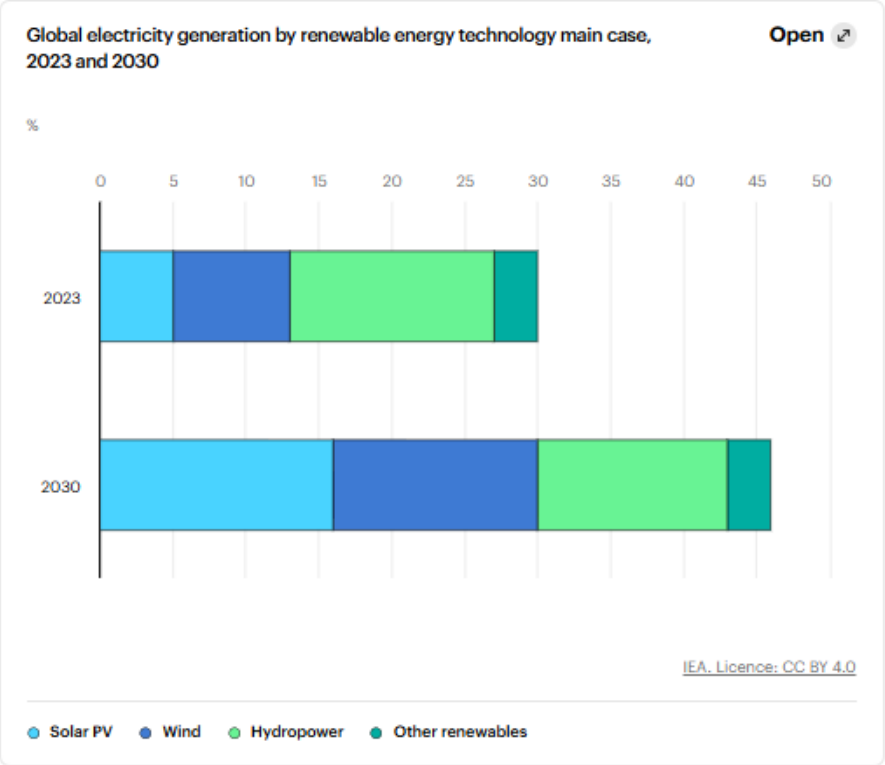


Source: SolarPowerEurope, Global Market Outlook for Solar Power 2025-2029 [May 2025]

By 2030, solar capacity is expected to surpass 7 terawatts [TW], delivering nearly two-thirds of the 11 TW global renewable energy target set at COP28. The IEA's main scenario envisions 5.5 TW of new renewable capacity by 2030, with annual installations approaching 940 GW by the end of the decade, 70% increase over recent (record) levels.

Wind energy continues to serve as a major pillar of the global energy transition, with both onshore and offshore segments expanding at a rapid pace. In 2024, global wind capacity additions reached a record 125 GW, bringing total installed capacity to 1,136 GW. The sector is expected to grow at a robust CAGR of 45.66% over the next five years. The IEA projects that wind, together with solar, will propel the renewable share of global electricity generation from 30% in 2023 to 46% by 2030. Offshore wind is gaining significant momentum due to its stable generation profile and declining costs, because the offshore market alone is projected to grow from $4.9 billion in 2024 to $6.6 billion in 2025.

Despite positive forecasts regarding wind energy's secular growth from various sources, we have to mention setbacks as well. In recent months, several high-profile wind projects have been canceled or postponed, particularly in developed markets like Europe and North America, due to rising costs, supply chain disruptions, and the rollback of government subsidies. Some major multinational corporations like Siemens and bp have also begun divesting from wind assets in certain markets, reflecting concerns about long-term profitability and policy uncertainty. The scaling back or elimination of subsidies in key regions has led to a reassessment of project pipelines, with some developers freezing or selling projects that are no longer financially viable under current market conditions.



Source: IEA, Renewables 2024 [October 2024]

Despite these challenges, technological advances and continued investment in grid infrastructure are expected to support the sector's long-term growth. As the above chart suggests, the share of wind in the global energy generation mix is forecasted to expand notably by 2030. The IEA notes that wind energy remains essential for meeting global climate targets, but emphasizes the need for stable policy frameworks, streamlined permitting processes, and continued cost reductions to ensure sustained expansion. As industry adapts to these evolving market dynamics, wind energy's contribution to the global renewable mix will depend on a balance between innovation, supportive policies, and market competitiveness.

Kazakhstan's Renewable Energy

For decades, the country's economic fortunes have been closely tied to its vast reserves of oil, gas, and coal. This legacy has shaped not only its industrial base but also its political and social structures. Yet, as the world shifts toward cleaner sources of energy, Kazakhstan has begun to reimagine its future. The transformation is neither swift nor simple, but the signs of progress are unmistakable. In 2024, renewables account for more than 6% of the nation's electricity generation, a remarkable leap from just a few years ago. Share of renewable

energy in the country's electricity generation mix is expected to expand further ahead as the Ministry of Energy forecasts contribution of this segment to expand above 11% by 2030.

Forecast balance of electric energy in the unified electric power system of the Republic of Kazakhstan for the period from 2025 to 2031

TWh (billion kWh)

#	Item	forecast						
		2025	2026	2027	2028	2029	2030	2031
1.	Electricity consumption	122.8	127.7	133.0	138.9	144.9	151.2	157.5
2.	Electricity production	117.1	125.2	134.2	142.1	149.9	150.6	150.6
3.	Existing stations	116.1	113.6	113.4	112.6	113.0	113.0	113.0
4.	Planned stations	1.0	11.5	20.8	29.5	36.9	37.6	37.6
5.	including renewable energy sources	7.7	9.2	10.5	10.5	16.9	16.9	16.9
6.	**Deficit (+), excess (-)**	**5.7**	**2.6**	**-1.1**	**-3.2**	**-5.0**	**0.5**	**6.9**

Source: Ministry of Energy of the Republic of Kazakhstan, adapted from Russian

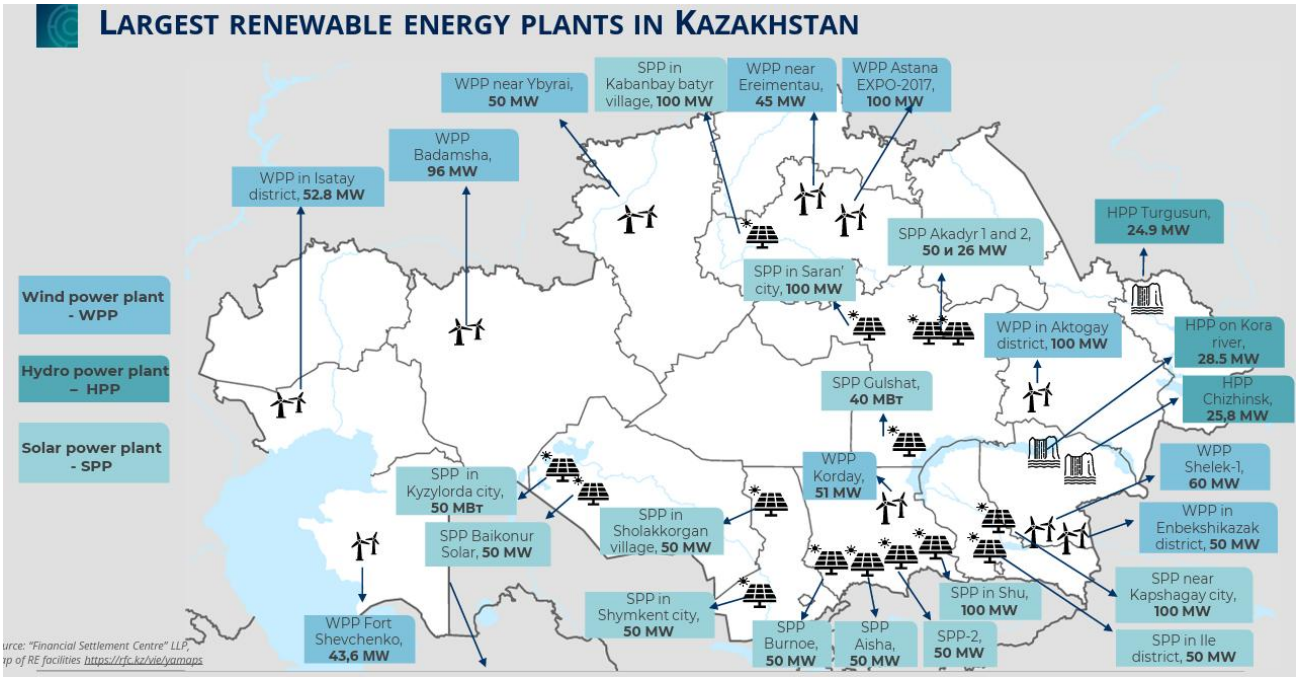
Kazakhstan's commitment to the clean energy shift is not just a temporary phenomenon but is one of the major strategic priorities of our country, which is outlined in the "Strategy for Achieving Carbon Neutrality in the Republic of Kazakhstan by 2060". The strategy is legally enshrined and includes both emission reduction and carbon removal goals. By 2030, Kazakhstan aims to reduce greenhouse gas emissions by 15% compared to 1990 levels unconditionally, and by 25% with additional international support. The strategy also underscores expected large-scale investments in clean technologies, with an estimated need of $610 billion through 2060, more than half of which will come from redirecting existing investments from traditional to green sectors.

Kazakhstan has demonstrated stable year-on-year growth in renewable energy generation over the past five years:

- 2021 – 3.69%
- 2022 – 4.53%
- 2023 – 5.92%
- 2024 – 6.43%

Source: Qazaq Green [May 2025]

The government's approach is pragmatic. It recognizes that shifting away from fossil fuels will not happen overnight, especially in a country where coal still supplies the lion's portion of electricity. To level the playing field, authorities have introduced reforms that include incentive-based tariff regulation and a phased reduction of fossil fuel subsidies. These subsidies, which have historically consumed about 6% of GDP, are among the highest in the world and have long distorted the energy market. International organizations such as the World Bank and the IEA have praised these reforms as essential for attracting private capital and fostering competition in the renewable sector.



Source: Astana International Finance Centre [September 2023]

As of 2024, more than 150 renewable energy facilities are in operation, producing 7.6 billion kWh of electricity. The government's auction-based support mechanism, introduced in 2018, has brought transparency and competition to the sector, lowering costs and attracting both domestic and foreign investors. Major financial institutions such as the European Bank for Reconstruction and Development and the Asian Development Bank have shown strong interest in financing new projects, a testament to the sector's growing credibility.

QAZAQ GREEN. In 2024, renewable energy sources (RES) in Kazakhstan generated 7.58 billion kWh of electricity, accounting for 6.43% of the country's total electricity production. This data was provided by the Ministry of Energy of the Republic of Kazakhstan.

According to the data, the total installed capacity of all RES facilities reached 3032.12 MW. The largest share in this volume is occupied by wind power plants – 1520.05 MW and solar power plants – 1222.61 MW. Small hydropower plants provide a capacity of 287.685 MW, while bioelectric power plants account for 1.77 MW.

By type of sources, wind power plants generated 4.51 billion kWh, solar power plants – 1.89 billion kWh, small hydropower plants – 1.18 billion kWh, and bioelectric power plants – 1.58 million kWh.

Source: Qazaq Green [April 2025]

As illustrated above, wind power is at the forefront of the renewables industry in Kazakhstan, generating almost 60% of the total electricity delivered by renewable sources. In 2024, wind power accounted for 4.5 billion kWh out of the country's total renewable generation of 7.6 billion kWh. Solar power, while having solid potential, still lags behind, contributing roughly one-quarter of the total renewable electricity output [1.9 billion kWh]. Small hydroelectric plants and biogas facilities play a more modest role.

Given that Kazakhstan's renewable energy sector is still in the relatively early stages of development, such an imbalance in the generation mix is not unusual. Early growth often favors the most economically viable and technologically accessible sources. However, as the industry matures, it will be important for policymakers to address this concentration by carefully regulating incentives and considering the economic feasibility and reasonableness of supporting a broader range of renewable technologies. Ultimately, smoothing out the generation mix will help mitigate concentration risks and foster a more resilient and sustainable energy system for the future.

Potential for Kazakhstan's Renewable Energy Growth

Kazakhstan's natural capabilities offer a compelling case for renewables. The country's wind potential is staggering. The vast steppes, swept by steady winds, could theoretically generate 1.8 trillion kWh of electricity each year, nearly ten times the nation's current consumption. Solar resources are equally promising, especially in the southern regions, where the sun shines for up to 3,000 hours annually. This abundance of wind and sunlight has already begun to reshape the energy landscape.

Looking forward, the government has made solar power a central pillar of its renewable strategy. The 2025 auction will allocate 90 MW for new solar photovoltaic projects, with reserved land and grid connections to speed up implementation.

Wind power is set for an even greater expansion. The national wind atlas, developed with the United Nations Development Program, identifies several regions with average wind speeds above seven meters per second at a height of 80 meters (ideal conditions for utility-scale wind farms). In 2025, the government will auction 1,200 MW of new wind capacity, including the country's first wind farm with integrated energy storage. This innovation is critical for grid reliability, as it will help smooth out fluctuations in wind generation and enable a higher share of renewables. A landmark one-gigawatt Mirny wind farm is construction start is scheduled for fall of the current year, with the first electricity brought into the grid in 2028.

The 2025 auction is the most ambitious yet, allocating a total of 1,810 MW across wind, solar, hydro, and biofuel projects. The auction process is designed to reduce risk and accelerate deployment, with pre-arranged land plots, grid connections, and a transparent regulatory framework. The government is also negotiating investment agreements for further grid modernization and upgrades to existing power plants.

The pipeline of new projects is impressive. In 2025, nine renewable energy facilities with a combined capacity of 456 MW will be launched. This builds on the momentum of recent years, with sixteen projects totaling 496 MW commissioned in 2023 and twelve projects adding 437 MW in 2022. As we saw above, all these investments have already pushed the

share of renewables in the national energy mix above 6%. The new projects span solar, wind, hydro, and biogas, and are distributed across key regions such as Almaty, Kyzylorda, Turkistan, and Ulytau.

Kazakhstan is also reforming its regulatory environment to attract investors and accelerate project delivery. Incentives include guaranteed electricity purchases at auction prices, annual tariff indexation, exemptions from grid fees, and a range of investment preferences. The government is promoting international partnerships and scientific approaches to project planning, while the Government enhances support mechanisms and has called for greater private sector participation. A single electricity purchase system for renewables, tax and customs incentives, and state grants are all part of the package. The Astana International Financial Centre is championing green bond issuance, with the green finance market now exceeding 169 billion tenge.

Kazakhstan's journey toward a greener energy future is far from complete. The challenges are real, and the stakes are high. Yet, the country's progress over the past few years offers a glimpse of what is possible when ambition is matched by action. With its vast natural resources, growing expertise, and a clear policy direction, Kazakhstan has the potential to become a regional leader in renewable energy. The transition will not be easy, but we see clearly that the momentum is building.

The Bottom Line

The global shift toward cleaner sources of electricity is an irreversible and powerful trend, as evidenced by significantly greater global investments in renewables compared to fossil fuels. Kazakhstan holds a strong position in traditional energy [coal, oil, and natural gas] while also possessing considerable potential in solar and wind power. For our country, the long-term priority is to balance the energy portfolio in a way that maximizes positive economic outcomes: channeling abundant traditional energy resources into deeper processing and the creation of higher value-added products, rather than simply burning them for electricity.

At the same time, to meet basic electricity needs, it is reasonable to harness the potential of renewables. However, this requires ensuring that storage and transmission infrastructure keeps up with the expanding role of electricity generated from solar and wind. This is essential for delivering electricity reliably and efficiently, given the intermittent nature of renewable sources. Building a strong and well-diversified energy system that leverages both traditional resources and renewables is crucial for creating a more resilient economy, which will be less vulnerable to the inherent cyclicality of hydrocarbons and the volatility of global crude oil prices. By pursuing this balanced approach, Kazakhstan can better safeguard its economic stability while advancing toward a sustainable energy future.

ENERGY Insights & Analytics

Analytical center "ENERGY" LLP (ENERGY Insight & Analytics) is a joint venture between the KAZENERGY Association and IT company AppStream. The company aims to become a priority source of data, analytical information, and recommendations for Kazakhstan's oil, gas, and electric power industries, allowing decision-makers to analyze and predict the most significant industry indicators with details on leading market players. Activities of ENERGY Insight & Analytics incorporate the whole analytics cycle with consequent stages: Descriptive, Diagnostic, Predictive, and Prescriptive analytics.

The key tool and product of ENERGY Insight & Analytics is internally developed software - the Analytical Platform EXia, aimed to identify, localize, format, and present data most efficiently for the specified use cases.

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www.exia.kz

info@exia.kz

https://www.linkedin.com/company/energy-insight/

10 D. Kunayev street, Astana, Kazakhstan