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Reshaping Energy in Eurasia: Insights from Kazakhstan and Uzbekistan

September 2025

Important Note

PwC presents the study titled “Reshaping Energy in Eurasia: Insights from Kazakhstan and Uzbekistan,” dated September 2025. This study encompasses global energy transition trends, a comparison between Kazakhstan and Uzbekistan regarding their energy transition progress, case studies of companies worldwide and in the region that are promoting energy transition, and opportunities for green financing.

The report also includes insights gathered from interviews with experts in Kazakhstan and Uzbekistan across various sectors, such as energy, oil and gas, and metals and mining.

In summary, the report highlights:

- Global trends in energy transition, including advancements and challenges
- Case studies of leading global companies engaged in energy transition
- A comparative analysis of the energy transition progress in Kazakhstan and Uzbekistan, along with examples of major companies making strides in energy transition
- Recommendations for actions necessary to enhance progress in energy transition.

Natalya Lim

Partner, Strategy& and Advisory Leader of Eurasia Region

Foreword

Each year, we at PwC strive to provide a clear, data-driven perspective on the evolving energy landscape in Kazakhstan.

In 2021, our inaugural report examined the potential and challenges of renewable energy in Kazakhstan, highlighting the foundational role of policy, investment, and infrastructure in shaping the sector's future.

The following year, we expanded our focus to the broader energy transition, exploring the impact of global crises, the role of coal, and the urgent need for decarbonization.

In 2024, we turned our attention to the digital transformation of the energy sector, exploring how smart technologies - including smart grids, EV charging, and smart home systems - can unlock new value and efficiency across the energy system. That report emphasized the importance of digital business models and the need for regulatory and infrastructure readiness to support innovation.

This year, we are proud to expand our scope beyond Kazakhstan to include Uzbekistan. This report offers a comparative view of both countries' energy transition journeys, drawing on local insights from industry leaders in energy, oil and gas, and metals and mining.

As the global energy landscape undergoes a profound transformation, Kazakhstan and Uzbekistan stand at a pivotal juncture. The urgency to transition toward sustainable, resilient, and inclusive energy systems is no longer a distant ambition - it is a present-day imperative.

This report reflects our commitment to supporting that transition. By examining global trends and best practices, and comparing the progress of Kazakhstan and Uzbekistan, we aim to provide actionable insights tailored to the region's unique challenges and opportunities. From renewable energy adoption to green financing strategies, the findings highlight the innovation and determination already shaping the future of energy in Central Asia.

Importantly, this study is grounded in the voices of those leading the change - local businesses, energy experts, and industry pioneers. Their perspectives have informed our recommendations and helped us identify the maturity levels that will guide the next steps for companies across the region.

At PwC, we believe that collaboration, transparency, and strategic foresight are essential to navigating the energy transition. We hope this report serves as a valuable resource for decision-makers, investors, and communities working to build a more sustainable energy future for Kazakhstan, Uzbekistan, and beyond.

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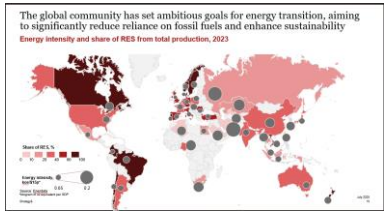

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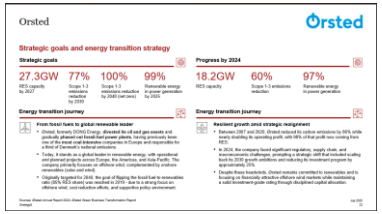

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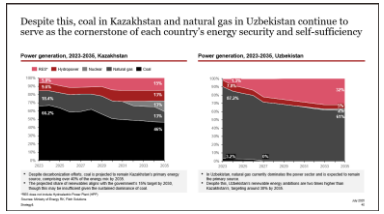

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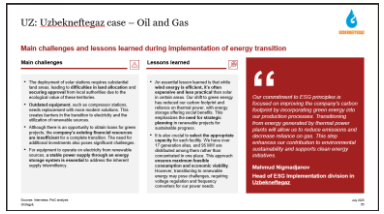

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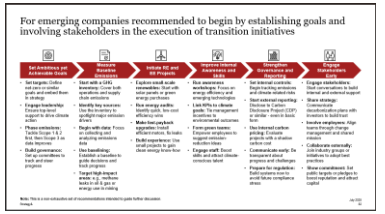


Key topics

- Maturity level assessment on energy transition
- Recommendations for companies based on their maturity level

Kazakhstan and Uzbekistan energy transition overview

Strategic goals and regulations

- Kazakhstan and Uzbekistan have both adopted national strategies and policy frameworks aimed at **decarbonization** and transitioning to a **green economy.**
- By 2030, **Kazakhstan** targets a **15% share of RES** in its energy mix, while **Uzbekistan** has set a more ambitious goal of **40%.**
- Both countries have enacted legislation governing the **use of RES**, underscoring their **strategic commitment** to sustainable development.

Progress and forecast

- **Fossil fuels** are projected to **remain dominant in both countries:** coal is expected to account for **40%** of Kazakhstan's energy mix, while natural gas will comprise around **60%** in Uzbekistan.
- The share of **RES** is forecasted to reach **15% in Kazakhstan** and **32% in Uzbekistan**.
- Kazakhstan is projected to face an **electricity deficit** by 2030, while Uzbekistan's energy consumption is expected to **double**, driving to accelerate the development of RES to meet growing demand.

Investments and projects

- **Kazakhstan** has invested over **$2.6 billion** in RES initiatives, while **Uzbekistan's** investments total approximately **$6 billion**.
- The **EBRD** has been the leading investor in both countries. In Kazakhstan, the **ADB** ranks second, whereas in Uzbekistan, the **World Bank and the IFC** are the next major contributors.
- These investments support a **range of projects**, including renewable energy plants, grid modernization, nuclear energy plants, EV charging infrastructure, and waste-to-energy facilities.

Energy transition barriers

Kazakhstan and Uzbekistan face **comparable challenges** in their transition to cleaner technologies, including:

1. Lack of implementation strategies
2. Infrastructure & technical constraints
3. Lack of a robust regulatory framework
4. Tariff-related issues
5. Financial barriers and investment risks
6. Lack of competency

Overview, objectives and conclusions of the study

This report has been developed by PwC as a component of the annual Energy Reviews. It examines the energy transition taking place in Kazakhstan and Uzbekistan while also offering some global context and best practices.

The research begins by addressing the global progress of energy transition, along with the common challenges and practices identified by industry leaders worldwide. It then focuses specifically on Kazakhstan and Uzbekistan, providing a detailed comparison of their transition progress and highlighting the best practices of local businesses. Additionally, the report outlines the green financing agenda in the region to enhance funding opportunities. Lastly, a series of key recommendations are offered as next steps based on the maturity level of each company.

The objective of this study is to present both global and regional perspectives, along with practical insights from case study companies, to support further energy transitions among businesses.

The climate risks, which have intensified over recent decades, have notably influenced the future of the energy and industrial sectors. Ongoing international environmental agreements have compelled nations and corporations to adhere to regulations regarding energy transition and emissions management. Simultaneously, the movement toward a greener global economy is gathering pace: this shift will necessitate significantly higher investments and stronger governmental backing.

The Eurasian region is progressing with its energy transition, with Kazakhstan and Uzbekistan actively developing renewable energy sources and managing greenhouse gas emissions. However, both nations remain heavily reliant on fossil fuels, and further progress towards green energy will require enhanced funding and a solid regulatory framework.

Data analysis approach and interview results (1/2)

What we analyzed

The study examined statistical data from publicly available sources on global energy trends, with a particular focus on the markets in Kazakhstan and Uzbekistan. It explored both the opportunities and the challenges associated with advancing the energy transition, as well as case studies of global and local companies.

More specific sources are mentioned below.

Overview of the global energy transition

- Energy intensity and share of renewables for 2023 from Enerdata database
- Reports on energy transition from IEA, IRENA, DNV
- Reports and scientific papers on common barriers, e.g. report of Columbia Center on Sustainable Development on financing pathways for the energy transition, paper on barriers from Energy for Sustainable Development journal
- Annual reports and official websites of case companies
- UNEP Emissions Gap report
- EU Policy Whitepaper

Overview of the energy transition in Kazakhstan and Uzbekistan

- Energy data from Ministry of Energy KZ, UZ
- Fitch Solutions, IEA Energy Database
- Kazakhstan’s and Uzbekistan’s official documents
- Annual reports of regional case companies
- Interviews

Overview of the green financing

- AIFC Green Finance Market in Kazakhstan report
- PwC Kazakhstan Sustainable Finance Go-to Market report
- AIFC State of Sustainable Finance in Central Asia
- AIFC, AIX, KASE websites
- ADB, EBRD websites, World Bank blogs
- OECD Financing Uzbekistan’s Green Transition
- Interviews

Data analysis approach and interview results (2/2)

What we analyzed

Key contributions to our report stemmed from interviews with the leaders of sustainability and transformation in various companies from Kazakhstan and Uzbekistan, along with experts in the energy sector.

They were invited to express their perspectives on the opportunities and obstacles surrounding the energy transition in Kazakhstan and Uzbekistan, as well as their experiences in implementing energy transition projects. The findings are summarized in an aggregated manner, and individual insights from participants were included in our study with their consent.

The interviews took place between May 2025 and July 2025, and the outcomes are detailed later in the report.

It is important to note that the views expressed by participants may represent their personal opinions on specific matters, rather than the official stance of the organization or department they belong to. Additionally, as of the release date of this study, the information regarding the employment and positions of our respondents may have changed due to the time elapsed since the interviews.

We express our deep gratitude to all our contributors for their time, interest and expert opinion.
We hope that this study will be useful for all readers and interested parties.

Glossary

- **bn** – billion
- **m** – million
- **ths.** – thousand
- **tn** – trillion
- **GJ –** Gigajoules
- **$GtCO_2e$ –** Gigatons (billion metric tons) of carbon dioxide equivalent
- **GW –** Gigawatt, billion watts
- **kV –** Kilovolt
- **kWh –** Kilowatt-hour
- **MW –** Megawatt, million watts
- **MWh** – Megawatt-hour
- **TJ –** Terajoules, trillion joules
- **TWh –** Terawatt-hour
- **ACRA** – Analytical Credit Rating Agency
- **ADB** – Asian Development Bank
- **AI** – Artificial Intelligence
- **AIFC** – Astana International Financial Center
- **AIIB** – Asian Infrastructure Investment Bank
- **AIX** – Astana International Exchange
- **BCC** – Bank CenterCredit
- **BDB** – Business Development Bank
- **CBI** – Climate Bonds Initiative
- **CBS** – Climate Bonds Standard
- **CCUS** – Carbon Capture, Utilization, and Storage
- **CICERO** – Center for International Climate and Environmental Research
- **CIS** – Commonwealth of Independent States
- **CO_2** – Carbon Dioxide
- **COP** – United Nations Climate Change Conference of the Parties
- **DAMU** – DAMU Entrepreneurship Development Fund
- **DBK** – Development Bank of Kazakhstan
- **EAR** – Effective Annual Rate
- **EBRD** - European Bank for Reconstruction and Development
- **EDB** – Eurasian Development Bank
- **EDC** – Entrepreneurship Development Company
- **ESCO** – Energy Saving Companies
- **ESG** – Environmental, Social, Governance
- **ETS** – Emissions Trading System
- **ETM** – Energy Transition Mechanism
- **EU** – European Union
- **EV** – Electric Vehicle
- **FE** – Foreign Enterprise
- **GBP** – Green Bond Principles
- **GDP** – Gross Domestic Product
- **GEFF** – Green Economy Financing Facility
- **GFC** – Green Finance Center
- **GGGI** – Global Green Growth Institute
- **GHG** – Greenhouse gas
- **HPP** – Hydroelectric Power Plant
- **ICMA** – International Capital Market Association
- **IEA** – International Energy Agency.
- **IFC** – International Finance Corporation
- **IFI** – International Financial Institutions
- **ILO** – International Labour Organization
- **JSC** – Joint-Stock Company
- **JSCB** – Joint-Stock Commercial Bank
- **KASE** – Kazakhstan Stock Exchange
- **KEGOC** – Kazakhstan Electricity Grid Operating Company
- **KPI** – Key Performance Indicator
- **KZT** – Kazakhstani Tenge
- **LLC** – Limited Liability Company
- **LLP** – Limited Liability Partnership
- **LNG** – Liquefied Natural Gas
- **LSE** – London Stock Exchange
- **MCDF** – Multilateral Cooperation Center for Development Finance
- **NDC** – Nationally Determined Contributions
- **OJSC** – Open Joint-Stock Company
- **PPA** – Power Purchase Agreement
- **PPP** – Public-Private Partnership
- **R&D** – Research and Development
- **RE** – Renewable Energy
- **RES** – Renewable Energy Sources
- **SAC** – Supreme Audit Chamber
- **SAF** – Sustainable Aviation Fuel
- **SDG** – United Nations Sustainable Development Goal
- **SLB** – Sustainability-linked bond
- **SLL** – Sustainability-linked loan
- **SME** – Small and Medium-sized enterprise
- **SPO** – Second Party Opinion
- **SQB** – Sanoat Qurilish Bank
- **UNDP** – United Nations Development Programme
- **UNECE** – United Nations Economic Commission for Europe
- **USD** – United States Dollar
- **UzDIF** – Uzbekistan Direct Investment Fund
- **UzMRC** – Uzbekistan Mortgage Refinancing Company
- **UZS** – Uzbekistani Som
- **VAT** – Value added tax

1

Global trends highlight the need for a coordinated approach to successfully tackle the energy transition

The role of energy transition is significant in addressing climate change

What is Energy Transition?

- **Energy transition** is the global move from fossil fuels to low-carbon energy sources to mitigate the consequences of climate change and support a **Net Zero** economy.
- Since about **70% of greenhouse gas (GHG) emissions** come from energy sector, shifting away from high-carbon fuels is essential.
- **International Renewable Energy Agency (IRENA)** estimates that **45%** of emission cuts must come from changes in **energy demand**.
- Major emission cuts come from **clean energy and electrification**, enhancing energy security and driving green innovation and sustainable growth.

Energy Transition in Eurasia

- Countries in the region are already advancing energy transition initiatives, recognizing their importance for sustainable development and long-term energy security.
- PwC CEO survey (2024), conducted in Kazakhstan, reveals that **73%** of surveyed companies have started or implemented **energy efficiency measures.**
- **63%** of CEOs state that their companies have begun or completed the **integration of eco-friendly products**, services, and technologies.
- In Uzbekistan, companies are advancing the energy transition through initiatives like 81 **industrial energy efficiency projects**, adoption of ISO 50001, and **green financing tools** such as green Sukuk bonds.

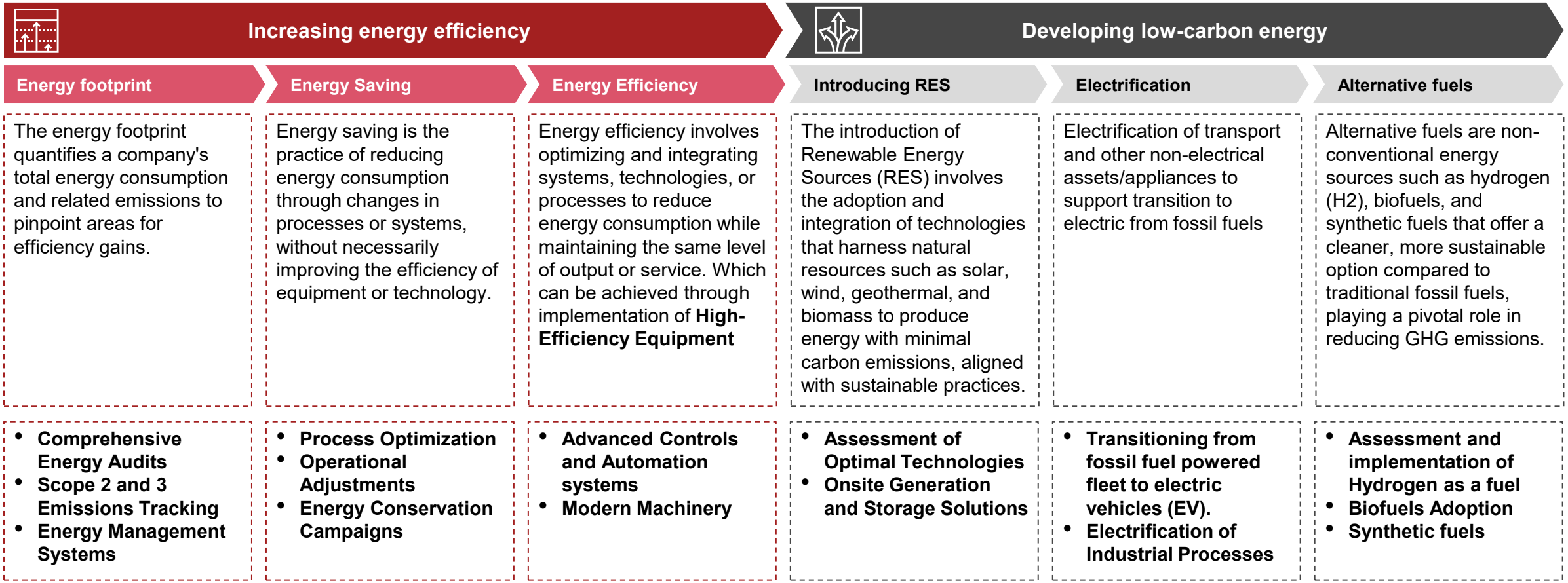
> If we want to avert climate catastrophe, renewables are the only credible path forward.
>
> Only renewables can safeguard our future, close the energy access gap, stabilize prices and ensure energy security.
>
> **António Guterres**
>
> **UN Secretary-General**

> The energy transition represents not only a technological, but also a social and economic challenge. It creates opportunities for regional economic growth, enhanced energy security, and job creation, however it also comes with risks that require proper attention.
>
> **Dinara Kumasheva**
>
> **Author of decarbonization scenarios and co-author of the Low-Carbon Development Program of JSC Samruk Energy**

Source: IRENA Perspectives for the Energy Transition

Energy transition could be achieved by implementing energy efficient practices and low-carbon technologies

Stages of Energy Transition and common practices at each stage



Sources: PwC analysis, Open sources

However, achieving energy transition requires overcoming substantial challenges

1 Technological barriers

1. Outdated grid infrastructure
2. Low efficiency and intermittency of RES
3. Limited availability of skilled technical personnel
4. Social Acceptance Barrier
5. Cybersecurity risks
6. Lack of Storage Capacity

2 Regulatory barriers

1. Lack of Integrated Legal Framework
2. Outdated Policies
3. Limited Institutional Capacity and Complex Permitting
4. Fragmented Regulations
5. Market Design Limitations
6. Land-Use Challenges

3 Financial barriers

1. High Cost of Capital for Clean Energy
2. Competing Budget Pressures
3. Debt Burden and Repayment Pressure
4. Conditional Financing Limits Flexibility

4 Geopolitical barriers

1. Critical minerals dependence and Resource Nationalism
2. Geopolitical tensions

Detailed information is available in Appendix (pp.95-98)

The global challenge of insufficient financing for green projects can be addressed by leveraging support from international institutions, banks and private investors

1 Green/Sustainable Financing and Stock Exchange Requirements:

- Green financing involves investments promoting environmental sustainability, such as renewable energy projects.
- Stock exchanges, like the London Stock Exchange (LSE), increasingly require companies to report their environmental, social, and governance (ESG) metrics, steering capital towards sustainable initiatives.

2 Role of International Financial Institutions (IFIs):

- IFIs are crucial in green finance by providing funding and expertise for sustainable projects worldwide. For example, the Climate Investment Funds (CIF) support low-carbon solutions and climate resilience initiatives, particularly in developing nations.

3 Public-Private Partnership (PPP) in Funding Green Projects:

- PPPs combine public and private resources to finance sustainable projects, leveraging private sector expertise to achieve green goals. The IFC-supported Scaling Solar program in Uzbekistan demonstrates this model in action, delivering competitively tendered solar PPPs through transparent, private-led procurement.

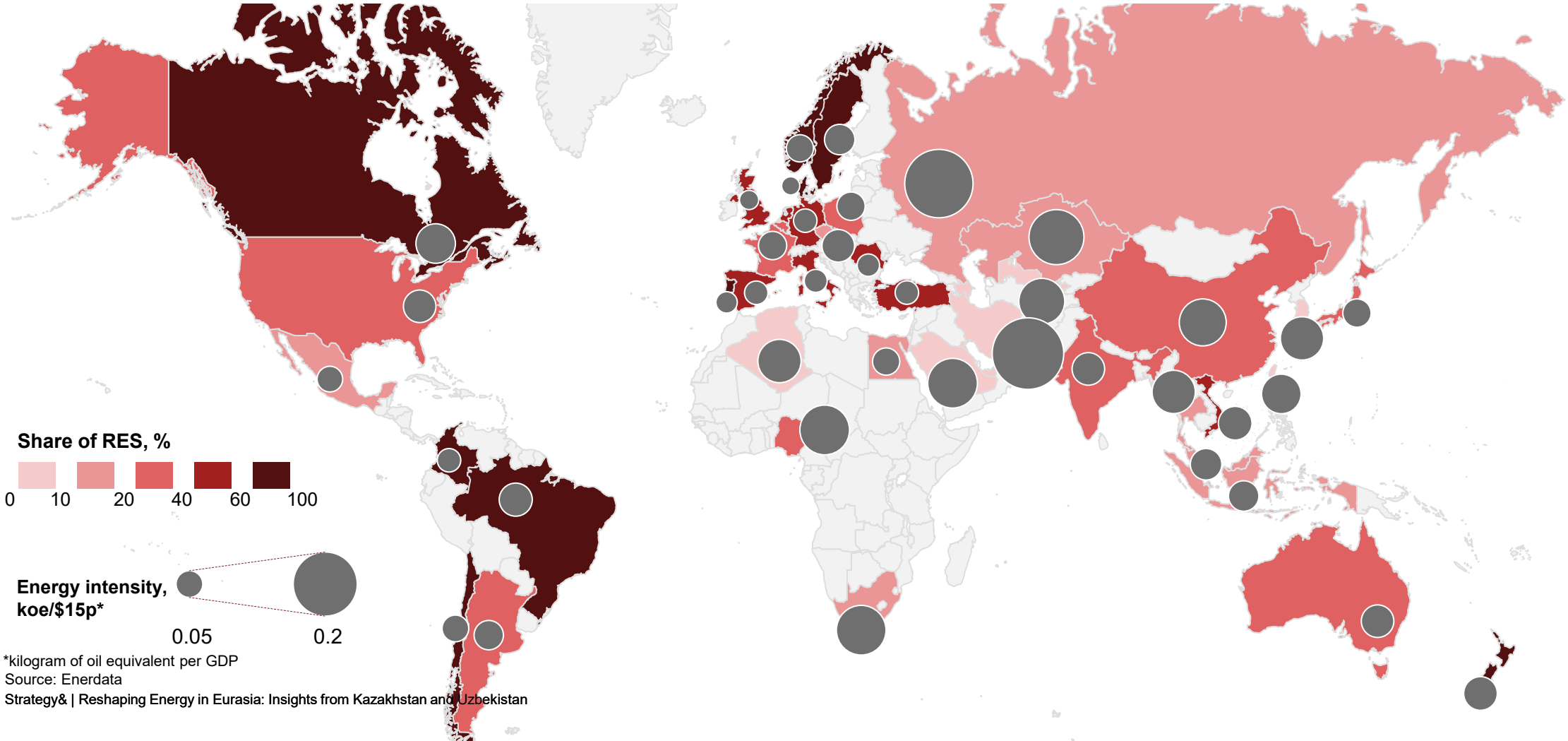
4 Green Taxonomy

- National green taxonomies are essential for integrated frameworks connecting climate, energy, and finance policies. The EU's taxonomy supports its 2050 climate goals, while Kazakhstan and Uzbekistan have adopted their own national taxonomies to guide sustainable investment and ensure consistent cross-sectoral standards.

Sources: PwC analysis, Open sources

The global community has set ambitious goals for energy transition, aiming to significantly reduce reliance on fossil fuels and enhance sustainability

Energy intensity and share of RES from total production, 2023



*kilogram of oil equivalent per GDP
Source: Enerdata

Europe as a region is at the forefront of the energy transition, driven by regulatory requirements, governmental support, and local community demand

Key regulations implemented

1 European Green Deal

- EU's **strategic roadmap** to achieve **climate neutrality by 2050** through sustainable economic transformation across all sectors.
- USD 359.7 bn in annual investments allocated for energy transition and decarbonization.

2 Renewable Energy Directive (RED)

- Establishes targets for increased renewable energy use, supporting cooperation between EU countries towards this goal.

3 Energy Efficiency Directive

- Establishes 'energy efficiency first' as a fundamental principle of EU energy policy, giving it legal-standing for the first time.

4 Carbon Border Adjustment Mechanism

- Taxing imports related to carbon emissions to accelerate decarbonization efforts.

5 EU Emissions Trading System (ETS)

- Cap-and-trade mechanism that limits GHG emissions and allows trading of allowances to incentivize cost-effective reductions.

Results achieved

37% GHG emissions reduction (1990-2023), while GDP continued to grow

20% share of renewables in final energy use – EU's 2020 target achieved; now aiming for 40% by 2030

30% reduction in building emissions since 2005 due to renovations, improved appliance efficiency, and electrification

9% fewer CO_2 emissions from energy were recorded in 2023 despite 0.7% GDP growth

Benefits

- The EU's renewable energy sector grew from **1.3 million jobs in 2020 to 1.8 million in 2023**, a 38% increase, reflecting strong job creation.
- Clean energy's **economic output** is rising, with the sector's turnover reaching **€163 bn in 2020**, up 9.2% from the previous year.
- The environmental economy's gross value added grew 15% in 2022 alone, outpacing overall GDP and reaching **€538 bn (3.3% of EU GDP).**
- Since 2005, the EU ETS has cut power and industry emissions **by 37%** and generated over **€152 bn** for reinvestment in the energy transition.
- From 2014 to 2021, every 1% increase in solar and wind share **reduced wholesale electricity prices** by 0.6% on average.
- Renewables saved the EU **around €100 bn** between 2021 and 2023 through lower electricity costs.

Source: EU Policy Whitepaper, DNV Energy Transition Outlook, press releases, European Council on Foreign Relations

2

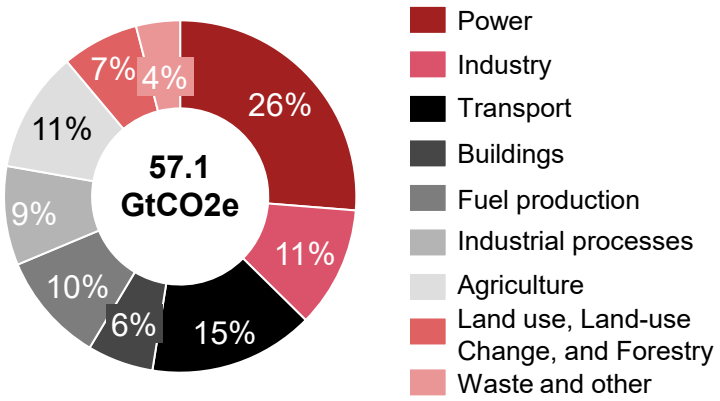
Global case studies

The energy transition relies not only on governmental initiatives but also requires active participation from major energy-consuming industries, including energy, oil and gas, and metals and mining

Why Energy, Oil and Gas, Metals and Mining?

1 High contribution to global GHG emissions

- The **power sector (electricity and heat generation)** accounts for the largest share of global emissions.
- Within **fuel production**, **oil and gas operations** contribute about **3%**.
- Under industrial process emissions**, metals processing** represents around **1%**, while other emissions from **fossil fuel combustion** in the metals and mining industry are reflected within the broader industry category.



2 Challenging to decarbonize

- All three are classified as "**hard-to-abate sectors**" due to:

1. Continuous production requirements
2. High-temperature processes (steel, aluminum)
3. Heavy reliance on fossil fuels for energy and process heat

- **Oil and gas operations** require decarbonization of their own emissions while simultaneously facing declining demand in the long term - a dual challenge.

3 Major impact on other industries

- The **energy supply** sector's transition is foundational, as decarbonizing electricity enables **downstream decarbonization** of industry, transport, and buildings.
- **Oil and gas companies control key infrastructure**, investment capital, and technical expertise. Their pivot toward carbon capture, utilization, and storage (CCUS), hydrogen, and renewables significantly influences global outcomes.
- The **metals and mining sector provides the materials for clean technologies** (solar panels, wind turbines, batteries, EVs). Without decarbonizing this supply chain, clean energy becomes carbon-intensive.

Sources: UNEP Emissions Gap Report

Pioneers and leaders in the energy transition establish market trends, making their examples and experiences vital considerations for guiding future sustainable energy efforts

Companies	Demonstrated Track Record of Transition at Scale	Influence on Global Supply Chains and Markets	Recognized as Global Standard-Setters and Policymakers
Ørsted	• **Ørsted** is ranked among the top global renewable developers, with a proven track record of delivering large-scale offshore wind and green hydrogen projects, driving the energy transition at scale.	• **Ørsted** is a trendsetter in global renewable energy, shaping supply chains and proving the viability of large-scale clean energy solutions across Europe, Asia, and emerging markets.	• **Ørsted** has been consistently ranked as the **world's most sustainable energy company**, pioneering offshore wind policy frameworks adopted globally.
Shell	• **Shell** is among the top global investors in hydrogen and CCUS, with some of the largest low-carbon projects globally.	• **Shell** is not only a global energy supplier but also a key architect of emerging hydrogen and CCUS markets, actively shaping early demand centers through strategic partnerships with governments and industry.	• **Shell** has faced and responded to groundbreaking legal rulings (e.g., the Dutch climate court case), forcing not only internal changes but also industry-wide shifts.
RioTinto	• **Rio Tinto** is a leader in decarbonizing hard-to-abate sectors, with some of the largest renewable energy deals in mining and taking early steps toward fleet electrification.	• **Rio Tinto** is a major global supplier of **copper and nickel**, directly enabling global clean energy deployment.	• **Rio Tinto** is helping set ESG benchmarks in the mining sector by pioneering sustainable supply chain partnerships and advancing low-carbon material solutions across global industries.

2.1 Energy sector

In the energy sector, the primary opportunities for advancing the energy transition lie in transitioning energy generation toward alternative fuels and electrification

- Integration of **RES**, such as solar, wind, hydro, geothermal, and biomass fuel, to diversify and **decarbonize the energy mix**.
- Feasibility assessment of the **emerging technologies** like green hydrogen, and floating wind turbines.
- Modernization of thermal power plants, including installation of **CCUS** technologies, and introduction of **low-carbon fuels** (e.g. transitioning from coal to natural gas as an interim solution to lower emissions intensity).

- Grid modernization through **digitalization** and **smart grid technologies**, enabling real-time monitoring, faster fault detection.
- **Deployment of high-voltage direct current** lines minimize transmission losses over long distances.
- **Development of regional interconnections,** allowing for optimized use of RES and balancing generation across larger areas.
- **Enhancing grid resilience** by addressing RES intermittency through large-scale battery storage systems and demand response programs.
- Implementation of **dynamic line rating** systems to maximize transmission line capacity based on real-time conditions.

- **Deployment of distributed energy resources** such as microgrids, community solar, and local battery storage to enable decentralized generation and consumption.
- **Implementation of smart meters** and **advanced metering infrastructure** to provide consumers with real-time data and enabling demand-side management through time-of-use tariffs.
- **Utilization of blockchain** technology to facilitate peer-to-peer energy trading among prosumers.
- **Development of decentralized distribution networks** with automated fault detection systems to ensure reliability and continuity of power supply, especially under extreme weather conditions and cyber threats.

- **Electrification of end use sectors** through the adoption EVs in transport and heat pumps in buildings, significantly reducing emissions.
- **Implementation of energy efficiency measures**, including stringent standards for appliances, buildings, and industrial equipment to lower energy consumption.
- **Adoption of dynamic pricing models** and consumer engagement tools to shift consumption to off-peak periods, optimizing grid performance.
- **Decarbonization of hard-to-abate** sectors such as heavy industry and aviation by using green hydrogen and sustainable fuels.
- Integration of **circular economy principles** to promote sustainable resource use across the product lifecycle.

Sources: Electricity supply chain

However, technical and organizational challenges persist that hinders integrating renewable technologies into existing grids, ensuring energy storage capacity, and maintaining system stability

1 Industrial challenges

Dependence on Fossil Fuels and Economic Sensitivity

- **Coal, oil, and gas** are the major commodities affecting energy and economy sectors.
- For instance, in **Kazakhstan**, relatively outdated and inefficient coal-fired power plants generate over 70% of the energy. Oil and gas sectors revenue accounts for the **35% of GDP** and **75% of exports**. Thus, making the fossil fuel industries major source of **revenue, employment, and energy security**. Leading to the **resistance** to energy transitioning.

Infrastructure Limitations

- Adoption of sustainable energy technologies is the main step of the energy transition. However, due to the **aging energy infrastructure**, insufficient grid capacity for RES, it prevents a constant energy transition and growth of the RES share in the total energy production and consumption.

2 Organizational challenges

Investment Needs & Insufficient Fundings

- The energy transition requires **significant investments** in renewable energy projects, grid modernization, and carbon reduction technologies. Due to the **limited access** to financing for the sustainable projects' adoption and realization are slowed down or cancelled due to their costs and **implausibility.**

Lack of expertise, skill gaps, and social impacts

- For the energy transition, a **workforce with skills** in advanced technologies, renewable energy and digital infrastructure are required. However, these areas remain underdeveloped and lack targeted education.
- Moreover, a rapid transition may lead to unemployment in the fossil-fuel intensive sectors. Resulting in the workforce retraining and upskilling to work in the renewable energy and advanced technologies sectors.

Dependence on fossil fuels hinders energy transition progress, while inadequate infrastructure and funding slow renewable adoption. Skill shortages and social impacts, like job displacement, require workforce retraining for renewable sector growth. Additionally, fostering strategic investment and policy support is essential to overcoming these challenges and accelerating the shift to cleaner energy.

Sources: Assessment of challenges and strategies for driving energy transitions in emerging markets: A socio-technological systems perspective
Strategy& | Reshaping Energy in Eurasia: Insights from Kazakhstan and Uzbekistan

Strategic goals and energy transition strategy

Strategic goals

27.3GW
RES capacity by 2027

77%
Scope 1-3 emissions reduction by 2030

100%
Scope 1-3 emissions reduction by 2040 (net zero)

99%
Renewable energy in power generation by 2025

Progress by 2024

18.2GW
RES capacity

60%
Scope 1-3 emissions reduction

97%
Renewable energy in power generation

Energy transition journey

From fossil fuels to global renewable leader

- Ørsted, formerly DONG Energy, **divested its oil and gas assets** and gradually **phased out fossil-fuel power plants**, having previously been one of the **most coal-intensive** companies in Europe and responsible for a third of Denmark's national emissions.
- Today, it stands as a global leader in renewable energy, with operational and planned projects across Europe, the Americas, and Asia-Pacific. The company primarily focuses on offshore wind, complemented by onshore renewables (solar and wind).
- Originally targeted for 2040, the goal of flipping the fossil fuel-to-renewables ratio (85% RES share) was reached in 2019 - due to a strong focus on offshore wind, cost reduction efforts, and supportive policy environment.

Energy transition journey

Resilient growth amid strategic realignment

- Between 2007 and 2020, Ørsted reduced its carbon emissions by 86% while nearly doubling its operating profit, with 98% of that profit now coming from RES.
- In 2024, the company faced significant regulatory, supply chain, and macroeconomic challenges, prompting a strategic shift that included scaling back its 2030 growth ambitions and reducing its investment program by approximately 25%.
- Despite these headwinds, Ørsted remains committed to renewables and is focusing on financially attractive offshore wind markets while maintaining a solid investment-grade rating through disciplined capital allocation.

Sources: Ørsted Annual Report 2024, Ørsted Green Business Transformation Report
Strategy& | Reshaping Energy in Eurasia: Insights from Kazakhstan and Uzbekistan

Key Lessons Learned

Set Clear Targets to Drive Organizational Alignment

- **Targets help mobilize resources and unify efforts**

  Ørsted set specific goals for decarbonization, offshore wind cost reduction, and coal phase-out. These targets proved instrumental in setting the pace and aligning the organization behind a shared objective.

- **Understanding long-term risks and opportunities is essential**

  Ørsted recognized the challenges facing fossil fuel models due to climate concerns and saw the potential in the growing renewable energy market.

Government Support Is Crucial for Green Transitions

- **A stable and supportive policy environment enables transformation**

  Ørsted's green shift was made possible in part by clear and consistent offshore wind policies that gave the company confidence to invest and innovate at scale.

- **Policy certainty drives a cycle of cost reduction and technology maturity**

  With visibility into future capacity volumes and support mechanisms, Ørsted was able to scale up, which in turn accelerated learning, reduced costs, and matured the technology.

- **Ambitious policy and business goals can reinforce each other**

  Ørsted's experience shows how a well-designed 'ambition loop' - where policy ambition and private sector action feed into each other - can unlock progress across industries.

Flexibility Is Key to Navigating Industry Disruption

- **Adapt strategy when conditions shift**

  Ørsted responded to macroeconomic, regulatory, and project-specific challenges by scaling back its growth targets, focusing on financially viable markets, and protecting its capital structure.

- **Refocus on what can be delivered with confidence**

  Instead of pursuing aggressive expansion, Ørsted prioritized completing existing projects, optimizing operations, and ensuring value creation from its current portfolio.

- **Invest in internal resilience to stay competitive**

  The company strengthened risk management, improved supply chain strategies, and streamlined its organization to better withstand external shocks and maintain long-term competitiveness.

Sources: Ørsted Annual Report 2024, Ørsted Green Business Transformation Report

2.2 Oil and Gas

Energy transition of oil and gas sector requires comprehensive strategies for reducing emissions across the value chain, from extraction to end use

Upstream – Exploration & Production

- **Flaring and venting** during oil extraction emit CO_2 and methane but can be significantly reduced by **capturing and using the gas for power or reinjection.**
- **Methane leaks from wells, valves, and pipelines** can be mitigated through **regular leak detection and repair** (LDAR) programs using advanced sensors and satellite monitoring.
- **Electrification of drilling operations using grid power or renewable sources**, where feasible, can replace diesel combustion.
- **CCUS** technologies can be applied at high-emission well sites to capture CO_2 before it is released into the atmosphere.

Midstream – Transportation & Storage

- During transportation and storage, emissions arise from methane leaks in pipelines and compressor stations, and from CO_2 released during liquefied natural gas (LNG) liquefaction and transport. Modernizing infrastructure with **real-time monitoring, repairing leaks promptly, and electrifying compressors using low-carbon power** can reduce these emissions.
- **Energy efficiency upgrades** at LNG terminals and the use of alternative marine fuels, such as **biofuels or ammonia**, also support emissions reduction.

Downstream – Refining, Distribution & Retail /Petrochemicals

- Refineries emit GHGs mainly through combustion in furnaces and boilers, as well as from hydrogen production processes that rely on fossil fuels. Transitioning to **low-carbon hydrogen** (blue or green), improving **energy efficiency**, and integrating carbon capture systems can significantly lower emissions.
- Additional measures include co-processing **bio-feedstocks, electrifying** certain units, and sourcing **electricity from renewables**.

End Use (Consumption and Combustion)

- Expanding production of **low-carbon fuels** such as green/blue hydrogen, sustainable aviation fuels (SAF), biofuels, and e-methanol.
- Provide **carbon-neutral or lower-carbon energy solutions** by bundling products with carbon capture, offsets, or clean energy partnerships tailored to end users.
- **Investing in petrochemicals, advanced materials**, and recycling systems enables a transition away from combustion-based end uses and reduces life-cycle emissions.
- **Development of clean energy infrastructure** – such as EV charging, hydrogen refueling stations, and carbon capture hubs – to support customers in decarbonizing fuel use.

Sources: IEA, IPIECA, OGCI, SBTi , PwC analysis

Complex barriers hinder oil and gas industry's decarbonization and transition to low-carbon solutions

1 Technical and Infrastructure Hurdles

- **Engineering challenges** involve retrofitting for solar or wind power, which requires storage, complex communication, and control systems, while CCUS remains costly, energy-intensive, and unproven at scale, demanding significant water and 11–40% more fuel.
- **Infrastructure gaps** include inefficient grids, a lack of CO_2 transport and storage networks, and pipelines unsuitable for hydrogen or electricity transfer.
- **Technological limitations** such as persistent hard-to-abate emissions from upstream flaring, methane leaks, and downstream product use, while low-carbon solutions like CCUS, hydrogen, and direct air capture remain neither commercially viable nor cost-effective at scale.

2 Regulatory and Policy Uncertainty

- Support mechanisms vary by country, causing inconsistent returns across assets.
- Decarbonisation efforts lag where policies are weak. In many emerging markets and NOCs (e.g., in CEE, Sub-Saharan Africa), programmatic plans are largely absent.
- Inconsistent policies (even within the EU and U.S.) including shifting windfall taxes or subsidies for CCUS, undermine confidence and planning favoring oil and gas production with CCUS over RES.
- Unclear or **unstable carbon pricing** mechanisms hinder investment planning.

3 Economic and Financial Barriers

- Renewables often offer internal rate of return (**IRRs) of ~5–10%,** while O&G projects yield significantly higher returns.
- Rising interest rates and inflation make **capital costlier for energy transition** projects.
- Many oil & gas firms are reducing decarbonisation spending: **budgets dropped from 0.92% of revenue (2023) to 0.82% (2024)** amid geopolitical uncertainty.

4 Organizational Obstacles and Operational Integration

- Decarbonizing assets across upstream, midstream, and downstream operations is **logistically and technically complex**.
- KPIs **prioritize "barrels produced"** rather than reducing carbon intensity or increasing renewables growth, creating misaligned incentives.
- **Shortage of clean-energy-skilled personnel** in O&G hampers project delivery.

5 Geopolitical Pressures and Market Uncertainty

- Following the Ukraine war, both the EU and UK approved new oil and gas projects, **prioritizing energy security over climate goals**.
- **Fossil-first U.S. policy** withdrawn climate incentives, reinforcing global fossil lock-in, discouraging green projects.
- Continued **global demand for oil and gas**, particularly in emerging markets, makes full divestment challenging.

Sources: IEA, open sources, PwC analysis

Shell

Shell outlines a “dual-priority” strategy as the foundation of its energy transition pathway to balance near-term energy security with long-term decarbonization goals

Strategic goals

100%
Scope 1-3 emissions reduction by 2050 (net zero)

0%
Routine flaring from upstream operations by 2025

0.02%
Methane emissions intensity and achieve near-zero by 2030

15-20%
Net carbon intensity reduction by 2030 compared to 2016*

Progress by 2024

30.5%
Scope 1-3 emissions reduction

0%
Routine flaring from upstream operations in 2025

0.04%
Methane emissions intensity

9%
Net carbon intensity reduction

Energy transition journey

Strategic Shift: Balancing Energy Security and Disciplined Transition

- Shell has revised its earlier plan to reduce oil production and will now **maintain flat output** through 2030 to ensure **energy security** and meet ongoing global demand.
- At the same time, it is **shifting away from large-scale renewables** toward **low-carbon solutions with faster returns**, including biofuels, low-carbon hydrogen, CCUS, and energy efficiency - backed by a **$10–15 bn** investment program through 2025.
- The company has **paused new offshore wind projects** and is focusing on **optimizing existing renewables**, battery storage, and flexible gas-fired plants, while continuing to grow its LNG business by 4–5% annually through 2030 as a key transitional fuel.

Energy transition journey

Accelerating transition across operations and investments

- Shell is phasing out **routine flaring** and expanding **methane monitoring**, with 80% of operated assets using leak detection and satellite-based pilots underway. It is also investing in high-integrity **carbon offsets** and leveraging **digital tools** like artificial intelligence (AI) and sensors to cut emissions.
- Shell operates 3.4 GW of **renewables** and is expanding **battery storage** and **EV charging**, aiming for 200,000 public charge points by 2030. It leads in **low-carbon fuels** with Europe’s largest renewable natural gas (RNG) network and bio-LNG plant, supports global S**AF distribution**, and is converting refineries into energy and chemical parks.
- Shell is expanding **green financing** through bond issuances, **co-investing** in major low-carbon projects, and securing **public funding** to support hydrogen, carbon capture, and offshore wind initiatives.

*target was weakened from 20% to 15-20% in 2024

Sources: Shell Energy transition Strategy 2024, Shell Annual Report 2024, Reuters

Key Lessons Learned

Different Transition Paths Can Be Pursued

- **Reassess where capital delivers the most impact**

  Shell paused large-scale offshore wind and solar projects due to high capital intensity, slow returns, and regulatory uncertainty - choosing instead to reallocate investment toward more modular, faster-payback solutions like battery storage, EV charging, and power trading.

- **Adapt to structural and policy realities, not just ambition**

  Faced with inflation, supply chain volatility, and inconsistent clean-energy incentives, Shell shifted focus to assets that offer operational flexibility and better alignment with commercial goals.

- **Pursue scalable solutions that match local conditions**

  Rather than forcing large-scale infrastructure in uncertain environments, Shell prioritized technologies that could scale incrementally and respond more nimbly to market signals.

Partnerships and Public Support Are Key for Complex Technologies

- **Some decarbonization pathways require shared risk**

  Shell prioritized carbon capture and low-carbon hydrogen to decarbonize operations where electrification isn't feasible - but acknowledged that these technologies are capital-intensive and commercially uncertain.

- **Collaborating reduces risk and unlocks scale**

  Shell partnered with companies like Equinor and TotalEnergies on large-scale projects (e.g. Northern Lights CCUS, Green Energy Oman) to share costs, access expertise, and improve project bankability.

- **Government support is essential for early-stage technologies**

  Shell actively leveraged public funding mechanisms like the EU Innovation Fund to make these projects viable – highlighting the importance of policy and financial backing in scaling complex infrastructure.

Internal Capability Is Essential for Long-Term Transition

- **Align incentives with transition goals**

  Shell revised its executive compensation policy to link bonuses to energy transition KPIs like carbon intensity reduction and low-carbon investment delivery.

- **Invest in people and systems, not just technology**

  The company increased research and development (R&D) and workforce training in areas such as AI, CCUS, hydrogen, and digital energy systems to close skills gaps and support new business models.

- **Embed climate goals into core decision-making**

  Shell integrated climate-related KPIs into strategic and operational processes to ensure that decarbonization efforts are not separate from – but central to – business performance.

Sources: Shell Energy transition Strategy 2024, Shell Annual Report 2024, Reuters, open sources, PwC analysis

2.3 Metals and Mining

Opportunities in metals and mining to reduce energy consumption and embrace low-carbon technologies lie in fuel alternatives and electrification

Mining

Drilling & Blasting | Excavation | Transporting

- On-site mining activities, such as drilling and blasting, excavation, loading, and material hauling, remain heavily dependent on fossil fuels, primarily **diesel**. Diesel generators alone account for approximately **72%** of the energy used in mining operations, leading to significant **GHG** emissions.
- Integration of RES, particularly solar and wind power, could **supply electricity** to mine-site infrastructure, ventilation systems, dewatering pumps, and lighting, effectively replacing the widespread use of diesel generators.
- **Electrification** is a one of the effective methods to reduce GHG emissions. Diesel-powered machinery and vehicle fleets can be replaced with electric alternatives, including battery-electric vehicles (BEVs) and electric drills and excavators.
- Conveyor belt systems **powered by renewable** electricity can replace diesel haul trucks, providing production and cost efficiency based on the distance covered.

Processing

Comminuting | Enrichment

- The processing stage is one of the **most energy-intensive** parts of mining, with comminution (crushing and grinding) accounting for **50–70% of total mine site energy consumption**.
- Integrating AI-powered sensor-based **ore sorting** can significantly reduce this demand. Advanced machine vision systems use high-resolution cameras to analyze X-ray, 3D, and multispectral images, along with laser and optical data, in real-time to identify ore from waste.
- Combined with **Internet of Things** (IoT), data is captured and analyzed instantly, allowing operators to monitor and adjust sorting processes. This approach reduces energy and water use, cuts transportation costs, and boosts ore grade and recovery. Additionally, AI can regulate feed rates and optimize grinding parameters, minimizing both overgrinding and undergrinding, resulting in enhanced energy efficiency and improving throughput.

Smelting

Smelting | Refining

- Smelting and refining are **highly energy intensive** stages, particularly due to the heat required for the smelting, providing the electricity for electrolysis, and powering the utilities and equipment.
- **Using of induction smelting furnaces.** In induction furnaces, the heat is generated directly in metal through an electromagnetic fields, improving the energy efficiency, reducing both heat loss, and GHG emissions. In combination with powering from the RES, the GHG emissions will be significantly lowered.
- **Waste heat recovery systems (WHRS).** Heat loss is one of the issues at the smelteries. However, by implementing WHRS allows to convert int back into energy using Organic Rankine Cycle (ORC) systems, to save and reuse energy, which increases operational efficiency, productivity, and reduces GHG emissions.

Sources: Integrating renewable energy into mining operations: Opportunities, challenges, and enabling approaches, PwC analysis

However, technical and organizational challenges persist that hinders integrating renewable technologies into existing grids

1 Technical challenges

Feedstock Demand

- Fossil fuels are vital element for various mining operations, both as a power source and chemical feedstock. Current renewable technologies are unable to replace fossil fuels to satisfy the feedstock demand.

High-Temperature Heat Requirement

- Mining requires high-temperature heat, which is efficiently provided by fossil fuels. While only few clean energy sources can provide such heat.

Continuous Power Need

- Mining operations require a continuous supply of energy 24/7. The intermittent nature of the RES, combined with limitations of the energy storages are unable to fulfill the energy demand.

Mining Industry Legacy

- Legacy investment and design of the mining complicates integration of the RES and clean technologies into the existing operations. For their efficient implementation, their integration must be from the planning stage.

2 Organizational challenges

Conflicting Business Models

- The misalignment between mining and energy industries complicates renewable contracts. Standard 20-year power purchase agreements (PPAs) don't suit the fluctuating energy needs of off-grid mines.

Need for Technology Proofs of Concept

- The lack of commercial experience with renewables in industrial settings poses challenges for smaller mining companies, unlike larger companies that can afford pilot programs to test renewable solutions.

Lack of Renewable Energy Awareness and Expertise

- A deficit in knowledge and tools prevents decision-makers in mining and government from considering renewables in project planning and operations.

Land Constraints

- Although mining companies often control large areas, much of this land is unsuitable for renewable installations due to challenging terrain conditions.

The energy transition in the metals and mining industry is impeded by multiple challenges. Technologically, renewable energy struggles to meet needs for high-temperature heat, continuous power, and suitable installation sites. Moreover, facing issues of the existent business model complexities, need for the empirical implementations, awareness of RES.

Sources: Renewable energy in mining, challenges PwC analysis

Rio Tinto

Strategic goals and energy transition strategy

Strategic goals

50%
Scope 1 and 2 emissions reduction by 2030 (compared to 2018 level)

100%
Scope 1-3 emissions reduction by 2050 (net zero)

90%
Renewable energy in power generation by 2030

$5-6bn
Estimated decarbonization capital expenditures in 2022-2030

Progress by 2024

17%
Scope 1 and 2 emissions reduction

78%
Renewable energy in power generation

$1.3bn
Decarbonization capital expenditures spend in 2022-2024

Energy transition journey

Energy Transition of a Mining Leader

- Rio Tinto, long recognized as one of the foremost producers of **iron and steel**, has embarked on a transformative journey to minimize its carbon emissions, implementing a Climate Action Plan.
- Previously dependent on conventional fossil fuels, blast furnace-basic oxygen smelting, and other high-carbon methods, Rio Tinto is focused on **decreasing Scope 1-3 emissions**.
- This commitment includes **utilizing electricity generated from RES** by constructing its own solar PV plants and wind farms, along with entering PPAs to supply energy to its operational sites.

Energy transition journey

Advancing the Low-Emission Practices

- Rio Tinto is transitioning its mining operations to lower-emission fuels by piloting **battery-electric haul trucks**, deploying battery-swap systems at Oyu Tolgoi, and switching sites like Kennecott and Boron to **renewable diesel**.
- The company is advancing low-carbon industrial processes through technologies like ELYSIS™ for **carbon-free aluminium smelting**, **hydrogen calcination** in alumina refining, and BlueSmelting™ for ilmenite, supported by **biocarbon feedstocks** and joint ventures.
- It is also investing in **nature-based solutions** and **carbon credit projects** across multiple regions, while embedding decarbonization into procurement, shipping, and steel value chain collaborations.

Sources: Rio Tinto Annual Report 2024

Key Lessons Learned

Government Support Can Unlock Industrial Decarbonization

- **Public funding helps overcome early-stage barriers**

  Rio Tinto's renewable energy and hydrogen initiatives, like the Weipa Solar Plant and the Yarwun Hydrogen Calcination Pilot, were made possible through substantial co-investment from the Australian Renewable Energy Agency (ARENA), helping reduce diesel use and emissions.

- **Partnerships with government enable innovation at scale**

  Projects like the Green Energy Oman and Northern Lights CCUS show how collaboration with public agencies and multilateral funds can de-risk complex technologies and accelerate deployment.

- **Feasibility studies and pilot programs build confidence**

  ARENA's support for early-stage studies allowed Rio Tinto to explore renewable hydrogen and CCUS applications in refining - laying the groundwork for future demonstration projects and long-term transformation.

Partnerships Are Essential to Scale Complex Solutions

- **Collaboration enables breakthrough technologies**

  Rio Tinto advanced projects like ELYSIS™ (carbon-free aluminium smelting), BlueSmelting™ (low-carbon ilmenite processing), and hydrogen calcination through partnerships with Alcoa, Hydro, Sumitomo, Aymium, and Carbfix, among others.

- **Shared risk accelerates learning and deployment**

  By working with peers like BHP, Baowu, and BlueScope on electric smelters and low-carbon steelmaking, Rio Tinto spreads cost and technical risk while building industry-wide momentum.

R&D Investment Builds Long-Term Leadership

- **Innovation takes time, but creates strategic advantage**

  Rio Tinto's long-term commitment to R&D has positioned it at the forefront of industrial decarbonization, with pilot and demonstration projects across hydrogen, electric boilers, biocarbon, and carbon capture.

- **Pilots and feasibility studies lay the groundwork**

  The company has invested in dozens of studies and trials - from electric calcination in alumina to biofuel feedstock cultivation - ensuring readiness when technologies mature.

- **Internal capability is key to scaling new solutions**

  Rio Tinto established dedicated teams like the Energy and Climate group and the Decarbonization Office to manage emissions data, coordinate pilots, and integrate climate into investment decisions.

Sources: Rio Tinto Annual Report 2024, PwC analysis

3

Comparison of progress in energy transition of Kazakhstan and Uzbekistan

Aligning with global trends, Kazakhstan and Uzbekistan have set ambitious targets towards sustainable energy and carbon neutrality

Kazakhstan

Program documents

- **Strategy for Achieving Carbon Neutrality by 2060**
- **The Concept for the transition of the Republic of Kazakhstan to a "Green Economy"**
- **The concept for advancing energy conservation and enhancing energy efficiency**

Targets (by 2030)

- **15%** GHG reduction by 2030, or 25% with international support, from 1990 levels per **NDC**
- **15%** share of renewable and alternative sources in electricity generation by 2030
- **10%** reduction in energy intensity of industries by 2029 compared to 2021 levels
- **5%** reduction in energy intensity of energy sector by 2029 compared to 2021 levels
- **100%** GHG reduction: Achieving carbon neutrality by offsetting CO_2 emissions with equivalent removals
- **15%** reduction in GDP energy intensity by 2030 compared to the 2021 level
- **5%** reduction in energy consumption per capita by 2029 compared to 2021 levels
- **10%** reduction in energy consumption per unit area of premises by 2029 compared to 2021 levels

Uzbekistan

Program documents

- **"Uzbekistan – 2030" strategy**
- **The Strategy for the Transition of the Republic of Uzbekistan to a "Green" Economy for 2019-2030**
- **Implementation of the strategy "Uzbekistan-2030" in the "Year of Environmental Protection" and the "Green Economy"**

Targets (by 2030)

- **30%** reduction in specific GHG emissions per unit of GDP from the 2010 level
- **40%** share of RES in total consumption *Official statements anticipate renewable energy will account for 54% by 2025*
- **40%** share of RES in total capacities *Experts suggest that renewable energy must be 80% of total capacity to meet goals*
- **20%** increase in energy efficiency in industry
- **26%** share of RES in total electricity production
- **15-25GW** RES capacity to be installed
- **30%** reduction in GDP energy intensity, boosting the use of RES

Sources: Open sources, official documents

Kazakhstan and Uzbekistan have aligned their decarbonization agendas with international climate agreements, using them as a framework for national policy development

Commitment			Comments
Paris Agreement	✓	✓	• Kazakhstan ratified the agreement in 2016 and committed to reducing its GHG emissions by **15% below 1990 levels by 2030 and a 40% reduction by 2050**. With international support, this target could increase to **25%**. • Uzbekistan ratified the agreement in 2018 and has committed to reducing GHG emissions per unit of GDP by **35% by 2030**, compared to 2010 levels. This ambitious target is part of the country's updated NDCs.
Kyoto Protocol	✓	✓	• **Kazakhstan and Uzbekistan** ratified the Kyoto Protocol in 1999, aligning with international efforts to reduce GHG emissions and combat climate change.
Just Energy Transition Partnership	✓		• **Kazakhstan** joined the Just Energy Transition Partnership (JETP) in 2023, signaling its commitment to accelerate decarbonization efforts with international financial and technical support. • **Uzbekistan** is not part of JETP but launched the “Promoting Just Energy Transition in Uzbekistan” program at COP29 in November 2024, supported by UNDP, ILO, and UNECE, focusing on strengthening regulatory frameworks, stakeholder engagement, and integrating Just Transition principles into its 2030 NDC.
Oil and Gas Decarbonization Charter	✓	✓	• Kazakhstan was one of 52 countries and organizations to sign the **Oil and Gas Decarbonization Charter (OGDC)**, committing to end routine flaring by 2030 and minimize methane emissions. • Uzbekistan’s state oil and gas company, **Uzbekneftegaz**, was among 50 firms that also signed the related **Oil and Gas Decarbonization Charter (OGDC).**
COPs	✓	✓	• Kazakhstan and Uzbekistan have actively participated in all United Nations Framework Convention on Climate Change (UNFCCC) COPs since joining in the 1990s. • Kazakhstan showcased its climate progress by presenting its first **Biennial Transparency Report** and securing **$3.7 bn** in green energy. • Uzbekistan and **Global Green Growth Institute (GGGI)** signed the **CPF 2024–2028 program** and a memorandum on climate risk management.

Sources: Open sources, official documents

The establishment of distinct legislative measures for RES and energy efficiency emphasizes the strategic priority assigned to energy transition in their national policy frameworks

Kazakhstan

Environmental code of the Republic of Kazakhstan (2021)	• The Code modernizes environmental regulation by aligning with EU standards and introducing Best Available Techniques (BAT) for environmental permitting across key sectors like energy, metallurgy, and waste management. • It also strengthens carbon emissions regulation through a national ETS, KazETS.
Law on Energy Saving and Energy Efficiency	• Law promotes reduced energy consumption and sustainable energy use by mandating energy audits, action plans, and minimum efficiency standards for new buildings, equipment, and technologies.
Law on Support for the use of Renewable Energy Sources	• Law established a legal framework to stimulate renewable energy production through state support measures such as fixed tariffs, auctions, guaranteed grid purchase, and streamlined connection, compared to conventional sources.

Uzbekistan

Law on Electric Power Industry	• Uzbekistan's 2024 Electricity Law establishes a unified legal framework for the power sector, clarifying market roles, licensing requirements, and regulatory responsibilities while setting the foundation for future competitive wholesale and retail markets. Although such markets are not yet in place, the framework is designed to support them once established.
Law on Saving Energy, Its Rational Use and Increasing Energy Efficiency	• Uzbekistan's 2024 Energy Efficiency Law establishes a national framework for responsible energy use, mandating efficiency standards, audits, labeling, and energy management, while supporting Energy service companies (ESCOs) and financing for energy-saving projects.
Law on the use of renewable energy sources	• The Law provides a legal framework to promote renewables through state support, favorable tariffs, green energy certification, and simplified rules for small producers, while ensuring grid access and compliance with technical and environmental standards.

Detailed information is available in Appendix (pp.104-109)

Sources: Open sources, official documents

The legislation of Kazakhstan provides for investment preferences

Renewable energy projects are provided with tax benefits depending on the type of project. To receive investment preferences, it is necessary to submit an application and supporting documents, in accordance with the Entrepreneurial Code of the Republic of Kazakhstan.

Exemption from Customs Duties

- When importing technological equipment and components for it for the period of validity of the investment contract, but not more than 5 years from the date of registration of the investment contract;
- When importing spare parts for technological equipment, raw materials and materials for a period of up to 5 years, depending on the volume of investments in fixed assets.

State Grants

Land plots, buildings, structures, machinery and equipment, computer equipment, measuring and regulating instruments and devices, vehicles (except for passenger vehicles), production and household inventory.
The amount of the in-kind grant should not exceed 30% of the volume of investments in fixed assets; It is necessary to provide a document confirming the prior consent of the local executive body.

Guarantees of Stability Amid Legislative Changes in the RoK

Legal entities implementing an investment project or an investment-priority project within the framework of an investment agreement are guaranteed stability in case of changes in:
1) tax legislation of the Republic of Kazakhstan;
2) legislation of the Republic of Kazakhstan on employment of the population in the field of attracting foreign labor.

Exemption from Value Added Tax on Imports

Provided that the raw materials are included in the List approved by Order No. 140 of the Minister for Investments and Development of the Republic of Kazakhstan dated February 27, 2018, the import of such materials shall be processed in accordance with the customs legislation of the Eurasian Economic Union and/or the Republic of Kazakhstan.

The imported raw materials and/or components will be used exclusively for activities carried out under the investment contract.

Investment priority project

Tax benefits for the creation of new production facilities

- Exemption from corporate income tax for a period of 10 years.
- Exemption from land tax for a period of 10 years. The provisions of this paragraph shall not apply in cases of leasing.
- Exemption from property tax for a period of 8 years.

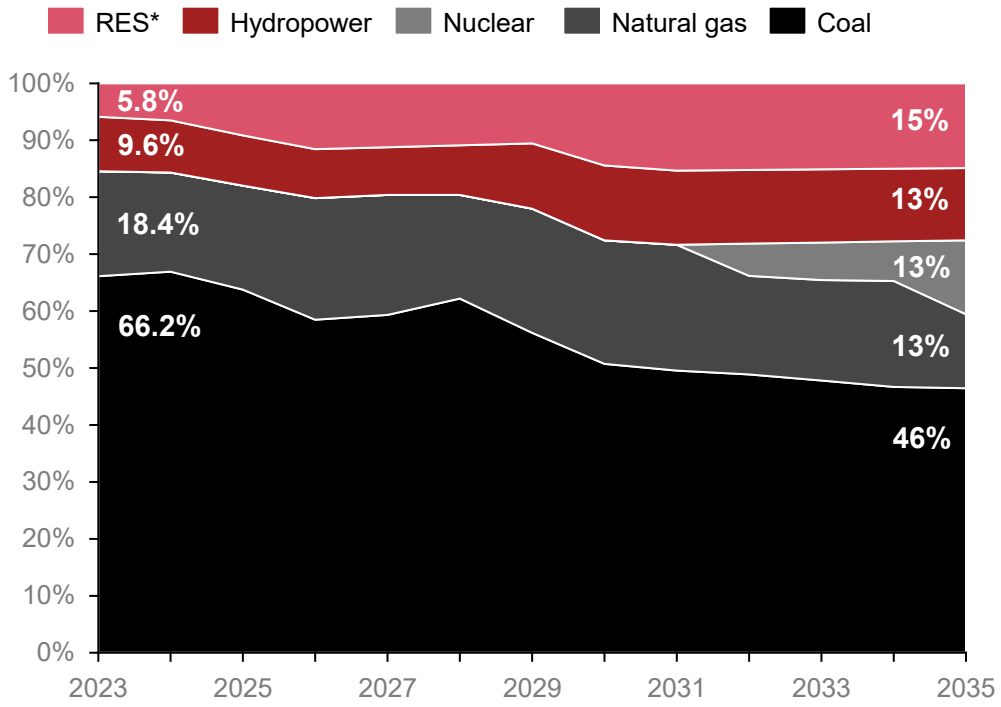
Tax benefits when expanding production

Exemption from corporate income tax for a period of 3 years.

Sources: Open sources, official documents

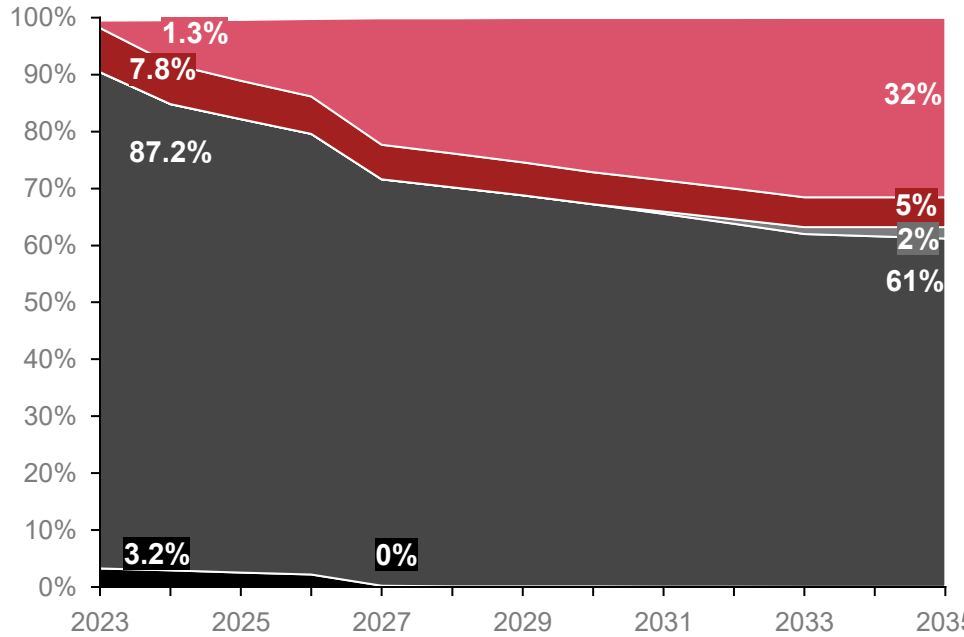
Despite this, coal in Kazakhstan and natural gas in Uzbekistan continue to serve as the cornerstone of each country's energy security and self-sufficiency

Power generation, 2023-2035, Kazakhstan



- Despite decarbonization efforts, coal is projected to remain Kazakhstan's primary energy source, comprising over 40% of the energy mix by 2035.
- The projected share of renewables aligns with the government's 15% target by 2030, though this may be insufficient given the sustained dominance of coal.

Power generation, 2023-2035, Uzbekistan



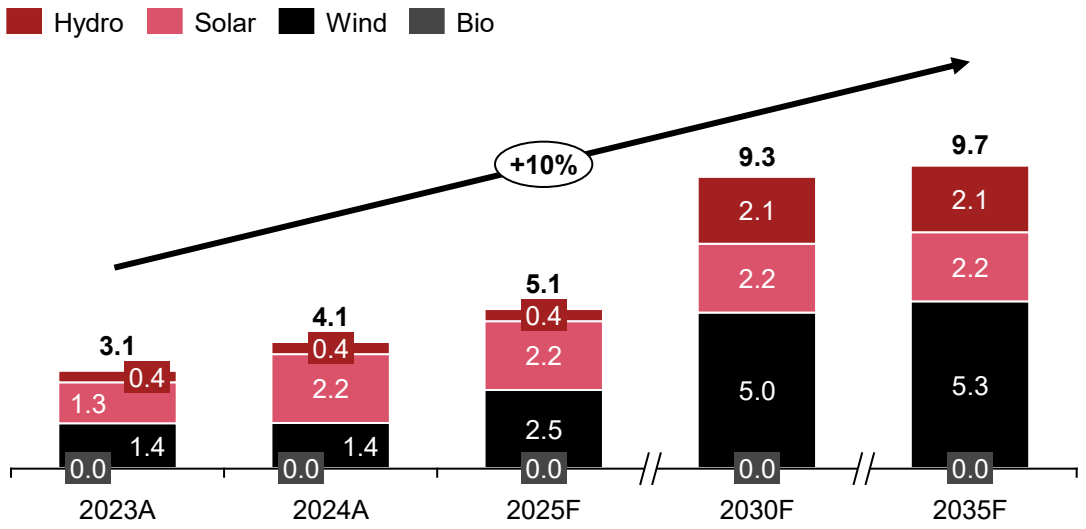
- In Uzbekistan, natural gas currently dominates the power sector and is expected to remain the primary source.
- Despite this, Uzbekistan's renewable energy ambitions are two times higher than Kazakhstan's, forecasted to reach around 30% by 2035.

*RES does not include Hydroelectric Power Plants (HPP)

Sources: Ministry of Energy KZ, Fitch Solutions

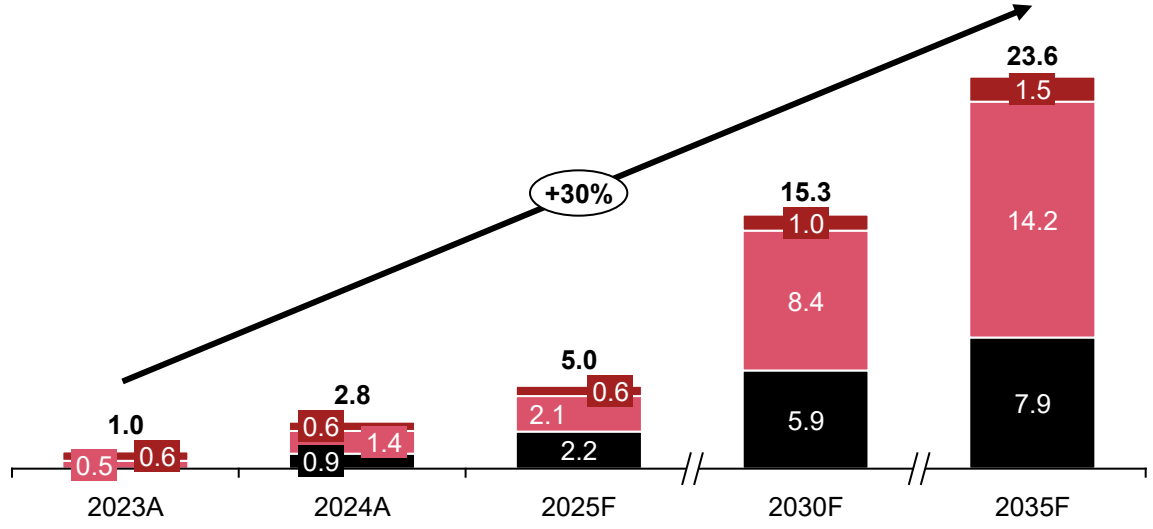
Both countries have taken initial steps toward diversifying their systems through renewable energy development

Total installed capacity of RES facilities in Kazakhstan, GW



- **Kazakhstan** has experienced steady growth in renewable energy capacity since 2013, supported by favorable legislation.
- **Wind farms** are widely deployed in both countries, offering up to 30% higher output than solar despite comparable per-MW investment costs.
- **Kazakhstan** is expected to have nearly half of its renewable capacity from **wind** power, driven by its strong wind resource potential.

Total installed capacity of RES facilities in Uzbekistan, GW

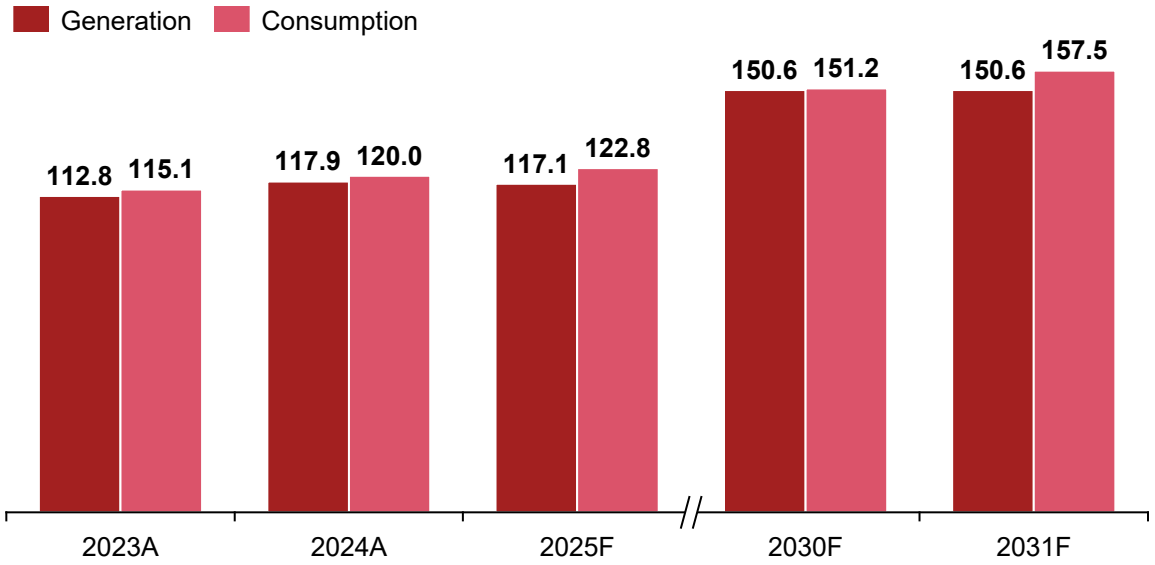


- In contrast, **Uzbekistan** has rapidly accelerated its renewable energy development since the early 2020s, with future projections indicating that its installed capacity and share of renewables in the energy mix will surpass those of Kazakhstan.
- In both countries, **solar plants** dominate due to quicker construction and simpler logistics and maintenance.
- **Uzbekistan** is set to significantly expand its solar capacity by 2035, making use of its advantageous climate and geographic potential.

Sources: Ministry of Energy KZ, Ministry of Energy UZ, National Committee of the Republic of Uzbekistan on Statistics, Fitch Solutions

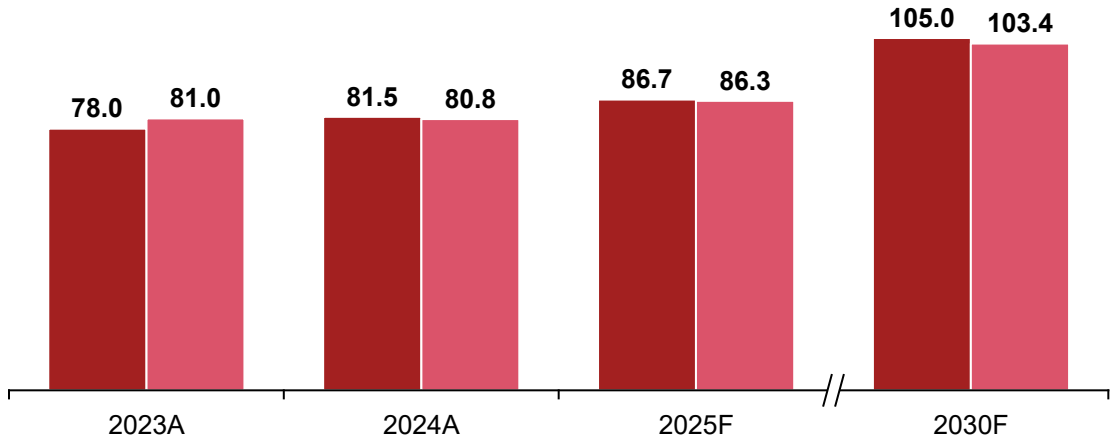
With electricity consumption projected to rise, Kazakhstan and Uzbekistan should prioritize expanding RE generation capacity

Electricity generation and consumption in Kazakhstan, TWh



- Although electricity consumption and generation are expected to increase, a supply deficit is forecasted to remain. A temporary surplus is projected between 2027 and 2029.
- Given the projected supply deficit, and considering the relatively low forecasted share of renewable energy sources, expanding generation capacity, particularly through additional RES development, should be prioritized.

Electricity generation and consumption in Uzbekistan, TWh*



- In contrast, Uzbekistan is forecasted to largely meet its future electricity consumption needs, with a slight surplus.
- According to Uzbekistan's Ministry of Energy, electricity demand is expected to grow steadily through 2030, prompting the need for new generation sources. In response, the country has adopted a program to develop solar and wind power capacity.

Sources: Ministry of Energy KZ, Ministry of Energy UZ, Samruk Energy analytical overview 2024, Bureau of National Statistics of KZ, CIS Electric Power Council Executive Committee, Fitch Solutions

*According to Uzbekistan's Strategy 2030, it is planned to increase electricity production to 120 billion kWh by 2030. However, we used a more conservative forecast based on historical actual figures and growth rates provided by Fitch Solutions.

Investments have been pivotal in the development of energy transition projects, significantly contributing to the construction of RES

Funding structure in Kazakhstan

$2.6B+ Investments in renewables from 2014 up to the end of 2024

- IFIs supply about **70%** of the capital for Kazakhstan's renewables boom, with foreign direct investment (FDI) accounting for 31% of all FDI inflows from 2015 to 2022.
- The Kazakh government's direct budget spending is limited, relying more on private investment backed by IFI loans, while state entities like the Development Bank of Kazakhstan (DBK) and Eurasian Development Bank (EDB) play key roles; a shift to competitive tenders in 2018 has attracted over 230 companies from 13 countries.

Funding structure in Uzbekistan

$6B Investments in renewables from 2019 to 2024, attracted in foreign investment

- Development bank support is used predominantly for projects involving FDI or PPP ventures, where foreign companies provide equity and debt, with Multilateral Development Banks (MDBs) often catalyzing or insuring the projects.
- Local banks play a minor role in large projects; competitive PPP tenders, such as Scaling Solar/Wind, have attracted diverse investors like Masdar and ACWA.

Funding allocated by each IFI

THE WORLD BANK	~$0m*	~$160m
IFC	~$0m*	~$280m
European Bank for Reconstruction and Development	~$535m	$870m+

ADB	~$42m	~$110m
AIIB	~$83m	~$145m

*Note: No dedicated WB/IFC loans for RE generation (support mainly via policy reforms – e.g. a $600 million "green" DPO loan in 2024).

Key investors and partnerships

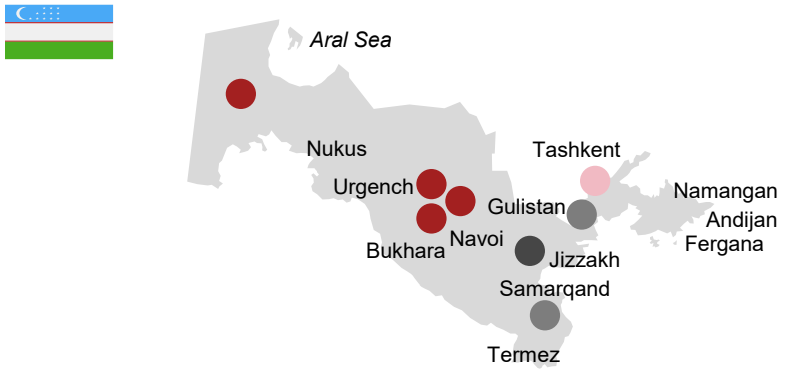
- Total Eren (France) has projects in **both countries**
- PowerChina has bid in **both countries**
- In 2023, ACWA Power (Saudi Arabia) expressed **interest in Kazakhstan** following their **success in Uzbekistan**
- **Gulf investors**, such as Masdar and ACWA, are **more prominent in Uzbekistan**,
- **Kazakhstan** attracts **European utilities** like Italy's ENI and Germany's Samruh-Solar collaboration, along with Russian and Chinese capital in certain projects.

TOTAL eren 中国电建 POWERCHINA ACWA POWER

Detailed information is available in section 5 on Green Finance

Sources: AIFC, QazaqGreen, Government portal of UZ, Energomost, open sources

Kazakhstan and Uzbekistan recognize the critical importance of energy transition and have implemented numerous projects, with more planned for the future



	Examples of projects implemented in Kazakhstan	Examples of projects implemented in Uzbekistan
Renewable energy (RE) projects	• Yereymentau Wind Farm (45 MW) • Saran Solar Plant (100 MW) • Burnoye Solar 1 and 2 Plants (50 MW each) • Masdar will develop a 1 GW wind power plant in the Zhambyl region	• Zarafshan Wind Farm (500 MW) by Masdar • Bash Wind Farm (500 MW) by ACWA Power • Nur Navoi Solar Park (100 MW) by Masdar • ACWA Power plans to build a 1.5 GW wind power plant in Karakalpakstan
Transmission	• West Kazakhstan Electricity Transmission Interconnection project - **$300 million,** EBRD and the DBK	• Transmission Modernization Program in Uzbekistan - **$500 million** (ADB and AIIB)*
Nuclear Energy	• **Kazakhstan** is developing **nuclear energy** and is currently planning construction of its first plant.	• **Uzbekistan** signed an agreement with **Russia** to construct a **small 330 MW Nuclear Power Plant (NPP)**
Cleaner energy alternatives	• Almaty Combined Heat and Power Plant 2 - €252 million loan by the EBRD, aimed at **replacing coal with natural gas** to lower CO_2 emissions	• $1.3 bn in **waste-to-energy projects** in collaboration with companies from China, the UAE, and South Korea
EV adoption	• **Astana Motors**, in collaboration with Chinese TELD, will invest $12 million to build **250 EV charging stations** in Astana, Almaty, and Shymkent by 2028	• In 2024–2025, **Uzbekistan** will install **32,400 EV charging stations** to expand EV charging infrastructure

Sources: Open sources, Masdar, ACWA Power, Astana Motors, Samruk Energy official websites

*The project locations have not been determined yet due to the need for detailed planning and coordination with local authorities and stakeholders.

Despite significant efforts, infrastructural, regulatory and financial barriers hinder further energy transition

Comparison of the main barriers by their level of prominence

	Barrier	Kazakhstan	Uzbekistan	Description
1	Lack of implementation strategies	●	●	Both countries have ambitious targets for energy transition, yet they lack detailed implementation strategies and actionable plans necessary for achieving these objectives.
2	Infrastructure & technical constraints	◕	●	The electrical grid is outdated and in need of modernization, including digitalization and enhanced system flexibility, to effectively support RES.
3	Lack of a robust regulatory framework	◕	◕	Kazakhstan's regulations are frequently changing, creating uncertainty, while Uzbekistan is still in the early stages of developing its regulatory base.
4	Tariff-related issues	◕	◕	Electricity tariffs in both Kazakhstan and Uzbekistan are government-regulated, often set below cost-recovery levels, which limits incentives for investment in renewable energy.
5	Financial barriers and investment risks	◑	◑	Infrastructural energy projects are highly capital-intensive, yet they remain unattractive to private investors due to persistent regulatory and technical barriers.
6	Lack of competency	◑	◑	There is a shortage of qualified specialists, technicians, and government officials with the expertise to evaluate and approve related projects.

● Highly pronounced barrier ◑ Moderately pronounced barrier ○ Weakly pronounced barrier

Sources: Open sources, interviews, PwC analysis

Further growth of RES capacities is constrained by several barriers (1/6)

Lack of implementation strategies

Lack of Consistency and Enforcement

- Kazakhstan aims for carbon neutrality by 2060, but lacks a clear implementation framework. The current National Development Plan (to 2029) outlines broad priorities without concrete, sector-level decarbonization measures, leading to fragmented efforts based on outdated strategies.
- In 2024, a government-affiliated institute was tasked with developing a comprehensive roadmap across 18 focus areas to bridge this gap.

Fossil Fuel Dependency in Strategic Plans

- Although Kazakhstan has joined international climate agreements, it continues to subsidize the coal industry and approve fossil fuel projects, including several new coal power plants announced in 2023.
- The absence of binding requirements to incorporate climate targets into planning at the ministerial, regional, and state enterprise levels hinders cross-sector alignment.

- Key strategic documents often present conflicting or inconsistent goals regarding the use of RES, creating confusion among stakeholders and undermining long-term planning. Moreover, the country expresses ambitious intentions that might seem slightly optimistic.
- The lack of binding national commitments and a clear action plan related to international climate agreements, such as the Kyoto Protocol and the Paris Agreement, further weakens accountability and slows progress toward a sustainable energy transition.

- Uzbekistan has yet to commit to achieving carbon neutrality in the foreseeable future. The lack of a clear target may imply the possibility of continuing investments in fossil fuels at this stage. However, without a clear plan for transitioning to carbon neutrality, such a strategy risks postponing the necessary changes for sustainable energy transformation.

Key takeaways:

- Both countries lack clear implementation strategies to support their energy transition goals, resulting in fragmented planning and inconsistent sectoral alignment.
- Despite climate commitments, both continue to invest in fossil fuel projects and maintain subsidies that hinder clean energy competitiveness.
- Kazakhstan has set a carbon neutrality target by 2060 and initiated work on a national roadmap, while Uzbekistan’s strategic documents remain less coordinated and often present conflicting goals.
- Neither country has binding mechanisms to enforce climate targets across ministries or sectors, weakening accountability and slowing progress.

Sources: Open sources, interviews, PwC analysis

Further growth of RES capacities is constrained by several barriers (2/6)

Infrastructure and technical limitations

Lack of Balancing Capacities

- Most gas turbines are isolated from the central grid, and energy storage remains minimal due to high costs.
- The system lacks the flexibility needed for efficient renewable integration. Coal plants are slow to ramp, and despite plans for 6.5 GW of gas capacity and 3 GW of storage, only a 7.5 MW storage pilot is currently operational.

Outdated Infrastructure

- Aging infrastructure further compounds the issue: over one-third of power plants are 70–90% worn out, with some regional grids experiencing up to 97% deterioration.
- This results in frequent outages, technical losses of up to 17%, and increasing system failures, all of which threaten the integration of new renewable capacity.

Lack of Digitalization

- The lack of smart grid infrastructure (e.g. real-time monitoring, automated dispatch, advanced forecasting, responsive storage systems) prevents efficient integration of variable renewables (*for further details, see our previous report*).
- Market participants also lack access to real-time data on imbalances, reserves, and prices, further limiting system flexibility.

- Uzbekistan's grid is not yet prepared to serve sudden spikes in electricity demand, especially with a growing share of renewables, leading to increased risks of outages and energy losses during peak periods due to limited capacity to meet sharp consumption surges.
- Surplus electricity generation from RES challenges storage capacity, which is costly and raises the overall expense of the power generation complex.

- Experts report that power lines operate at 90% capacity, while their optimal load is 60%. During peak periods, they hit 100%, leading to shutdowns. The necessity to extend separate power transmission lines arises because outdated infrastructure prevents the efficient transfer of electricity through existing lines, which complicates energy distribution and limits access to reliable power sources.
- Nowadays, transmission losses account for about 15% of total electricity generation (2020 – 2023).

- Modern smart grids provide real-time energy management and system flexibility, and without them, efficient energy utilization and distribution are hindered. The lack of digitalization, including systems like SCADA (Supervisory Control and Data Acquisition), obstructs optimization and reduces resilience to disruptions.

Key takeaways:

- Both Kazakhstan and Uzbekistan face challenges in deploying renewable energy due to aging energy infrastructure, limited balancing capacity - such as flexible generation and storage - and a lack of digital tools like automated dispatch and real-time grid monitoring systems.

Sources: Open sources, interviews, PwC analysis

Further growth of RES capacities is constrained by several barriers (3/6)

Lack of a robust regulatory framework

Policy Inconsistency and Uncertainty

- Frequent changes in renewable energy support schemes create regulatory instability.
- Lack of long-term investment security discourages private sector participation in the renewable energy sector.
- Grid connection for renewables is complex, costly, and lacks procedural clarity.
- There is no guaranteed priority access for renewable energy, which delays project development.

Electricity Market Design and Balancing

- The balancing market, introduced in 2023, does not incentivize accurate forecasting, flexibility, or renewable integration. Balancing prices are based on a cost-plus model rather than market pricing, distorting investment signals.
- RES are excluded from the balancing market due to the absence of imbalance compensation and undefined financial responsibility for deviations. This leads to cross-subsidization and limits market participation, particularly for new entrants.

- Ambitious targets exist, but there is no formal roadmap for phasing out fossil fuels, target indicators are not always clear and create the possibility for different interpretations.
- Different target indicators are found in different key strategic documents which leads to lack of clarity and creates confusion for stakeholders.

- The current regulatory framework is in the process of transformation, as the sector is currently being reformed to take into account the increased involvement of private sector. So the sector is on the path of creating electricity market considering the reduction of regulation by the state. Thus there is still no clear and defined regulatory landscape.

Key takeaways:

- Both Kazakhstan and Uzbekistan face regulatory uncertainty and limited institutional capacity, which continue to deter renewable energy investment. However, Uzbekistan has seen comparatively stronger investor interest, supported by recent policy reforms and international partnerships.
- Kazakhstan lacks stable support schemes and fair grid access.
- Competitive market structures remain underdeveloped in both, with Kazakhstan excluding RES from balancing and Uzbekistan lacking a wholesale market.

Sources: Open sources, interviews, PwC analysis

Expert opinions on challenges and barriers

To support the development of the energy transition, we expect targeted government measures that can enhance the viability and attractiveness of low-carbon projects. These include financial subsidies or tax incentives for renewable energy and low-carbon initiatives, state guarantees to facilitate access to external financing, and the establishment of a carbon market or regulatory framework that encourages the adoption of green technologies. Such support mechanisms are seen as essential for accelerating investment and ensuring long-term sustainability in the sector.

Aizhan Baimagzumova

Head of Sustainable Development Office in KMG

The regulatory environment significantly influences the development of the energy transition, presenting both enabling and constraining aspects.

On one hand, there is government support reflected in strategic documents, renewable energy support mechanisms, and the signing of intergovernmental agreements and protocols, which create favorable conditions for investment and a foundation for stable development.

However, there are also challenges, such as complex administrative procedures, insufficient predictability and long-term consistency of changes. The current tariff policy for conventional generation does not always reflect the investment needs of the sector, making it less attractive compared to renewable energy sources.

Dinara Kumasheva

Author of decarbonization scenarios and co-author of the Low-Carbon Development Program of JSC Samruk Energy

Sources: Interviews

Further growth of RES capacities is constrained by several barriers (4/6)

Tariff-related issues

- Electricity tariffs in Kazakhstan remain heavily regulated under a cost-plus model, limiting incentives for efficiency, innovation, and low-carbon investment.
- Current tariffs do not reflect actual generation, grid, or environmental costs, distorting market signals and disadvantaging renewables and storage.
- Conventional power tariffs are often kept artificially low for political and social reasons, hindering the competitiveness of cleaner alternatives.
- The absence of time-of-use and location-based pricing reduces demand-side flexibility and discourages efficient grid use.
- Without comprehensive tariff reform, progress on the energy transition may stall.
- A national modernization project launched in late 2024 aims to eliminate cross-subsidies, adopt cost-reflective pricing, and introduce progressive tariffs to protect low-income consumers.
- *More detailed analysis on this issue can be found in our 2022 report.*

- Given that the electricity sector is still significantly regulated by the state, including tariff controls, the increase in electricity prices is artificially limited by the government in order to maintain stable and affordable prices for consumers.
- However, this situation places a burden on the state budget, as price increases are restrained through government subsidies to electricity producers. This, in turn, negatively affects the producers of electricity.
- Additionally low retail electricity tariffs reduce the market's attractiveness for private and foreign investors. Economically unviable pricing limits return on investment, especially in capital-intensive sectors like renewables.
- This hampers private capital inflow, slows infrastructure modernization, and delays the development of a competitive energy market.
- According to the presidential decree, the schedule for adjusting fuel and energy prices for 2024–2025 has been amended, postponing the price increase from April 1 to May 1. Electricity and natural gas prices will be indexed annually from May 1, based on inflation, with a cap of 10%.

Key takeaways:

- Both Kazakhstan and Uzbekistan maintain artificially low electricity tariffs, which discourage investment in renewables and delay market development.
- Both countries are gradually shifting toward cost-reflective pricing, though reforms remain politically sensitive.
- Uzbekistan has moved faster, with staged tariff increases starting in 2023-2024, while Kazakhstan's major reforms were only launched in late 2024.
- Kazakhstan still lacks time-of-use and location-based pricing, further limiting efficiency and grid flexibility.

Sources: Open sources, interviews, PwC analysis

Further growth of RES capacities is constrained by several barriers (5/6)

Financial barriers and investment risks

- Over $25 bn is needed by 2029 to upgrade aging infrastructure and expand renewables in Kazakhstan.
- Low and regulated electricity tariffs, policy uncertainty, and limited local financing capacity deter private investment.
- Many projects depend on foreign loans, exposing them to currency risk from tenge depreciation, especially for grid and flexible capacity.
- Competitive auctions have helped reduce tariffs for new renewable and gas-fired capacity, but overall progress remains slow.
- The government seeks international support through mechanisms like the Just Energy Transition Partnership (JETP) to close the funding gap.

- Uzbekistan is undergoing a large-scale reform of its energy sector, shifting from state dominance toward a more market-oriented model with increased private sector participation.
- This transition is accompanied by a high degree of uncertainty, particularly due to the unpredictability of tariff policies and the risks of regulatory changes.
- The shift to green energy in Uzbekistan is largely being implemented through foreign companies - both in terms of designing and constructing renewable energy facilities and providing financing.
- This approach may lead to several challenges: limited transfer of knowledge and technology, external dependency, and difficulties in exercising control over critical infrastructure.

Key takeaways:

- Both governments seek international support and are implementing reforms to improve investment conditions and accelerate clean energy growth.
- Kazakhstan faces financing challenges, whereas both Kazakhstan and Uzbekistan face regulatory uncertainty that may hinder private investment in energy transition.
- Kazakhstan needs over $25 bn by 2029 and relies on foreign loans, exposing projects to currency risk.
- Uzbekistan is introducing financial tools such as green bonds and PPPs to attract investment and directly address financial barriers, including limited public funding and high project risks in a still-evolving regulatory environment.

Sources: Open sources, interviews, PwC analysis

Further growth of RES capacities is constrained by several barriers (6/6)

Lack of local competency

- In both Kazakhstan and Uzbekistan, most of the workforce remains trained primarily for legacy fossil fuel systems, resulting in significant skill gaps in renewables, energy efficiency, and grid flexibility critical for energy transition.
- Existing training programs are insufficient to meet demand, causing continued dependence on foreign experts and slowing project timelines.
- The underdeveloped local manufacturing sector forces reliance on imported renewable energy components, which raises costs and hinders domestic technology transfer and industry growth.
- Capacity constraints within public institutions, including limited technical expertise to assess and approve complex energy transition projects, can contribute to delays and regulatory uncertainty, potentially affecting investor confidence.

> Despite significant investments in the renewable energy sector, and the successful implementation of solar and wind energy projects, our countries are facing a critical shortage of qualified personnel, and we still remain dependent on imported labor. To ensure sustainable development, it is imperative to establish specialized educational programs and institutions capable of preparing professionals for the innovative renewable energy sector.
>
> **Bahtiyor Eshchanov**
>
> **Energy economist | Professor | Consultant**

Key takeaways:

- Both Kazakhstan and Uzbekistan face skill gaps in renewables and rely heavily on foreign experts due to insufficient local training and education programs.
- Both countries have underdeveloped local manufacturing or industrial bases for renewable technologies, increasing costs and limiting domestic growth.
- Limited technical capacity in public institutions can delay project approvals and reduce investor confidence.

Sources: Open sources, interviews, PwC analysis

Expert opinions on challenges and barriers

As consultants working closely with the metals and mining sector, we see firsthand how energy-intensive industries are both vulnerable to transition risks and uniquely positioned to lead. The shift to renewables, energy efficiency, and low-carbon technologies is not just a climate imperative - it's a strategic necessity for competitiveness in a world shaped by CBAM, ESG scrutiny, and volatile fossil fuel markets.

Kazakhstan's ERG case, for example, illustrates how industrial players are investing in wind power, digitalization, and internal carbon pricing to future-proof operations. Uzbekistan, meanwhile, is scaling up solar capacity while navigating grid constraints and regulatory gaps.

Askar Kukeyev

Senior Manager at Strategy&, leading the Metals & Mining and Energy practices

Once again, we have seen the critical importance of strategic planning and long-term partnerships. Renewable energy and energy efficiency projects require significant investment and long implementation cycles. Our collaboration with international partners such as Total Energies, China Power International Holding, and MASDAR, as well as strategic agreements with governments, demonstrates that success is achieved through the pooling of resources, expertise, and shared goals. Without a clear vision and reliable partners, it is difficult to ensure the necessary momentum.

Dinara Kumasheva

Author of decarbonization scenarios and co-author of the Low-Carbon Development Program of JSC Samruk Energy

Sources: Interviews

4

Case studies in Kazakhstan and Uzbekistan

Companies already introducing energy transition initiatives

For the case studies, the most prominent companies from Kazakhstan and Uzbekistan were chosen, as they are key players in sectors such as energy, oil and gas, and metals and mining.

These firms are not only leaders in their respective fields but are also actively embracing energy transition practices.

Key Initiatives

- **Emissions reduction goals:** Companies in both Kazakhstan and Uzbekistan have established targets for reducing emissions, with several committing to achieve Net Zero, including Samruk Energy, ERG, and Uzbekneftegaz.
- **Renewable energy initiatives:** Companies in Kazakhstan and Uzbekistan are actively investing in and developing renewable energy plants, primarily focusing on solar power, while Kazakhstani firms are also working on wind energy projects.
- **Energy efficiency measures:** All companies are adopting practices aimed at enhancing energy and operational efficiency, which helps lower their operating expenses by modernizing equipment and improving monitoring systems through digitalization. Uzbekneftegaz is particularly focused on a digitalization program to boost the efficiency of natural gas production.
- **Development of low-carbon technologies:** In comparison, Kazakhstan is advancing more low-carbon technologies than Uzbekistan. KazMunayGas and Samruk Energy have made investments in carbon capture technologies, while KazMunayGas is also investing in SAF, EV charging infrastructure, and hydrogen technologies.

Key Challenges and Lessons learned

- **Technological challenges:** Companies cite complexities in the transition and issues specific to their industries, along with the intermittent nature of renewables.
- **Aging infrastructure:** There is a need for infrastructure upgrades, which hinders further digitalization and integration of renewables.
- **Administrative hurdles:** Approval and permitting processes remain bureaucratic, with complications in land allocation.
- **Regulatory ambiguity:** Fluctuating regulations complicate long-term planning and investment, with companies highlighting the need for government support.
- **Significant capital expenses:** High upfront costs related to RES and modernization are a major barrier, prompting companies to seek financing and government aid.
- **Importance of strategic planning:** Many companies stress the need for strategic planning to support energy transition initiatives.
- **Essential international collaborations:** Partnerships with more experienced entities are crucial for successful implementation due to limited local expertise.
- **Social dimensions of energy transition:** Establishing relevant culture must be considered, as it impacts the transition's success.

Sources: Open sources, interviews, PwC analysis

KZ: Samruk Energy case – Energy Generation

Strategic goals and energy transition strategy

Strategic goals

30%
Net carbon emissions reduction by 2031 from 2021 level

100%
Net carbon emissions reduction by 2060 (net zero)

35%
Share of clean electricity (RES and HPP) in total generation by 2031

Progress by 2023

3%
Net carbon emissions reduction

8%
Share of clean electricity (RES and HPP) in total generation

947.1MW
RES installed capacity (including 790MW HPP)

Energy transition journey

Renewable and alternative energy initiatives

- Samruk-Energy has adopted a long-term Energy Transition Program through 2060, aiming to reduce its carbon footprint in line with global and national climate policy trends.
- The company is expanding renewables while transitioning thermal plants from coal to gas. In 2024, a 1 GW renewables roadmap was approved, strategic agreements were signed with Qatar for the Semey HPP, and a 1 GW wind project with energy storage is planned with TotalEnergies. Renewable generation by Samruk-Energy grew by 4.2%.
- A dedicated working group led by the Chairman of the Management Board oversees the implementation of the transition plan, with a strong focus on regulatory engagement, ESG integration, and international cooperation.

Energy transition journey

Emissions reduction and energy efficiency measures

- Automated emission monitoring systems have been installed at major power stations (GRES-1, GRES-2, and ALES) to track environmental impact in real time.
- The company is investing in CCUS technologies and chemical byproduct recovery through R&D, aiming to reduce GHG emissions.
- Green financing tools are being utilized, including the sale of carbon offsets from renewable energy facilities and the use of low-emission coal burners.
- The company is modernizing infrastructure and boosting energy efficiency through new substations, grid optimization, and offset initiatives. In 2024, Samruk-Energy saved **258,229 tons of fuel** - cutting CO_2 emissions by **~800,000 tons**.

Sources: Samruk Energy Annual Report 2023, interview excerpts

KZ: Samruk Energy case – Energy Generation

Main challenges and lessons learned during implementation of energy transition

Main challenges

- **High capital costs and long payback periods** make RES and infrastructure modernization projects financially demanding, especially in volatile markets.
- **Regulatory uncertainty and administrative barriers** - such as land allocation, permitting, and tariff-setting - can delay project implementation and deter investment.
- **Technological limitations**, including the intermittency of RES and the high cost and immaturity of large-scale storage systems, hinder grid stability.
- **Modernization of base-load generation** is critical for energy security, but lacks sufficient regulatory and financial support, especially for integrating CCUS technologies.
- **Grid infrastructure is outdated** and not fully compatible with decentralized generation, requiring major investment in smart grids.
- **The regulatory environment is mixed**, with strategic support at the national level but challenges in predictability, long-term consistency, and adequate tariffs for base-load power.

Lessons learned

- **Strategic planning and long term partnerships are vital** for delivering capital-intensive, long-cycle RES and energy efficiency projects.
- **Flexibility is key**, as the energy transition requires adapting to evolving technologies, regulations, and markets.
- **Innovation enhances resilience**, with energy storage and CCUS technologies improving system stability and sustainability.
- **The transition brings socio-economic opportunities and risks**, requiring proactive planning and risk management.

> The energy transition is not a linear process; it involves technological changes, regulatory adjustments, and market fluctuations. The ability to respond promptly to evolving requirements is a key factor in achieving our goals. We continuously analyze and adjust our plans in response to new data and opportunities. This allows us to optimize resources and make timely decisions.
>
> **Dinara Kumasheva**
>
> **Author of decarbonization scenarios and co-author of the Low-Carbon Development Program of JSC Samruk Energy**

Sources: Interviews, PwC analysis

KZ: KazMunayGas case – Oil and Gas

Strategic goals and energy transition strategy

Strategic goals

15-64%	15-60%	15-50%	32-96%
Net carbon emissions reduction by 2031-2060 (compared to 2019)	Carbon intensity reduction of production by 2031-2060	Share of RES in electricity consumption by 2031-2060	Reduction of methane emissions by 2031-2060

Progress by 2024

+2%	+2%	+30%	0.089%
Net carbon emissions	Energy and carbon intensity	Methane emissions	Share of energy consumed from RES

Energy transition journey

Key directions of KMG's decarbonization

- By adopting Low-Carbon Development Program 2060, KazMunayGas sets goals for the carbon reduction, by developing energy efficient measurements, RES, methane monitoring systems.
- A hybrid power plant (247 MW) is under development in Zhanaozen with Eni; early construction is complete, and equipment installation is underway.
- The 1 GW Mirny wind project with storage in Zhambyl region is progressing with Total Eren - feasibility studies are done, wind potential assessed, and equipment supplier selected.
- KazMunayGas is exploring the prospects of sustainable aviation fuel (SAF) production in Kazakhstan. Currently, a feasibility study is under development.

Energy transition journey

- To assess and reduce methane emissions, KazMunayGas has conducted three measurement campaigns at its upstream assets and reports annually under the OGMP 2.0 framework.
- KazMunayGas is implementing energy efficiency programs across upstream, midstream, and downstream segments. In 2024, 70 initiatives saved 2.36 million GJ equivalent to 174.9 thousand tons of CO_2 emissions.
- KazMunayGas in collaboration with Baker Hughes and Chevron, is exploring the possibility of implementing a pilot carbon capture and storage (CCUS) facility.
- Development of Hydrogen Energy: a pilot project for green hydrogen production is being implemented in Atyrau in collaboration with Green Spark Limited.
- In partnership with Chevron, a reforestation offset project is underway, aiming to establish a green zone covering 1,600 hectares near the city of Pavlodar.

Sources: KMG Annual Report 2024, interview excerpts

KZ: KazMunayGas case – Oil and Gas

Main challenges and lessons learned during implementation of energy transition

Main challenges

- **Limited local availability of CCUS**, hydrogen and methane reduction technologies
- **Limited local availability of equipment for RES**, import dependence for equipment and technological solutions
- **Shortage of qualified personnel** in the field of ESG and energy audit, as well as infrastructure for new technologies (for example, production of SAF or green hydrogen)
- **High interest rate** (high cost of capital) in the context of rising global rates and macroeconomic instability
- **Co-financing necessity for large-scale projects**, hence the need for additional guarantees from the state to attract investors
- **Long-term payback** of low-carbon projects

Lessons learned

- **Long-term government support** in the form of tax incentives and tariff regulation is necessary
- **Attracting and cooperating with international technology and investment partners** (experience with Eni, Total Eren, Sinopec, SIBUR, etc.) provides access to best practices and technologies
- **A systematic approach** to ESG risks is required
- Energy transition requires not only technological but also **organizational changes**
- **Having a strategic plan** allows you to build long-term partnerships and attract financing more effectively

> While renewable energy projects require significant upfront capital and operational investments, they open access to green financing tools such as sustainable bonds and subsidies. At the same time, these initiatives contribute to long-term sustainability by reducing greenhouse gas emissions, increasing the share of renewables in Kazakhstan's energy mix, creating regional jobs, and promoting energy efficiency and waste minimization.
>
> **Aizhan Baimagzumova**
>
> **Head of Sustainable Development Office in KMG**

Sources: Interviews, PwC analysis

KZ: ERG case – Metals and Mining

Strategic goals and energy transition strategy

Strategic goals

100%
Net carbon emissions reduction by 2050 (net zero)

30%
Carbon footprint reduction of key products by 2035

Progress by 2023

3%
Net carbon emissions (Scope 1 and 2) reduction from 2021 level

150 MW
RES capacity will be installed in 2025

Energy transition journey

Renewable energy and emissions reduction initiatives

- ERG aims for Net Zero by 2050, supported by a Decarbonization Strategy that includes a 30% reduction in the carbon footprint of key products like ferrochrome, aluminium, and iron ore pellets by 2035.
- Renewable energy projects include the construction of a 150MW wind power plant in Khromtau and an 80MW power plant that utilizes ferroalloy off-gas, together expected to reduce CO_2 emissions by up to 1 mln tons.
- Green metallurgy efforts involve building a 2 mln ton hot briquetted iron (HBI) production facility, which will cut CO_2 emissions in the steel value chain by at least 1 mln tons.
- ERG is developing methodologies to calculate and automate the carbon footprint of its products, enabling better transparency and emissions management across the value chain.

Energy transition journey

Low-carbon operations and energy efficiency initiatives

- ERG is implementing energy efficiency projects across its operations, including heat recovery systems, upgraded boilers, and enhanced sintering equipment to reduce energy consumption and emissions.
- The company has adopted a Climate Change Impact and Adaptation Management Policy that integrates carbon costs into investment decisions and promotes low-emission technologies through partnerships.
- The company is also working to reduce its carbon intensity by shifting from coal to cleaner energy sources, while maintaining energy security through a new Energy Security Policy.
- Energy efficiency improvements at the Pavlodar alumina refinery include a simulation digital model of technological process that allowed to develop a program to cut steam consumption by 20%.

Sources: ERG Annual Report 2023, interviews

KZ: ERG case – Metals and Mining

Main challenges and lessons learned during implementation of energy transition

Main challenges

- The sector presents inherent **difficulties in reducing direct technological emissions**. Some solutions, such as carbon capture or inert anodes, are extremely expensive, while others are not yet available in the market
- **Lack of clear and predictable regulatory policy**
- **High barriers to direct access to concessional financing** for green projects, while the conditions of this concessional financing is not sufficiently favorable

Lessons learned

- It is essential to **encourage internal brainstorming and innovations** and **pursue strong synergies** between decarbonization, energy efficiency, cost reduction, and improvements in product quality and value
- In terms of energy efficiency, it is critical to **consistently embed this culture through organizational changes** - at every employee level, primarily through clear communication and continuous awareness-building

> To accelerate the energy transition, we need a stable and supportive regulatory environment. Key expectations include a predictable carbon regulation policy, incentives for industrial energy efficiency, and government guarantees to improve access to project financing.
>
> **Dauren Mendeshev**
>
> **Deputy CEO – Chief Strategy and Transformation Officer in ERG**

Sources: Interviews, PwC analysis

UZ: AGMK case – Metals and Mining

Strategic goals and energy transition strategy

Strategic goals

50%
GHG emissions reduction by 2050 (compared to 2023)

25%
Increase of share of RES use by 2050

Progress by 2023

N/A
Net carbon emissions reduction (base year)

1.17 mt
of waste were transferred for disposal and neutralization

328,000
trees planted across central roads and mahallas in Almalyk

Energy transition journey

Renewable energy and emissions reduction efforts

- In 2023, AGMK installed two PV stations with a combined capacity of 500 kW.
- AGMK improved its emission control by building sulfuric acid plants that capture 95% of exhaust gases, greatly decreasing air pollution.
- AGMK has established a Climate Change Policy, defined targets, and initiated a draft for a climate strategy in collaboration with ADB. This project aims to create a comprehensive plan for effective climate risk management and achieving climate goals.

Energy transition journey

Low-carbon operations and energy efficiency initiatives

- In 2023, AGMK cut its monthly electricity use by 1.56 million kWh (41%) through its solar power system, saving 1.56 bn UZS.
- AGMK's strategy includes upgrading equipment with green technologies and modernizing its vehicle fleet, including electric vehicle purchases, to boost energy efficiency.
- AGMK set up an ESG Department to pursue ESG ratings and Copper Mark certification.
- The company received ISO 50001:2018 certification, indicating a structured energy management approach, and achieved a 17% reduction in energy consumption from 2022.

Sources: AGMK Annual Report 2023, interviews, PwC analysis

UZ: AGMK case – Metals and Mining

Main challenges and lessons learned during implementation of energy transition

Main challenges

- **Modernizing equipment** and **switching to renewable energy** sources **require significant upfront investment.** This includes costs for new machinery, electrical upgrades, and energy management systems. Securing financing and balancing these capital expenses with day-to-day operational needs remains a key challenge.
- **Adapting** existing production processes **to renewable sources** like solar or wind **demands careful planning**. Legacy systems may be incompatible, requiring redesigns or full replacements. Ensuring continuous operations during the transition adds further complexity and risk of production downtime.
- Effective implementation **requires alignment between** technical, financial, and operational **departments**.

Lessons learned

- **Detailed energy audits help** identify key inefficiencies and prioritize areas for optimization.
- **Continuous training is essential** to ensure safe and efficient operation of new energy technologies.
- **Employee engagement and a shift in corporate mindset are critical** for long-term success in the energy transition.

> The shift to energy-efficient solutions requires not only significant financial investment and technical effort, but also a transformation of corporate culture. This process taught us that without employee engagement and a focus on environmental and social aspects, long-term sustainable results are unattainable.
>
> **Davran Dustmetov**
>
> **Head of the Energy Department in AGMK**

Sources: Open sources, interviews

UZ: Uzbekneftegaz case – Oil and Gas

Strategic goals and energy transition strategy

Strategic goals

100%
Scope 1-2 emissions reduction by 2050 (net zero)

35%
Sulfur oxide reduction by 2030

30%
Increase of energy efficiency by 2030

Progress by 2023

7.8%
Scope 1 emissions reduction

2.9%
Scope 2 emissions reduction

Energy transition journey

Renewable energy and emissions reduction initiatives

- Uzbekneftegaz aims to reduce GHG emissions by 25% by 2030 and achieve full carbon neutrality by 2050.
- In 2023, the company reduced Scope 1 emissions by 7.8% and Scope 2 emissions by 2.9%, primarily through equipment upgrades, process optimization, and energy efficiency measures.
- Energy consumption from renewable sources increased nearly fivefold in 2023, reaching 16,739 GJ, driven by the deployment of solar panels, solar thermal generators, and solar water heaters.
- The company implemented 91 renewable energy projects, including solar power plants and GHG to-electricity systems, contributing to a total energy savings of 131,400 GJ and fuel gas savings of 824,381 GJ.

Energy transition journey

Low-carbon operations and energy efficiency initiatives

- The “E-kon” project digitized 1,406 wells and 96 gas gathering points, enabling real-time monitoring of over 800 data points per well per day. This significantly improved gas production efficiency and reduced energy waste and methane leaks - key contributors to emissions.
- The Drilling Control Center introduced 24/7 real-time monitoring of drilling operations, which reduced well construction time and energy use. This supports lower emissions and safer, more efficient resource extraction.
- Uzbekneftegaz implemented automated systems for electricity monitoring (ASKUE), and solar energy tracking (UNG-PMS), all contributing to reduced energy use and improved transparency.
- The company introduced a comprehensive energy conservation plan, fulfilling it by 104.9% and saving 32.9 bn UZS in electricity and 10.86 bn UZS in fuel gas costs.

Sources: Uzbekneftegaz Annual Report 2023, interview

UZ: Uzbekneftegaz case – Oil and Gas

Main challenges and lessons learned during implementation of energy transition

Main challenges

- The deployment of solar stations requires substantial land areas, leading to **difficulties in land allocation** and **securing approval** from local authorities due to the ecological value of these territories.
- **Outdated equipment**, such as compressor stations, needs replacement with more modern solutions. This creates barriers in the transition to electricity and the utilization of renewable sources.
- Although there is an opportunity to obtain loans for green projects, the **company's existing financial resources are insufficient** for a complete transition. The need for additional investments also poses significant challenges.
- For equipment to operate on electricity from renewable sources, **a stable power supply through an energy storage system is essential** to address the inherent supply intermittency.

Lessons learned

- An essential lesson learned is that while **wind energy is efficient, it's often expensive and less practical** than solar in certain areas. Our shift to green energy has reduced our carbon footprint and reliance on thermal power, with energy storage offering social benefits. This emphasizes the **need for strategic planning** in renewable projects for sustainable progress.
- It is also crucial to **select the appropriate capacity** for each facility. We have over 17 generation sites, and 95 MW are distributed among them rather than concentrated in one place. This approach **ensures maximum feasible consumption and economic viability**. However, transitioning to renewable energy may pose challenges, requiring voltage regulation and frequency converters for our power needs.

> Our commitment to ESG principles is focused on improving the company's carbon footprint by incorporating green energy into our production processes. Transitioning from energy generated by thermal power plants will allow us to reduce emissions and decrease reliance on gas. This step enhances our contribution to environmental sustainability and supports clean energy initiatives.
>
> **Mahmud Nigmadjanov**
>
> **Head of ESG Implementation division in Uzbekneftegaz**

Sources: Interviews, PwC analysis

5

Green finance

Sustainable finance is a rapidly growing field that is redefining investment standards, strengthening companies' ESG agendas, and enhancing access to capital

Main principles

- Sustainable finance is a rapidly evolving field that aims to align financial activities with the ESG framework and the UN Sustainable Development Goals (SDG), such as mitigating climate change, promoting social inclusion and enhancing economic growth.
- International Capital Market Association (ICMA) sets out 4 main principles: The Green Bond Principles (2021), Social Bond Principles (2023), Sustainability Bond Guidelines (2021), Sustainability-Linked Bond Principles (2024).
- Sustainable financing takes place through debt and equity instruments (sustainable investing).
- More investors demand credible ESG practices before providing funding, creating both regulatory and financial incentives for sustainable finance.

Types of sustainable finance

Green bond	Green bond is a fixed-income instrument, all proceeds of which are allocated to climate or environmental projects. It can be issued by public, private, or multilateral entities to fund initiatives with clear environmental benefits.
Green loan	Green loan is used exclusively for projects with clear environmental or climate benefits. Unlike green bonds, which are larger and may be traded on stock exchanges, green loans are private agreements between a borrower and a bank.
Sustainability -linked bond	Sustainability-linked bond (SLB) is a fixed income instrument, financial and/or structural characteristics of which are tied to predefined sustainability objectives that support the issuer's overall sustainability strategy.
Sustainability -linked loan	Like SLB, sustainability-linked loan (SLL) is a type of lending arrangement in which the company's borrowing costs are tied to its progress on meeting a certain set of measurable annual sustainability targets (Sustainability Performance Targets).
Social bond	Social bond is a fixed income security, proceeds of which are earmarked to finance projects with a defined social impact, often targeted at vulnerable population groups.
Social loan	Social loan is a type of credit instrument or conditional credit provided exclusively for the purpose of financing, refinancing or guaranteeing of eligible social projects.

Advantages of sustainable financing instruments

01 Stronger resilience and risk management
Sustainable finance helps companies prepare for risks linked to issues spanning from climate-related events to supply chain disruptions. Companies with high ESG standards are better insulated against regulatory changes or environmental impacts.

02 Better access to capital
Sustainable finance products incentivise responsible corporate behavior. Companies meeting ESG benchmarks often qualify for favourable loan terms, lower interest rates, or preferential access to capital.

03 Enhanced brand value and competitive position
Adopting sustainable finance practices demonstrates a company's commitment to ESG principles, which fosters trust among investors, customers and employees, leading to increased sales, employee retention, and stronger business partnerships.

04 Social impact
Sustainable finance promotes inclusive growth by supporting investments in affordable housing, healthcare, and education. It helps reduce social inequalities and supports job creation and economic development in underserved communities.

Sources: PwC Kazakhstan Sustainable finance Go-to-Market report, Nordea, ESGpedia, The Heinrich Böll Foundation, United Nations Global Compact, AIFC GFC: casebook of sustainable development financial instruments

Green financing involves using financial instruments and investments to support environmentally beneficial projects and initiatives that contribute to a more sustainable future

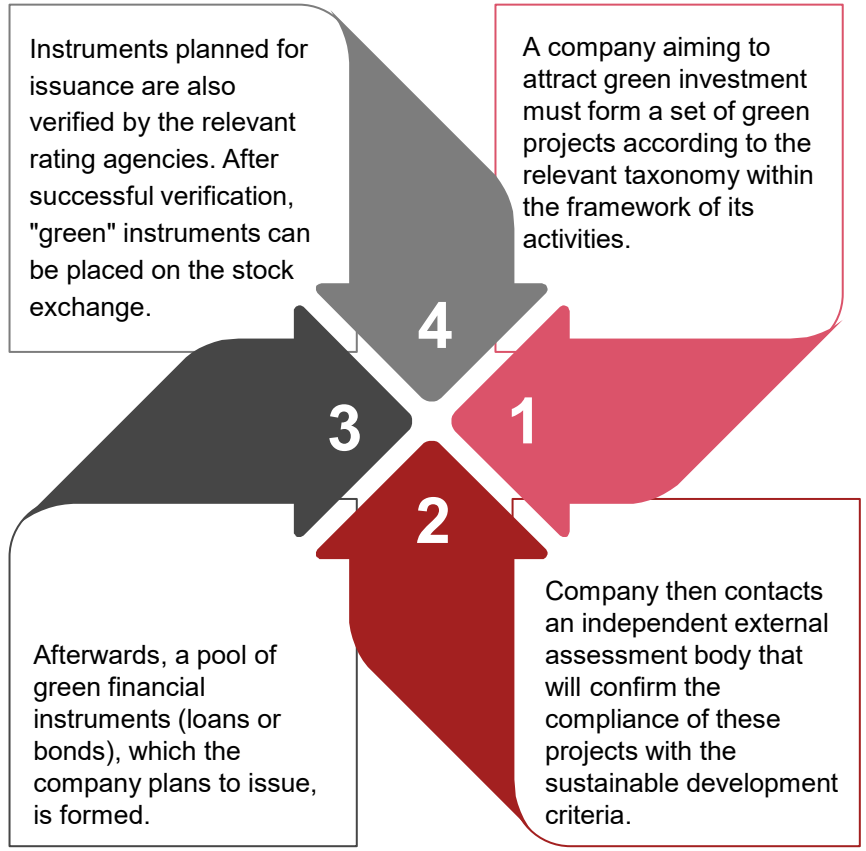
Main principles

- The main instruments of green finance are green bonds and loans. The proceeds from their placement and issuance are used to finance environmentally sustainable projects.
- Green instruments should comply with internationally recognised standards, such as the Green Bond Principles of the ICMA and the Climate Bonds Standard of the Climate Bonds Initiative (CBI).
- To verify green financing instruments, issuers use external assessment in the Second party opinion (SPO) format.

Main types of green finance

Green bond	The proceeds from these special-purpose bonds are allocated to finance eligible green projects that deliver environmentally sustainable benefits. These projects comply with the Green Bond Principles by the ICMA and relevant green taxonomies.
Carbon credit	As part of the GHG emissions trading system, which operates on the cap-and-trade principle, governments or international organisations set an upper limit on permissible GHG emissions through allocated quotas. These quotas are distributed to companies either free of charge or for a fee. Companies that emit less than their allocated quota can sell their surplus to others.
Green loan	Targeted green loans are provided to support the implementation of environmentally beneficial projects. These projects aim to improve the efficiency of natural resource use, reduce environmental impact, enhance energy savings, and mitigate the effects of climate change.
Green project subsidy	Legislative incentives are also offered to support small and medium-sized enterprises (SMEs). These include subsidised interest rates on loans and coupon rates on green bonds, as well as government-backed guarantees to encourage green bond issuance and investment.

General algorithm of obtaining green financing



Sources: AIFC Green Finance Market in Kazakhstan report, AIFC GFC Methodological explanations for the application of the Green Taxonomy report, QazaqGreen, hpbs

Kazakhstan has implemented numerous initiatives in green financing, recognising the critical importance of energy transition

Overview of the sustainable financing sector in Kazakhstan

- Kazakhstan, the first country in Central Asia to adopt green finance standards, has made substantial progress in developing the local sustainable finance market, with over 20 issues of sustainable bonds and loans. As of May 2024, the country's sustainable finance segment has exceeded $1.3bn.
- In 2023, Kazakhstan, announced the release of the first Sustainability-linked bonds (SLBs) in the region: the EDB signed an agreement to finance the reconstruction of Almaty Thermal Power Plant-3 from coal to natural gas-fired plant.
- The government also introduced loan subsidies and bond issuance guarantees for SMEs to encourage further sustainable investments. Moreover, in 2021, the country adopted a National Green Taxonomy. The document sets out the key criteria and types of eligible green projects for financing. A draft social taxonomy is currently under review.

Main active institutions in sustainable financing sector

Astana International Financial Centre (AIFC) aims to promote the transition to a low-carbon economy, by attracting investments and creating a supportive financial ecosystem. The AIFC established the Green Finance Centre (GFC), which accelerates regional transition to a more sustainable economy by establishing a well-functioning sustainable finance market and developing policies and mechanisms.

- AIFC GFC is the only company in Central Asia **accredited by CBI** to verify sustainable finance instruments and included in the External Review Service Mapping of ICMA.
- AIFC GFC is a key institution supporting the verification of about **70% of green bonds/loans** in Kazakhstan.
- The **National Green Taxonomy** was jointly developed by the AIFC GFC and the International Green Technologies and Investment Projects Center.
- The GFC's thorough effort in developing g green financial instruments framework resulted in the **debut issuance of green bonds for Kazakhstan and Central Asia** on the Astana AIX in 2020.

The Kazakhstan Stock Exchange (KASE), established in 1993, is the main financial trading platform in Kazakhstan. It supports the issuance of Sustainable Development Bonds (ESG bonds). To promote ESG financing, KASE provides relief for the payment of listing fees to issuers of sustainable development bonds, as well as appropriate consulting support.

Astana International Exchange (AIX), established in 2017 within the AIFC facilitates the issuance and trading of green and ESG-labelled bonds, supporting projects focused on renewable energy and sustainability.

- The region's **first CBI-certified green bonds** by the Development Bank of Kazakhstan were placed on the AIX in 2023.

Sources: AIFC State Of Sustainable Finance In Central Asia report, EDB press release, The Astana Times, AIFC, AIX, KASE websites

There is a well-developed taxonomy and regulatory framework for the issuers of green financing in Kazakhstan

Requirements to obtain green financing

Green Bond Principles (GBP) of ICMA:

- Use of revenues for environmentally sustainable activities.
- Definition of project eligibility.
- Transparent and verifiable revenue management.
- Annual report on the use of proceeds.

Climate Bonds Standard (CBS) of CBI:

- Full compliance with the CBS.
- Compliance with the criteria for selecting green projects.
- Transparent use of proceeds, monitoring and reporting.
- External audit.
- Independent external control.
- Certification by an external reviewer.

- An applicant needs to satisfy the general listing requirements set out in the AIX Markets Listing Rules.
- Company then completes the AIX Green Bond Application Form, including an explicit declaration of the security as green.
- Applicant should clearly disclose the nature of the use of proceeds into 100% financing or refinancing of green projects in accordance with GBP and/or CBS.
- Company conducts an independent external review of the security before applying to join the AIX.
- Company commits to post issuance reporting.

- Company develops the ESG bond framework. Once the framework is approved, an external verifier confirms its alignment with ICMA, CBI.
- To register the prospectus, company provides the regulator with a framework policy and an independent verifier's report. The prospectus must include details on the intended use of proceeds and project description.
- To list the bonds, company follows regulatory requirements for the listing of regular bonds.
- After the placement, company engages auditors to verify the use of funds and publishes the results.

Green taxonomy

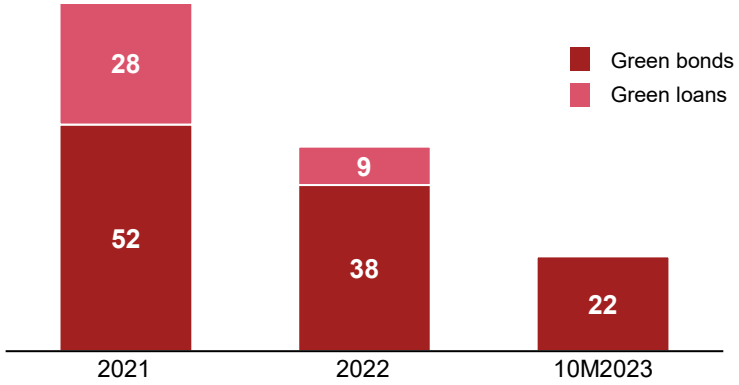
- Taxonomy of Green Projects in Republic of Kazakhstan was approved by the Government Resolution No 996 in 31.12.2021.
- It is a standardised framework for classifying economic activities and assets that promote efficient resource use, reduce environmental impact, enhance energy efficiency, and support climate change mitigation and adaptation.

№	Categories of green projects according to the Green Taxonomy
1	Renewable energy
2	Energy efficiency
3	Green buildings
4	Prevention and control of pollution
5	Sustainable usage of water and waste
6	Sustainable agriculture, land management, forestry, biodiversity conservation, & ecotourism
7	Clean transport

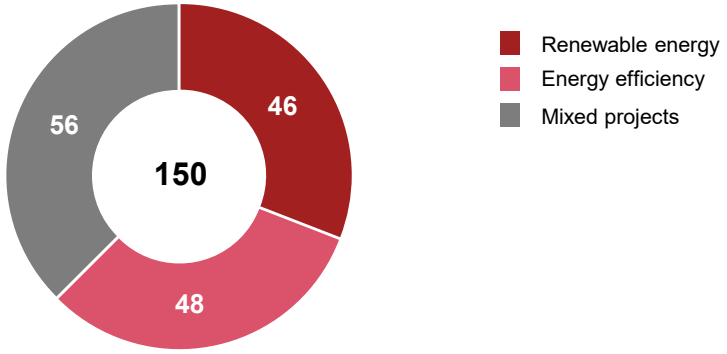
Sources: AIFC Green Finance Market in Kazakhstan report, AIX Green Bonds Rules, KASE website

Kazakhstan’s green financing sector is dominated by the IFIs and major energy companies

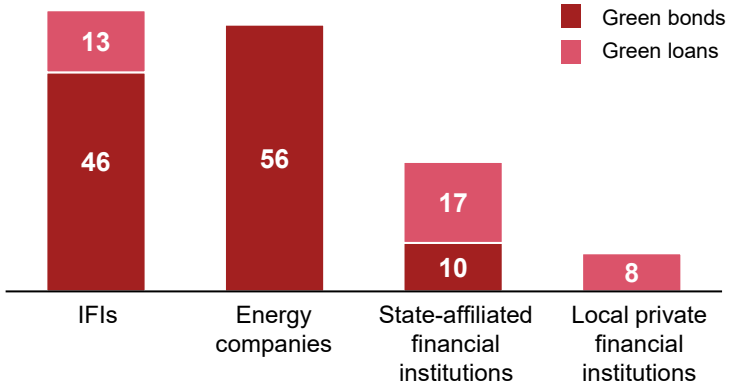
Issuance of green finance instruments as of the end of October 2023, KZT bn



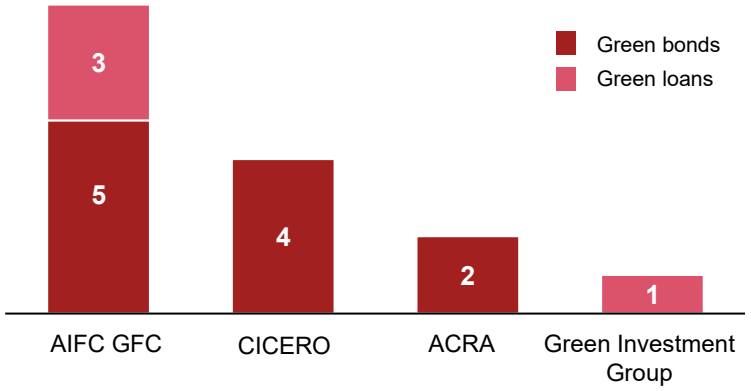
Use of proceeds by sectors from the issuance of green bonds/loans as of the end of October 2023



Issuance of green bonds and loans by issuer type as of the end of October 2023, KZT bn



External review providers by number of green finance reviews as of the end of October 2023



Leading institutions driving green finance

- IFIs, such as the ADB and EDB, are the leading issuers of green financial instruments in Kazakhstan. They are followed by major energy companies like JSC “Samruk-Energy” and JSC “ KEGOC”, state-affiliated financial institutions like JSC “Development Bank of Kazakhstan” and the JSC "DAMU Entrepreneurship Development Fund“ (Damu), and local private banks, such as JSC “Halyk Bank”.
- In Kazakhstan, issuers use Second Party Opinions to verify green finance instruments. External reviews have been provided by AIFC GFC, Center for International Climate and Environmental Research (CICERO), Analytical Credit Rating Agency (ACRA), and Green Investment Group, with AIFC GFC leading the market.
- In Aug 2020, The Damu Fund, in partnership with United Nations Development Programme (UNDP), issued Kazakhstan’s first green bonds on the AIX worth 200m tenge, with a maturity of 36 months and a 11.75% coupon. Proceeds supported SMEs implementing renewable energy projects through second-tier banks and microfinance institutions. The AIFC GFC provided an independent second-party opinion confirming compliance with the AIX rules and ICMA GBP.

Sources: PwC Kazakhstan Sustainable finance Go-to-Market report, AIFC Green Finance Market in Kazakhstan report, AIX press release

Uzbekistan supported the green transition with public-sector loans and landmark sustainable bond issuances

Overview of the sustainable financing sector in Uzbekistan

- State-owned financial institutions provide 70% of all loans and lead the green transition by investing in clean energy, sustainable agriculture, and climate-resilient infrastructure.
- Uzbekistani banking sector is active in green consumer lending for RE projects, with banks such as JSCB “Ipoteka Bank” (Ipoteka Bank), JSCB “ASIA ALLIANCE BANK” and JSC “Xalq banki” offering loans for acquiring RE equipment.
- In 2021, Uzbekistan became the first country in the region and the second in the world to issue Sovereign SDG Bonds worth $235m in Uzbekistani Som (UZS) equivalent, with a 14% coupon rate and a three-year maturity. Proceeds were distributed on public transport (54%), health (22%), education (17%) and water (7%).
- In 2023, Uzbekistan issued its first sovereign green Eurobonds worth UZS 4.25 trillion on the LSE – the first such issuance in the CIS.

IFIs active in sustainable financing sector of Uzbekistan

GGGI	European Bank for Reconstruction and Development	ADB Asian Development Bank
Issued in 2024 through joint efforts of Agrobank and GGGI, the $445m green bond will promote green growth, as 80% of the proceeds will be allocated to Climate Smart Agriculture practices in Uzbekistan.	The EBRD offered green & inclusive financing of $20m to Ipoteka Bank under the Uzbekistan Green Economy Financing Facility II and Women in Business programs.	In 2024, the ADB approved a $250m loan to support the efforts in enhancing climate transition frameworks, aligning climate change adaptation priorities, and accelerating climate change mitigation.

Main active institutions in sustainable financing sector

Uzbekistan Direct Investment Fund (UzDIF)

- UzDIF, founded in 2022, acts as a direct investor into large and long-term projects. UzDIF is in a strong position to support the launch of green projects and influence the corporate practices and strategies of firms that it invests in.
- In January 2024, UzDIF invested in the first green bonds issued by a private company, Saipro Group, which has projects in solar power and eco-tourism.

Entrepreneurship Development Company (EDC)

- A state-owned entity aimed to independently implement tools for comprehensive support for SMEs, raise funds on capital markets.
- EDC is financing solar energy and other green projects, aiming for 35% of its funding to support green initiatives by 2026.
- Company has committed to channeling an additional $100m from IFIs into SME green economy projects.

Business Development Bank (BDB)

- BDB provides long-term financing to small businesses at interest rates below the market average and with less demanding collateral requirements.
- As part of its 2024-2026 strategy, BDB aimed to perform climate risk stress tests for its credit portfolio.

Uzbekistan Mortgage Refinancing Company (UzMRC)

- UzMRC aims to develop the housing sector, improve mechanisms for providing mortgage loans, and expand opportunities for all social strata to use mortgage loans based on market principles.
- In 2024, UzMRC issued its first green bonds, totaling UZS 50bn, on the Tashkent Stock Exchange with the support of the AIFC GFC.
- In 2022, UzMRC received a $150m from ADB, with financing of sustainable and climate change resilient assets as one of the focuses.

Sources: World Bank Blogs, OECD Financing Uzbekistan’s Green Transition, World Bank Prime Picks for a Green Pivot report, AIFC State Of Sustainable Finance In Central Asia report, AIFC news, Gazeta news, GGGI, ADB, EBRD, UzMRC websites, Kun.uz news, S&P Global Ratings

Uzbekistan’s well-developed regulatory framework facilitates the country’s green transition

Sustainable finance initiatives by the Government of Uzbekistan

January 2022

In recent years, green transition considerations have become central components of the country’s main strategic planning documents, including the New Uzbekistan Development Strategy 2022-2026.

December 2022

Presidential Resolution No. 436, passed in 2022, lays out the government’s strategy to cut GHG emissions by 35% per unit of GDP by 2030, improving resource efficiency, as well as reforestation and urban greening.

March 2025

President Shavkat Mirziyoyev held a meeting on issues of increasing the efficiency of consumption and rational use of energy resources. In this regard, energy efficiency principles have been introduced. A separate program is being implemented in the context of large enterprises and energy sectors.

April 2025

PwC Uzbekistan, together with the World Bank, prepared an updated version of the green taxonomy, transforming the existing taxonomy into a fully operational one and providing technical specifications for the digital tools to effectively implement the taxonomy. It is to be authorised by the Government.

Documents required for the state registration of a bond issue

01. A copy of the appraisal report confirming the appraisal of the property.
02. Financial statements (for the last completed financial year and quarter) of the third party that provided security for the bonds.
03. A copy of the document stating that a third party has provided security to back the issuer’s bond obligations, if such security exists.
04. The original of the audit organisation's report confirming the presence of a positive indicator of profitability, solvency, financial stability and liquidity of the issuer.
05. The original of the audit organisation's report confirming the amount of the issuer's equity capital as of the approval date of the bond issuance decision.
06. A copy of the document containing an independent rating assessment of the issuer.
07. A copy of the agreement between the issuer and the underwriter indicating the terms of the bond placement in the case of bond placement by underwriters.
08. A copy of the agreement where the commercial bank agrees to act as a paying agent, handling investor payments of the issuer.
09. Copy of the certificate of compliance with the green framework program from a specialised organisation authorised by the ICMA or CBI or registered by the European Securities and Markets Authority (ESMA).
10. A certificate stating the intended use of bond proceeds and their compliance with the National Green Taxonomy.

Sources: President of the Republic of Uzbekistan press release, World Bank Blogs, Information retrieval and expert systems: all legislation of Uzbekistan, OECD Financing Uzbekistan’s Green Transition

Green financing by IFIs and energy companies offers significant benefits for the development of green transition initiatives

Kazakhstan and Uzbekistan have implemented green energy initiatives aimed at supporting the energy transition:

Kazakhstan

- The Concept for the transition of the Republic of Kazakhstan to a "Green Economy" regulates the development of the solid waste management sector and has 3 stages: 1) resource use optimisation, enhancement of environmental protection, and establishment of green infrastructure, 2) economic transformation via water conservation, renewables and efficiency, 3) transition to a sustainable economy and creation of an integrated municipal solid waste management system.
- Kazakhstan offers state support for renewable energy projects in the form of exemption from customs duties and VAT on imports, simplified licensing procedures, and subsidies.
- Kazakhstan' national Action Plan for the Development of the Electric Power Industry until 2035 outlines the commissioning of at least 8.4 gigawatts (GW) of renewable energy.

Uzbekistan

- Strategy for the Transition to a Green Economy for the 2019-2030 Period aims to improve energy efficiency, rational consumption and conservation of natural resources, reducing greenhouse gas emissions, ensuring access to green energy, creating green jobs and ensuring climate resilience.
- According to the Tax Code of the Republic of Uzbekistan, income from the sale of "green energy" certificates from generating facilities based on the RES usage is not considered during taxation. Renewable energy installations are exempt from land and property taxes. Profits received from the sale of electrical energy using renewable energy installations with a capacity of up to 100 kW are exempt from the corporate income tax.
- The country plans to implement $1.3bn in waste-to-energy projects with partners from China, the UAE, and South Korea to convert 4.7m tons of waste into 2.1bn kWh of electricity annually by 2027.

Major energy companies and IFIs actively support those initiatives:

Kazakhstan

ACWA Power

- In March 2023, Saudi Arabia's ACWA Power aimed to support national climate action, with an initial investment of $1.5bn to build a 1 GW wind farm with battery storage until 2027 in partnership with Kazakhstan's Ministry of Energy and Samruk-Kazyna.

Asian Infrastructure Investment Bank and Development Bank of Kazakhstan

- In 2024, Multilateral Cooperation Center for Development Finance (MCDF) approved a $840,000 grant that will help the DBK prepare green and cross-border infrastructure financing. The project will be implemented by the AIIB.

Uzbekistan

Asian Development Bank

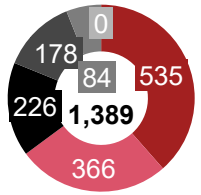
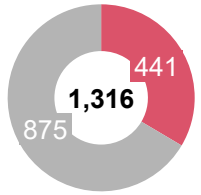
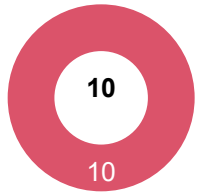
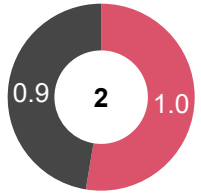
- In 2020, ADB and "Nur Navoi Solar" FE LLC signed up to $17.5m in loans for Uzbekistan's first PPP renewable energy project - a 100 MW solar plant aimed at improving rural access to affordable, reliable power.
- ADB's concept for the construction of a 100 MW solar photoelectric power station in Fergana region was approved by the Cabinet of Ministers of the Republic of Uzbekistan in July 2022.

European Bank for Reconstruction and Development

- In May 2023, EBRD extended a $19.3m loan to "ACWA Power Wind Karatau" FE LLC to finance construction and operation of a 100 MW wind power plant in Karakalpakstan. This project is the outcome of the first phase of EBRD's programme to support authorities on developing 2,000 MW of wind capacity.

Sources: ACWA Power press release, EBRD press release, ADB press release, ADB Public–Private Partnership Monitor Kazakhstan, iea.org, MCDF press release, Astana Times, Reuters, Kursiv, QazaqGreen, lex.uz

Central Asia is aligning with sustainable development trends as its sustainable finance market, valued at $2.7+ billion as of May 2024, continues to grow

Country	Structure of sustainable finance, $m	Selected issuers	Partners/investors	Description
Kazakhstan		SOLVA, KEGOC, Halyk Bank, ADB, AL KARAL, KazWind, ARNUR CREDIT, Development Bank of Kazakhstan, BAITEREK, JET, Eurasian Development Bank	GREEN CLIMATE FUND, AIFC, GFC, DAMU, Eurasian Development Bank, European Bank for Reconstruction and Development, Development Bank of Kazakhstan	• Among the countries of Central Asia, Kazakhstan has made the most progress in developing the local corporate sustainable finance market, with over 20 issues of sustainable bonds and loans.
Uzbekistan		MINISTRY OF ECONOMY AND FINANCE OF THE REPUBLIC OF UZBEKISTAN, SQB	IFC, AIIB, QEB, UNDP, IDOS German Institute of Development and Sustainability, *Bookrunners*, GAZPROMBANK, J.P.Morgan, citi, MUFG	• In 2024, the Ministry of Economy and Finance issued 3-year SDG bonds worth ~ $640m. • In 2023, Uzbekistan issued its first sovereign green Eurobonds totalling ~ $337m and SQB issued 5-year green Eurobonds worth $100m. • In 2021, Uzbekistan issued $235m worth bonds for SDG projects.
Tajikistan		Eskhata	IFC	• OJSC “Bank Eskhata”, a major commercial bank in Tajikistan, partnered with the IFC to issue Tajikistan's inaugural green bonds worth $10m in February 2024. The funds raised will empower the bank to assist SMEs in Tajikistan with their green project initiatives.
Kyrgyzstan		DOSCREDOBANK, Bank of Asia	AIFC, GFC, СЕНТИ ФИНАНСОВАЯ КОМПАНИЯ, UN WOMEN, КЫРГЫЗ ФОНДУЛУК БИРЖАСЫ КЫРГЫЗСКАЯ ФОНДОВАЯ БИРЖА KYRGYZ STOCK EXCHANGE	• First green bonds (3-year, worth ~ $1m) in Kyrgyzstan were issued by OJSC “Doscredobank” in June 2023 and supported green initiatives such as construction from eco-friendly materials and environmentally friendly transportation. • Debut sustainable (3-year, worth $0.9m, gender) bonds were listed in November 2022 by Bank of Asia.

Sustainability-linked bonds | Green bonds | Sustainability bonds | Social bonds | Green loans (labelled) | Sustainable Development Goals Bonds

Sources: AIFC State Of Sustainable Finance In Central Asia report, Uzbekistan July 2021 SDG Bond Allocation And Impact Report

Well-defined procedures in Kazakhstan and Uzbekistan support the active issuance of green bonds

Process for the issuance of green bonds in Kazakhstan

Stage	Description	Responsible entities
Preparatory stage	• Study of principles and documents related to green finance, including the Exchange rules • Identification of a pool of assets/projects for bond issuance • Preparation of an internal policy in the field of green bonds or financing (Green Financing Framework or Green Bond Framework)	Issuer
Verification	• Submission to the SPO provider of documents, including the Green Bond Framework, issuance materials, and internal policies • Analysis of the issuer and project for compliance with the principles of green bonds • Final decision by the verifier and issuance of a Second Party Opinion report	GFC, CICERO, AKPA, GIG, Sustainable Fitch
Listing	• Preparation and submission of listing documents in accordance with Exchange rules, including the issuance prospectus • Signing of the listing agreement • Listing and admission to trading	JUSAN INVEST, HALYK FINANCE, TENIZ CAPITAL, FREEDOM finance, bcc invest, SkyBridge Invest
Annual report	• Submission of an annual report on the targeted use of funds raised and the achieved environmental impact	Issuer and SPO provider

Process for the issuance of green bonds in Uzbekistan

Stage	Description	Responsible entities
Development and approval of the framework program	• Preparation of the framework program in the field of green bonds	Issuer
SPO	• Issuers should contract external reviewers to confirm framework compliance with the GBP	GFC, SUSTAINALYTICS, Sustainable Fitch
State registration of the issuance	• The state requires a green bond framework and a copy of preliminary SPO	Issuer
Management of proceeds and project financing	• Tracking of alignment of net proceeds with green project investments should be done	Issuer
Annual Report	• Publishing of annual reports on fund allocation and achieved environmental impact in accordance with the framework program	Issuer

Sources: AIFC Green Finance Market in Kazakhstan report, AIFC GFC instructions on green bond issuance, AIFC GFC press release, Sustainable Fitch press releases, SkyBridge Invest, Halyk Finance, Freedom Finance, BCC Invest, Teniz Capital, Portal for discussion of draft regulatory legal acts in Uzbekistan, Forbes, Sustainable Fitch press releases, Sustainalytics press release

PwC interview insights: ADB – one of the leaders in the global energy transition and RES financing

The ADB leads the Energy Transition Mechanism (ETM) initiative, working closely with the Government of Kazakhstan. ADB has already conducted a pre-feasibility study and screened potential candidates. The goal of the initiative is to replace coal-fired generation with RES, with shortlisted regions including Karaganda, Turkistan, Akmola, and Zhambyl regions.
Bekzhan Mukatov (Energy Specialist in the ADB)

- The ETM is ADB's collaborative initiative with developing countries to accelerate transition from fossil fuels to clean energy, promote energy security and affordability, create livelihood opportunities for people and businesses, and cut harmful emissions and pollutants.
- In November 2024, Kazakhstan signed a memorandum of understanding with the ADB on ETM as the country is set to cut emissions 15% by 2030 and achieve net-zero by 2050. A pre-feasibility study, funded partially by $225,000 provided by ADB, has identified coal power plants for retirement and defined the scope a full feasibility study.

ADB actively engages in the private sector development, specifically the RES industry: there were major projects in solar power generation in partnership with Total Eren (TotalEnergies).

- Total Eren, in partnership with the ADB and EBRD, developed two solar power plants (Nomad Solar Power Plant and M-KAT Green Solar Power Plant) in Kazakhstan. These projects supply 225 GWh/year (enough to cater to the needs of 40,000 people) and cut CO_2 emissions by ~300,000 tons annually.
- The M-KAT Green Solar Power Plant, a 100 MW solar power facility in Zhambyl Region, was launched in 2020. ADB has co-financed this project with the EBRD, approving a $41.4m loan denominated in tenge. Total project cost was estimated at $165.5m. The financing supports Concept for Transition of the Republic of Kazakhstan to Green Economy, which aims to increase electricity generation from non-thermal sources to 50% by 2050.

The main constraint to the energy sector development is the limited balancing capacity - the inability to maintain a stable balance between electricity generation and consumption, which increases the risk of system failures.

- According to the country's forecast balance, electricity generation in 2025 is expected to reach 117.1bn kWh, while consumption will total 122.8bn kWh, leaving a supply gap of 5.7 TWh. However, generation is projected to outstrip demand by 2027, driven by large gas-fired power projects scheduled to come online in the southern regions between 2025 and 2027. In total, Kazakhstan plans to add about 26 GW of new generating capacity by the end of 2035.
- Kazakhstan Electricity Grid Operating Company (KEGOC) has warned that the accelerated deployment of renewable energy in Kazakhstan could raise their share in total generation to 34% by 2030, potentially leading to excess capacity, higher tariffs, and risks of system imbalance.

Sources: PwC interview with the ADB, ADB website, ADB Total Eren Access M-KAT Solar Power Project Report, Pinset Masons news, khl.com, LS news, KEGOC press release, inbusiness.kz

PwC interview insights: EBRD - one of the leading investors into Kazakhstan

EBRD actively supports investment in Kazakhstan and Central Asia:

On June 24, 2025, Kazakhstan President Kassym-Jomart Tokayev met with the EBRD President Odile Renaud-Basso in Astana. At a meeting the EBRD promised to provide over €2bn in financing for energy and utilities over 5 years. It will also support transport and raw materials sectors and the country's energy transition.

€2.26bn

The EBRD invested €2.26bn through 121 projects in Central Asia in 2024. 58% of investments promote green economy financing.

€913m

In 2024 the EBRD more than tripled the volume of its annual investment in Kazakhstan by signing 25 projects worth €913m. Project spanned such sectors as sustainable infrastructure, corporate sector and financial institutions, including the construction of new treatment facilities and related infrastructure in Aktobe, the first major PPP project for the construction of a 630-bed multidisciplinary hospital in Kokshetau and others.

1/3

EBRD financed approximately a third of the country's renewable energy installed capacity, contributing to the Kazakhstan's shift to cleaner sources of energy.

Despite current developments, there is a lack of balancing of generation capacity:

Kazakhstan faces a technical constraint in the form of a shortage of balancing capacities, particularly in peak generation. This poses a serious barrier to the further development of RES and the overall modernisation of the power system.

Yerlan Ramazanov (Regional Head of Energy in the Eurasia team at EBRD)

As noted in the audit report of the Supreme Audit Chamber (SAC), energy generation and consumption in the regions are locally unbalanced. Most of the capacity is located in the northern energy zone, while a quarter of consumption is in the south. Only Pavlodar region, East Kazakhstan and North Kazakhstan can be called self-sufficient.

Recent projects of EBRD:

AQTOBE SU-ENERGY GROUP

In 2024, the EBRD provided a €96.4m loan to a state-owned JSC "Aqtobe Su-Energy Group" for the construction of a new wastewater treatment plant with a sludge treatment facility and a biogas-fuelled power generation unit in Aktobe, western Kazakhstan, which became the bank's largest municipal project in Central Asia.

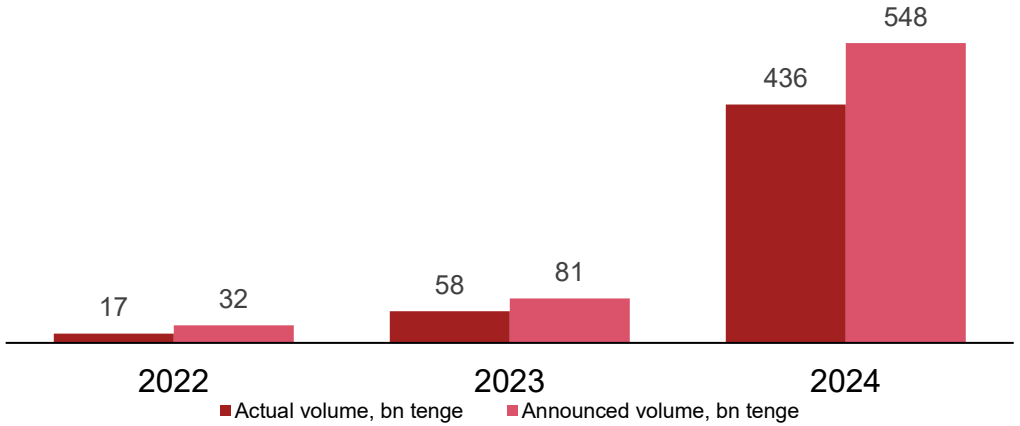
KEGOC

In December 2024, the EBRD arranged financing for the KEGOC, consisting of an EBRD loan of up to €252m and a concessional loan of €15m from the government of Canada.
The financing will allow KEGOC to construct around 600 km of 500 kV of transmission infrastructure and to facilitate integration of the West Kazakhstan Power System into the country's Unified Power System.

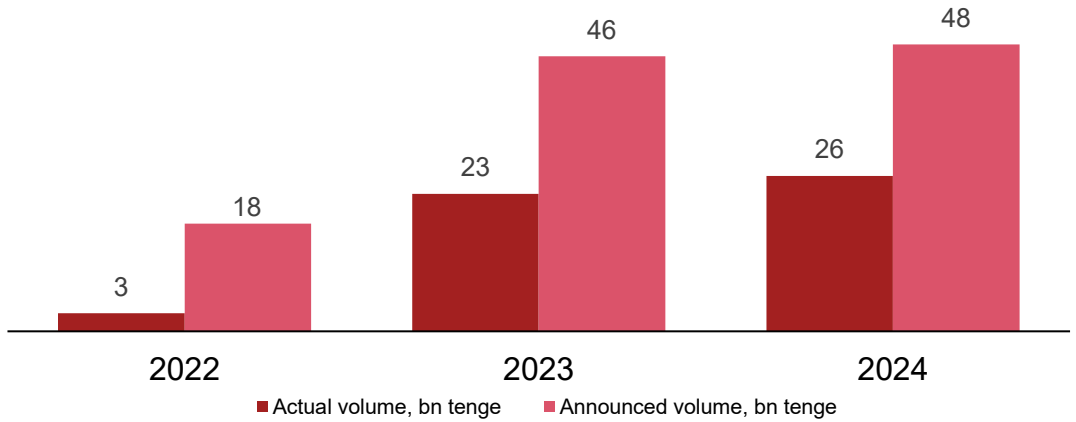
Sources: PwC interview with the EBRD, official website of the President of the Republic of Kazakhstan, EBRD website, Kazakhstan Newsline, Akorda.kz, kzaif.kz, Astana Times, The EBRD in Kazakhstan Results snapshot report

PwC interview insights: Kazakhstan Stock Exchange – the driver of sustainable finance advancement in Kazakhstan

There is an increasing trend in ESG bond issuances on KASE:



Green bonds are a major part of ESG bond issuances on KASE:



KASE is active in the ESG agenda of Kazakhstan:

KZT 202bn	KZT 678bn	KZT 100bn
Volume of issued green bonds	Volume of issued social bonds	Volume of issued SDG bonds
18	15	34+
Issuances of green bonds	Issuances of social bonds	ESG events in 2020-6M2025

> **Green bonds market is developing quite well, for example, in 2020, we issued 2 bonds from the ADB. In 2024, compared to 2023, there was a 7-fold excess, that is, the volumes of announced ESG bond issuances have grown very strongly. If, for example, in 2020-2021 these were mainly bonds from development banks and the quasi-state sector, in 2023, small and medium-sized businesses entered the market for the first time, placing green bonds as well.**
>
> **Madina Kassymbayeva** (ESG Officer in the KASE)

Companies that placed ESG bonds on KASE:

Sources: PwC interview with the KASE, Listing and Disclosure on KASE report, Cbonds

Second-tier banks and the DBK also play an important role in developing green financing projects in Kazakhstan

Bank	Date of issue	Amount, m	Currency	Maturity	Coupon rate	Bank rating	Description
HOME CREDIT BANK	15.05.25	25	USD	N/A	N/A	BB-/Stable (Fitch, 04.03.25)	In May 2025, JSC “Home Credit Bank” has entered into an agreement with the EBRD to receive a loan of $25m. The financing is provided under the GEFF Kazakhstan II program and will be aimed at supporting clients who want to modernise their housing, reduce energy costs and take a step towards a more sustainable lifestyle.
Development Bank of Kazakhstan	25.12.23	15	USD	1 year	5.65%	BBB/Stable (S&P, 16.08.24)	DBK successfully issued its first green bonds on the AIX with CBI certification. The funds received from the placement will be used to finance a project in the field of renewable energy in Kazakhstan.
Halyk	03.12.24	20,000	KZT	3 year	1.25%	BBB-/Stable (S&P, 07.03.25)	JSC “Halyk Bank” issued its first green bonds, funding projects that promote resource efficiency, reduce environmental impact, and address climate change in line with the UN Sustainable Development Goals.
Development Bank of Kazakhstan	29.03.23	10,000	KZT	3 year	TONIA Compounded + 2.00%	BBB/Stable (S&P, 16.08.24)	DBK issued green bonds to raise funds for financing investment projects aimed at enhancing the efficiency of the energy system and improving the reliability of electricity supply in the western regions.

Sources: AIFC GFC Sustainable Finance Analytics, AIFC GFC: casebook of sustainable development financial instruments, KASE News, EBRD, AIX, DBK, JSC “Home Credit Bank”, S&P, Fitch website

Second-tier banks have launched or participated in several programs aimed at securing green financing in Kazakhstan

Bank	Program name	Program description	Amount	Term	Interest Rate	Purpose	Eligibility	Projects eligible for financing
bcc.kz	GEFF Kazakhstan II	JSC “Bank CenterCredit” (BCC) and JSC "Shinhan Bank Kazakhstan“ (Shinhan Bank) offer green loans through the EBRD-supported Green Economy Financing Facility (GEFF) II program. These funds help private sector borrowers invest in climate-friendly projects that cut emissions and boost energy efficiency, aligning with the EBRD’s Green Economy Transition strategy. Within the framework of this program, BCC and Shinhan Bank received several credit lines to support green projects: 1. In Mar 2025, senior secured loan of up to $30m in KZT was provided to BCC. 2. In Aug 2024, 3-year senior loan of up to $20m in KZT equivalent was provided to Shinhan Bank. 3. In Jun 2024, 3-year senior loan in the amount of up to $30m in KZT was provided to BCC.	Up to 4.5bn tenge	N/A	19.00% (EAR: 20.64-22.72%)	To finance investments and replenish working capital	Private enterprises	Technologies, equipment, or projects assessed by GEFF or listed in the Green Technology Selector
SHINHAN BANK KAZAKHSTAN			Up to 2.5bn tenge	N/A	18.00% (EAR: 19.90%)		SMEs, private enterprises, individuals	
NURBANK	Financing of Green projects related to the reduction of negative impact on the environment	The goal of the program is to support projects aimed at reducing the negative impact on the environment, increasing energy efficiency and adapting to climate change.	Up to 3bn tenge	1. To replenish working capital - up to 60 months 2. For investments - up to 84 months	21.00-22.00% (EAR: 24.90-31.10%)	To finance investments and replenish working capital	SMEs	Projects related to the green taxonomy
OTBASY BANK	Green Mortgage	The first mortgage program in Kazakhstan aligned with sustainable development and aimed at decarbonising the economy in Kazakhstan.	Up to 50m tenge	Up to 25 years	12.50% (EAR: 13.30-18.10%)	Purchase and renovation of primary housing buildings with green certification	Individuals	N/A

Sources: EBRD GEFF, Bank CenterCredit, Shinhan Bank Kazakhstan, Nurbank, Otbasy Bank websites

Second-tier banks play an important role in developing sustainable finance in Uzbekistan

Bank	Date of issue	Amount, m	Currency	Maturity	Bank rating	Description
SQB	25.07.24	400	USD	N/A	BB/Stable (Fitch, 30.06.25)	SQB, with technical support from the GGGI, has issued an internationally verified Sustainability Bond on the London Stock Exchange. This bond issuance will support SQB to issue new and progressive green transformational loans to individuals, SMEs, state and municipal borrowers, and corporations in line with the four core pillars of the ICMA.
		2,250,000	UZS	N/A		
	04.08.23	100	USD	5 year		In August 2023, SQB completed a private placement of 5-year Eurobond with use of proceeds directed towards eligible climate-related projects. The bank issued the first corporate green bond in the history of Uzbekistan. The investors were the IFC, the Austrian Development Bank (OeEB), the AIIB and the German development finance institution DEG.
Agrobank	03.10.24	400	USD	5 year	BB/Stable (Fitch, 30.06.25)	JSCB “Agrobank”, with technical support from the GGGI, has issued an internationally verified green bond on the London Stock Exchange. The proceeds will be used primarily for renewable energy, clean transportation and climate change adaptation with 80% of the bond targeting Climate Smart Agriculture activities in Uzbekistan.
		700,000	UZS	2 year		

Sources: SQB website, GGGI press-release, Fitch Ratings, London Stock Exchange

Banks in Uzbekistan are active in numerous programs* aimed at securing green financing and renewable energy solutions

Bank	Program name	Program description	Amount	Term	Interest Rate	Eligibility
SQB	Corporate green loan	The program is aimed at financing projects to support green initiatives such as purchase of equipment for RES.	Up to $2m	Up to 60 months	8% (for international currency) and 21% (for local currency)	Corporate clients
	Green loan	The program covers the projects aimed at increasing energy efficiency and using renewable energy sources or projects related to the national green taxonomy.	Up to $60 ths.	Up to 60 months	From 20.5%	SMEs
	Green energy microloan	The program is aimed at providing credit for the purchase of solar panels.	Up to $60 ths.	Up to 60 months	22%	Corporate clients
	Green comfort	Program represents a loan for the purchase of energy efficient equipment and renewable energy installations with a capacity of up to 1 MW.	Up to UZS 200m	Up to 60 months	20%*	Individuals
MKBANK	Green energy	The loan program provides funding for projects focused on the purchase and installation of RES, implementation of energy-saving technologies, and enhancement of energy efficiency in production processes.	Up to UZS 5bn	Up to 36 months	21%	Individual entrepreneurs and corporate clients
XalqBanki since 1875	Green Energy Credit	The program is aimed at providing credit for the purchase of renewable energy sources.	Up to UZS 5bn	Up to 12 months	20.5%	Individual entrepreneurs and corporate clients
	Consumer loan "Green"	The program is aimed at providing credit for the purchase of solar panels.	Up to UZS 100m	Up to 60 months	20%	Individuals
Agrobank	Green energy loan	The program is aimed at purchase and installation of special energy-efficient equipment.	Up to UZS 5bn	36 months	21%	Corporate clients
	Green energy loan	The program is aimed at purchase and installation of special energy-efficient domestic equipment.	Up to UZS 100m	36 months	20%	Individuals

** Other programs are provided in Appendix 2*

Sources: SQB, Microcreditbank, Xalq banki, Agrobank websites, Yashil Energiya.uz

6

Recommendations

Energy Transition presents valuable opportunities for businesses, making it crucial to determine the best starting point

Why invest in Energy Transition?

Let us recap on the energy transition:

Strategic Imperative

The energy transition is not just a technological shift, it is a strategic response to global climate goals, energy security needs, and long-term economic resilience.

Multidimensional Challenge

It involves complex technological, regulatory, and market transformations. Navigating these requires adaptability, innovation, and coordinated action.

Catalyst for Growth

When managed effectively, the transition can drive regional economic development, job creation, and infrastructure modernization.

Operational Efficiency and Cost Reduction

Even with low energy prices, energy efficiency measures can reduce waste, improve reliability, and lower long-term operating costs - especially in energy-intensive sectors like mining, metallurgy, and manufacturing.

Access to Green Finance

International financial institutions are actively funding clean energy and decarbonization projects in Central Asia. Companies with credible transition plans are more likely to attract concessional loans, grants, and blended finance.

Export Market Access

As global buyers and regulators (e.g. EU CBAM) demand lower-carbon products, investing in clean energy and emissions reduction is becoming essential to maintain access to international markets.

Reputation and Stakeholder Expectations

Local and international stakeholders, including investors, clients, and employees, increasingly expect companies to demonstrate environmental responsibility and climate action.

Regulatory Preparedness

Both Kazakhstan and Uzbekistan have committed to emissions reduction targets and are gradually tightening environmental regulations. Early movers will be better positioned to comply and influence future policy.

Energy Security and Reliability

Diversifying energy sources (e.g. solar, wind, storage) enhances resilience and reduces reliance on outdated fossil fuels.

Sources: Open Sources, PwC analysis

Energy Transition presents valuable opportunities for businesses, making it crucial to determine the best starting point

How are businesses progressing?

We have identified three distinct categories of maturity levels for companies in Kazakhstan and Uzbekistan as they navigate the energy transition. These categories represent different stages of progress and readiness in adopting sustainable energy practices:

01 Emerging

Early-stage awareness, limited action, ad hoc initiatives

02 Advancing

Defined goals, pilot projects, growing internal capacity

03 Leading

Integrated strategy, measurable impact, industry influence

Understanding these maturity levels is crucial for tailoring strategies and recommendations to the specific needs and challenges of each company to help them advance in their energy transition journey.

Sources: Open Sources, PwC analysis

Assessing maturity is key to guiding next steps in the energy transition, including strategy, renewable energy, and efficiency improvements

Maturity level	Strategic Vision and Plan	RES Integration	Energy Efficiency and Low-Carbon Tech
Emerging	• No clear energy transition goals • Limited awareness of long-term climate risks • Energy strategy not integrated into business planning	• Minimal or no use of renewables • Reliance on fossil fuels remains high • No structured procurement of green energy	• Basic energy audits, few efficiency measures • Low awareness of low-carbon tech • No decarbonization roadmap
Advancing	• Defined medium-term goals (e.g., 2030 targets) • Energy transition included in corporate strategy • Some stakeholder engagement on climate issues	• Partial shift to renewables • Use of PPAs or green tariffs • Pilots for on-site generation (e.g., solar panels)	• Energy efficiency programs in key operations • Adoption of some low-carbon technologies • Carbon footprint tracked for major assets
Leading	• Net-zero or science-based targets in place • Fully integrated energy and climate strategy • Transparent reporting and strong governance	• Majority of energy from renewables • Active investment in RES infrastructure • Grid flexibility and storage solutions in place	• Continuous improvement culture • Widespread use of digital tools (IoT, AI) for optimization • Investment in breakthrough tech (e.g., hydrogen, CCUS)

Note: The characteristics presented across the three maturity levels are indicative. They are intended to illustrate general patterns and may not capture all nuances or variations across sectors or organizations.

Sources: Open Sources, PwC analysis

For emerging companies recommended to begin by establishing goals and involving stakeholders in the execution of transition initiatives

Set Ambitious yet Achievable Goals

- **Set targets:** Define net-zero or similar goals and embed them in strategy
- **Engage leadership:** Ensure top-level support to drive climate action
- **Phase emissions:** Tackle Scope 1 & 2 first, then Scope 3 as data improves
- **Build governance:** Set up committees to track and steer progress

Measure Baseline Emissions

- **Start with a GHG inventory:** Cover both operations and supply chain emissions
- **Identify key sources:** Use the inventory to spotlight major emission drivers
- **Begin with data:** Focus on collecting and analyzing emissions data
- **Use baselining:** Establish a baseline to guide decisions and track progress
- **Target high-impact areas:** e.g., methane leaks in oil & gas or energy use in mining

Initiate RE and EE Projects

- **Explore small-scale renewables:** Start with solar panels or green energy purchases
- **Run energy audits:** Identify quick, low-cost efficiency wins
- **Make fast-payback upgrades:** Install efficient motors, fix leaks
- **Build experience:** Use small projects to gain clean energy know-how

Improve Internal Awareness and Skills

- **Run awareness workshops:** Focus on energy efficiency and emerging technologies
- **Link KPIs to climate goals:** Tie management incentives to environmental outcomes
- **Form green teams:** Empower employees to suggest emission-reduction ideas
- **Engage staff:** Boost skills and attract climate-conscious talent

Strengthen Governance and Reporting

- **Set internal controls:** Begin tracking emissions and climate-related risks
- **Start external reporting:** Disclose to Carbon Disclosure Project (CDP) or similar - even in basic form
- **Use internal carbon pricing:** Evaluate projects with a shadow carbon cost
- **Communicate early:** Be transparent about progress and challenges
- **Prepare for regulation:** Build systems now to avoid future compliance stress

Engage Stakeholders Early

- **Engage stakeholders:** Start conversations to build internal and external support
- **Share strategy:** Communicate decarbonization plans with investors to build trust
- **Involve employees:** Align teams through change management and shared mission
- **Collaborate externally:** Join industry groups or initiatives to adopt best practices
- **Show commitment:** Set public targets or pledges to boost reputation and attract capital

Note: This is a non-exhaustive set of recommendations intended to guide further discussion.

Sources: Open Sources, PwC analysis

For advancing companies, building upon previously successful projects and investing in emerging low-carbon technologies is recommended

Optimize and Decarbonize Operations at Scale

- **Scale efficiency programs:** Roll out previously identified low-cost improvements across all sites
- **Retrofit and electrify:** Upgrade equipment, electrify processes, and reduce waste energy enterprise-wide
- **Optimize sector-specific systems:** Streamline power use in oil & gas; improve hauling, ventilation, and grinding in mining
- **Track impact:** Monitor emissions and cost savings to guide further scaling and investment

Deploy Emissions-Reducing Technologies

- **Pilot heavy decarbonization tech:** Launch CCUS at large emission sources, often with public or partner support
- **Electrify and switch fuels:** Replace fossil-fueled equipment with electric or alternative-fuel options (e.g., trolley-assist trucks, grid-powered rigs)
- **Scale renewables:** Move from pilots to large-scale PPAs, on-site solar/wind, and battery storage to manage intermittency
- **Retire high-carbon assets:** Phase out coal and ramp up clean energy generation to exceed interim targets

Integrate ESG into Supply Chains

- **Engage suppliers:** Require emissions disclosure and reduction targets; embed sustainability criteria in contracts and requests for proposals (RFPs)
- **Support low-carbon inputs:** Encourage use of RE, cleaner transport, and emissions-reducing technologies across the supply base
- **Collaborate with customers:** Co-develop low-carbon product options (e.g., green aluminum, low-methane gas) to meet growing demand
- **Drive Scope 3 impact:** Partner across the value chain to align climate goals and expand decarbonization beyond direct operations

Engage Stakeholders and Regulators Proactively

- **Empower the workforce:** Reskill employees for new technologies and recognize internal sustainability champions
- **Build community trust:** Engage local stakeholders early on major projects and offer visible benefits (e.g., jobs, environmental safeguards)
- **Collaborate with regulators:** Participate in consultations and panels to shape practical, forward-looking climate policies
- **Secure early approvals:** Work with authorities to unlock pilot projects and influence emerging carbon standards

Solidify Reporting and Transparency

- **Enhance disclosures:** Report emissions in more detail (by scope, business unit, etc.) and align with relevant frameworks
- **Communicate openly:** Share both progress and setbacks to build stakeholder trust
- **Seek external validation:** Certify targets (e.g., via Science Based Target initiatives) and assure sustainability reports through third parties
- **Prepare for regulation:** Align early with emerging rules to stay ahead

Note: This is a non-exhaustive set of recommendations intended to guide further discussion.

Sources: Open Sources, PwC analysis

Leading businesses can strengthen their initiatives by partnering with industry experts and promoting new policies with government entities

Leverage Data Analytics, Digital Tools, and AI

- **Monitor in Real Time:** Integrate emissions analytics into decision-making
- **Deploy Digital Twins:** Use virtual asset models to optimize performance and reduce emissions
- **Optimize with AI & ML:** Run scenarios and adjust operations dynamically to cut waste
- **Integrate Systems:** Feed data into enterprise platforms for automated carbon management
- **Link GHG to Accounting:** Embed GHG data into financial and production systems for operational control

Invest in New Tech and Business Models

- **Invest in Hydrogen & Electrification:** Deploy hydrogen-powered systems to decarbonize hard-to-abate sectors like mining and refining
- **Scale Carbon Removal:** Advance technologies like Direct Air Capture and CO_2 reuse to neutralize residual emissions and unlock new revenue streams
- **Transform Portfolios:** Shift from fossil-based to renewable and circular business models to align with the low-carbon economy

Industry Collaboration and Alliances

- **Form Tech Alliances:** Join industry consortia to share knowledge, set standards, and co-invest in low-carbon technologies
- **Collaborate Cross-Sector:** Partner with other industries (e.g. oil with renewables or tech) to accelerate innovation and sustainable sourcing
- **Build PPPs:** Work with governments on large-scale projects like hydrogen hubs, CCUS infrastructure, and workforce transition programs

Policy Advocacy

- **Advocate Carbon Pricing:** Support clear pricing and market mechanisms (e.g. global carbon price)
- **Co-Develop Standards:** Collaborate with regulators to shape practical, ambitious rules (e.g. methane monitoring, fuel standards, tailings management)
- **Position for Policy:** Align early with emerging regulations to benefit from incentives and level playing fields (e.g. tradable credits, faster permitting)

Public Communication & Transparency

- **Report Transparently:** Publish detailed climate reports and share methodologies to build credibility
- **Engage Publicly:** Participate in climate policy discussions as solution-oriented contributors
- **Lead with Communication:** Use public messaging to influence policy aligned with science-based targets and earn stakeholder trust

Addressing Obstacles at Advanced Stage

- **Secure Capital:** Tap into green funds, subsidies, and partnerships to fund high-cost tech and monetize decarbonization through premium products or carbon credits
- **Manage Tech Risk:** Pilot innovations in stages, invest in R&D, and maintain a flexible portfolio to learn from setbacks and scale what works
- **Reskill Workforce:** Build in-house academies, partner with universities, and inspire employees with purpose-driven roles to support operational shifts and attract new talent

Note: This is a non-exhaustive set of recommendations intended to guide further discussion.

Sources: Open Sources, PwC analysis

We are grateful to our participants for providing their valuable insights

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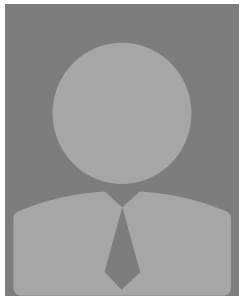

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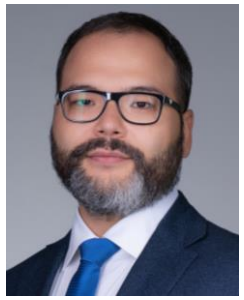

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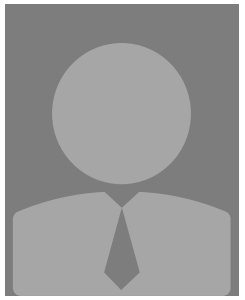

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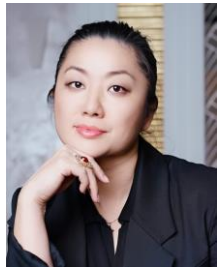

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Appendix

Appendix 1. Energy Transition Barriers (1/4)

1 Technological barriers

Outdated grid infrastructure: Traditional grids were built for fossil-fuel based operations, lacking flexibility to integrate RES, potentially leading to voltage instabilities and disruptions.

Low efficiency and intermittency of RES: RES are generally less efficient than traditional sources and facing the issue of intermittency with solar and wind heavily dependent on weather conditions, requiring advanced battery technologies for energy storage.

Limited availability of skilled technical personnel: Deficit in trained professionals, such as grid engineers and renewable energy technicians, to operate and control the new technologies, postpones industrial growth in this sector.

Social Acceptance Barrier: Public opposition to renewable projects, driven by concerns over land use, visual impact, noise, and lack of awareness, can delay deployment, highlighting the need for better communication and community engagement.

Cybersecurity risks: Architecture of modern energy systems is based on the digitalized sphere, which makes them susceptible to the cyber threats, like hacking, service disruptions, and server attacks, which leads to the further financial losses.

Lack of Storage Capacity: Limited storage capacity - due to high costs, immature technology, and lack of investment - hinders reliable integration of variable renewable energy into the grid.

These challenges highlight that the energy transition is not only a technological shift but also a systemic transformation requiring parallel investment in infrastructure, skills, digital security, and innovation to ensure grid stability and resilience. Without addressing these gaps, the transition risks slowing down and compromising energy reliability.

Source: Barriers to Energy Transition: Comparing developing with developed countries, Growing Cybersecurity Threats in the Energy Sector

Appendix 1. Energy Transition Barriers (2/4)

2 Regulatory barriers

- **Lack of Integrated Legal Framework:** Absence of unified legal structure aligning climate goals, energy, land, and market regulations slows coordinated action on the energy transition.
- **Outdated Policies**: Energy policies, developed before modern renewable technologies, fail to accommodate unique traits and benefits, limiting market entry and stifling innovation.
- **Limited Institutional Capacity and Complex Permitting**: Weak administrative capacity, lack of technical expertise, and bureaucratic procedures lead to lengthy permitting processes, slow project approvals, and challenges in managing complex agreements with the private sector.
- **Fragmented Regulations**: Projects across local, state/provincial, and national levels face regulatory inconsistencies, complicating compliance and increasing legal risks.
- **Market Design Limitations**: Traditional energy markets inadequately support variable sources like wind and solar, lacking necessary services such as flexibility and frequency regulation.
- **Land-Use Challenges**: Land availability for renewables is often limited by competition with agriculture, urban use, and conservation, along with legal hurdles, ownership disputes, and community resistance.

The success of the energy transition hinges on solving deep governance challenges — from modernizing institutions and legal frameworks to redesigning market rules — as regulatory and institutional bottlenecks can stall progress regardless of funding.

Source: Financing Pathways for the Energy Transition
Strategy& | Reshaping Energy in Eurasia: Insights from Kazakhstan and Uzbekistan

Appendix 1. Energy Transition Barriers (3/4)

3 Financial barriers

High Cost of Capital for Clean Energy: Renewable energy and infrastructure projects remain expensive to finance in emerging markets due to weak credit ratings, currency risks, investor flight, and limited access to affordable financing.

Competing Budget Pressures: Governments face tough choices between funding essential services and investing in the energy transition.

Debt Burden and Repayment Pressure: High interest rates, short repayment terms, and restrictive debt sustainability rules limit financial flexibility for clean energy investments.

Conditional Financing Limits Flexibility: Financial support from donors often includes stringent conditions that raise costs or constrain policy choices.

Financial barriers reveal that the energy transition in emerging markets is not just constrained by technology, but by structural weaknesses in global and domestic financial systems. Without reforming access to affordable capital and easing debt-related constraints, the transition risks being delayed not by lack of ambition, but by the cost of financing it.

Source: Financing Pathways for the Energy Transition

Appendix 1. Energy Transition Barriers (4/4)

4 Geopolitical barriers

Critical minerals dependence and Resource Nationalism. Many new energy technologies heavily rely on critical minerals, which often available in certain countries and not that widespread. Moreover, these countries may enact the protectionist policies which may cause disruptions in the producing of the energy efficient technologies. For example: Indonesia's export ban on raw minerals, particularly raw lithium, which is essential for the EV batteries.

Geopolitical tensions.

- Geopolitical conflicts and instabilities, such as Russian invasion in Ukraine, and US-China trade war worsens trust and cooperation, leading to trade disputes, economic sanctions, and delays in cross-border collaboration. These tensions disrupts important supply chains, negatively impacting the development of the energy technologies and projects, that rely on international cooperation and supply chains.
- Economically leading countries compete within the regions and countries for access to scarce resources. Such as race for dominance for lithium production in South America, and race for critical minerals in Africa. Aggressive policies, which cause diplomatic strains conflicts, lead to disruptions of the critical materials needed for new technologies.

The energy transition is increasingly shaped by resource competition and geopolitical tensions, exposing its dependence on fragile supply chains for critical minerals. Without stronger international cooperation and diversified supply strategies, clean energy ambitions risk being constrained by the same vulnerabilities that historically plagued fossil fuel markets.

Source: Geopolitics of Energy Transition, The Ukraine war and energy transition

Appendix 2. Kazakhstan's sustainable financing market has been actively developing with numerous placements of green and social bonds

Company	Date of issue	Amount of issue, m	Currency	Maturity	Coupon rate	Description
KEGOC	21.12.22	35,000	KZT	15 year	TONIA + 3.00% = 16.86%	JSC "KEGOC" issued its first green bonds in 2022. The funds were allocated to enhance grid infrastructure, facilitating the integration of RES and improving electricity transmission efficiency.
SOLVA	02.06.23	20,000	KZT	2 year	21.50%	JSC "Microfinance Organization OnlineKazFinance" (Solva) completed Kazakhstan's first corporate gender bond issue. The proceeds were used to finance female entrepreneurship.
EVO TAXI	11.07.24	3,000	KZT	3 year	19.50%	"A-Cars" LLP placed bonds at 19.50%, 13.50% of which is subsidized by Damu. Proceeds from the issue are directed to the modernization of fixed assets (taxi fleet) and launch of an electric taxi service in the city.
JET	22.12.23	3,000	KZT	3 year	20.75%	"Jet Group" Ltd. placed its green bonds on the AIX and used the financing to update the fleet of its electric scooters. The coupon rate for these bonds was subsidised by Damu.
KazWind Energy Ltd.	17.10.23	3,000	KZT	5 year	21.75%	"KazWind Energy" LLP issued green bonds in October 2023 with a coupon rate of 21.75%, 15.75% of which was subsidized by Damu. Funds raised were used to build a 48 MW wind power plant.
AL KARAL	17.11.23	2,000	KZT	3 year	21.50%	"Black Biotechnology" LLP issued green bonds to build a plant for the production of innovative bio-feed additives and fertilizers for the development of organic agriculture. The coupon rate was subsidized by Damu in the amount of 15.5% per annum.
ARNUR CREDIT	08.12.23	1,500	KZT	2 year	19.00%	"Microfinance Organization Arnur Credit" LLP issued social bonds that supported women-led micro, small, and medium-sized enterprises.

Sources: AIFC GFC Sustainable Finance Analytics, KEGOC press release, A-Cars report, Kursiv

Appendix 2. IFIs are crucial in promoting green financing projects in Kazakhstan

Bank	Date of issue	Amount of issue, m	Currency	Maturity	Coupon/ Interest rate	Description
Eurasian Development Bank	21.09.21	20 000	KZT	3 year	10.50%	The EDB has issued its first green bond on KASE, verified by ACRA for compliance with the ICMA Green Bond Principles. The funds raised are planned to be used to finance ESG projects in Kazakhstan.
ADB ASIAN DEVELOPMENT BANK	25.01.23	8 900	KZT	2 year	16.65%	The ADB raised 8.9bn tenge through a subscription on KASE, placing green international bonds with a yield to maturity of 16.65% per annum. In the total volume of active applications, banks accounted for 42.4%, while other institutional investors accounted for 57.6%. As a result of the placement, 5 applications were satisfied.
ADB ASIAN DEVELOPMENT BANK	20.01.25	7 644	KZT	2 year	13.94%	The ADB has issued two-year green international bonds on the KASE. The bank accepted 6 bids from 4 participants, placing bonds worth approximately $14.5m at a coupon rate of 13.94%. Notably, 77.1% of the issued bonds were purchased by banks, while 22.9% were acquired by other institutional investors.
ADB ASIAN DEVELOPMENT BANK	20.10.22	3 411	KZT	2 year	14.50%	The ADB raised 3.4bn tenge through a subscription on KASE by placing green international bonds with a yield to maturity of 14.50% per annum.

Sources: AIFC GFC Sustainable Finance Analytics, ACRA ratings, KASE news, Kursiv

Appendix 2. IFIs such as EBRD launched programs aimed at securing green financing

Bank/Fund	Program name	Program description	Program requirements
GREEN CLIMATE FUND European Bank for Reconstruction and Development	GCF-EBRD Kazakhstan Renewables Framework	The GCF-EBRD Kazakhstan Renewables Framework is a collaborative initiative between the Green Climate Fund (GCF) and the EBRD, aimed at accelerating Kazakhstan's transition to a low-carbon economy by promoting renewable energy development. Approved in 2017, the program supports the construction of 8–11 renewable energy projects in Kazakhstan, with a total capacity of 330 MW and total financing of $557m.	1. **Eligible entities:** local or international private or institutional companies, electricity distribution and transmission companies. 2. **Purpose:** to finance the construction, connection to the grid, commissioning and launch of the RES projects (solar, wind, small hydropower and biogas) and to electricity distribution and transmission companies to finance modernisation and strengthening of the electricity grid to enhance the integration of RES into the electricity grid.
European Bank for Reconstruction and Development	GEFF Kazakhstan II	In 2022, the EBRD approved financing of up to $150m in KZT equivalent to Partner Financial Institutions (PFIs) such as JSC “Bank CenterCredit”, JSC “Shinhan Bank Kazakhstan” for on-lending to private sector sub-borrowers to finance energy efficiency, renewable energy, resource efficiency, circular economy and climate resilience investments under the Bank's Green Economic Transition approach in Kazakhstan.	**Pre-Approved Technologies:** investments in technologies listed in the Green Technology Selector are automatically eligible for financing. 1. **Complex Projects:** for more complex investments the EBRD GEFF team provides free technical assessments to determine project eligibility. 2. **Maximum Financing Amounts:** • Individual borrowers & small projects: up to $50,000. Applies to individual borrowers and small, well-defined projects using high-performance equipment and materials from the Green Technology Selector. • For all borrowers of JSC “Bank CenterCredit”: up to $10m and for all borrowers of JSC “Shinhan Bank Kazakhstan”: up to $5m. Funding available for projects focused on energy efficiency, resource conservation, and renewable energy, for which GEFF provides advisory support and guidance.

Sources: GCF Funding Proposal, GCF-EBRD Kazakhstan Renewables Framework, GEFF, EBRD websites

Appendix 2. Precedents of RES financing (companies)

Company/Bank	Date	Amount, m	Currency	Description
MASDAR	02.12.23	1,400	USD	The UAE state-owned clean energy company Masdar announced the construction of a large-scale 1 GW wind power station in Kazakhstan. The $1.4bn project aligns with Kazakhstan's goal to transition from fossil fuels towards clean energy, as the country has pledged to reach net zero carbon emissions by 2060.
European Bank for Reconstruction and Development	31.05.23	50	USD	Senior loan of up to $50m was provided to "Shokpar Wind Power Station" LLP for the development, construction, and operation of a wind power plant with an installed capacity of 100MW located in Sarysu district of Zhambyl region.
AIIB ASIAN INFRASTRUCTURE INVESTMENT BANK	07.11.23	36	USD	The Asian Infrastructure Investment Bank has signed a $36m loan agreement for the development, construction and operation of a 100MW wind power plant in the Zhambyl region of Southern Kazakhstan.
+ stellarenergy Expect More™	01.11.24	10	USD	Memorandum of cooperation on the construction of a solar power plant between the Akimat of Mangystau region and Stellar Energy LLP for $10m was signed.
Development Bank of Kazakhstan	13.03.25	200	EUR	EIB Global signed a €200m loan deal with Kazakhstan's DBK to support green transport and renewable energy projects. Focus areas include the Trans-Caspian Corridor and climate initiatives.
ADB ASIAN DEVELOPMENT BANK	19.06.23	98,000	KZT	ADB signed a 98bn tenge loan deal with Samruk-Energy to modernise Almaty CHP-2 by replacing outdated coal-fired units with advanced gas turbine technology, which will significantly reduce GHG emissions.
ADB ASIAN DEVELOPMENT BANK	19.07.24	58,200	KZT	ADB and KEGOC signed a financing agreement worth 58.2bn tenge to enhance Kazakhstan's high-voltage transmission network in the southern region. The project includes constructing 500 kV overhead transmission lines and upgrading key substations in Shu, Jambyl, and Shymkent.
Development Bank of Kazakhstan	2024	37,504	KZT	EnergoBuildService LLP is implementing a project to construct two hydropower plants in the Kerbulak district of the Zhetisu region, with a combined capacity of 42 MW. The total project cost is 44.6bn tenge, with the DBK providing financing of up to 37.5bn tenge.

Sources: AIFC GFC Sustainable Finance Analytics, EBRD, ADB, EIB, DBK press releases, Kazinform International News Agency, The Astana Times, Solar Quarter

Appendix 2. Banks in Uzbekistan are active in numerous green and RES financing programs

Bank	Program name	Program description	Amount	Term	Interest Rate	Eligibility
AloqaBank	Modular loan for alternative energy	The loan program supports the purchasing of equipment and inventory aimed at ensuring access to alternative RES, including solar panels, wind power systems, and other similar technologies.	Up to 1.5bn soums	Up to 36 months	From 20.5%	Corporate clients and small enterprises
ipotekabank	Auto loan product "Super BYD"	The program is aimed at purchasing electric vehicles from BYD brand.	Up to 480m soums	From 36 to 60 months	From 18.9% to 21.9%	Individuals
TRASTBANK	Green financing	The loan program is designed to finance expenses related to the purchase and installation of certified solar panels, acquisition of renewable energy devices, and equipment for producing alternative energy.	Up to 1000 BCV* (412m soums)	Up to 60 months	Central Bank base rate + 7%	Corporate clients
	Loan for solar panels	Program represents a loan for the purchase and installation of solar panels.	Up to 200 BCV (82m soums)	60 months	20%	Individuals
BRB	Green energy loan	The program is aimed at purchase and installation of special energy-efficient equipment.	Up to 200m soums	Up to 36 months	Central Bank base rate + 6%	Individuals
ASIA ALLIANCE BANK	Green economy loan	The program is aimed at implementation of projects related to the renewable energy sources.	Up to 100m soums	From 60 months	Central Bank base rate + 7%	Individual entrepreneurs and corporate clients
	Consumer loan "Alternative energy"	The program is aimed at purchasing and installation of renewable energy sources.	Up to 220 BCV (90m soums)	Up to 36 months	20%	Individuals
IPAK YO'LI BANKI	Green Space loan	The program is aimed at financing the purchase of solar panels.	Up to 80m soums	Up to 60 months	From 19.5%	Individuals
Hamkor Bank	Loan for solar panels	The program is aimed at financing the purchase of solar panels.	Up to 75m soums	Up to 36 months	19.5%	Individuals
NATIONAL BANK OF UZBEKISTAN	National Green	Program represents a loan for the purchase and installation of RES and energy-saving equipment.	Up to 70m soums	Up to 60 months	From 20%	Individuals

** Base calculation value*

Sources: Aloqabank, Ipoteka bank, Trustbank, Business development bank, Asia Alliance Bank, Ipak Yuli Bank, Hamkorbank, National Bank of Uzbekistan websites

Appendix 3. Analysis of regulatory requirements on energy transition in Kazakhstan (1/3)

Environmental code of the Republic of Kazakhstan

The **Environmental Code**, adopted in 2021, is a comprehensive legal framework that modernizes the country's approach to environmental protection. It aims to align Kazakhstan with international environmental standards, especially those of the European Union, while encouraging sustainable industrial development.
A key innovation in the Code is the introduction of **Best Available Techniques (BAT)** as the foundation for environmental permitting. These techniques are defined in sector-specific BAT reference documents, covering sectors like energy, metallurgy, chemicals, cement, and waste management.

In addition to BAT, the Code introduces significant measures for **carbon emissions regulation**. It establishes a national **emissions trading system (KazETS)**, requiring major emitters—particularly in the power generation, oil and gas, and industrial sectors—to monitor, report, and verify their GHG emissions.

The Code also reinforces several broader principles and mechanisms:
- The "**polluter pays**" principle and environmental liability;
- Enhanced **public participation** in environmental decision-making, especially through environmental impact assessments (EIA);
- Mandatory use of **digital monitoring and reporting systems**;
- Introduction of **green taxonomy** and encouragement of **ESG practices** in the business sector.

Specific elements

Best Available Techniques (BAT):
- Between 2021 and 2023, Kazakhstan developed 16 BAT reference documents in alignment with the EU Industrial Emissions Directive. These documents aim to **promote energy-efficient and low-emission technologies** by adjusting EU BREFs to Kazakhstan's climatic, environmental, and economic conditions.
- Starting January 1, 2025, companies in Environmental Category I (i.e., with significant environmental impact) **must implement** Comprehensive Environmental Permits (CEP) with BAT conclusions, with a full rollout for all Category I facilities by **2031**. **Non-compliance will lead to penalties (50-300 MCI)**.
- **Reduced environmental fees** are provided for adoption of BAT, while non-adopters might face up to 8 times higher emissions payment.
- There is cross-compliance with carbon and ESG regulations.

Carbon Quota System:
- The Environmental Code establishes a **national carbon quota system** to reduce GHG emissions, with a national carbon budget reducing by 1.5% annually to support long-term decarbonization goals.
- Entities emitting **more than 20,000 tons of CO_2** must adhere to carbon regulations.
- Annual **GHG emissions inventories** dictate the assignment of carbon quotas.
- Companies can **request additional quotas** from a special reserve for expansion or new facilities, or purchase additional quotas via the carbon market if needed, while excess quotas can be banked or sold.
- **Carbon offset credits** may be earned by reducing CO_2 production or increasing GHG absorption. The GHG emissions inventory must be **validated by third-party** entities to prevent revocation of carbon quotas.

Sources: Official documents

Appendix 3. Analysis of regulatory requirements on energy transition in Kazakhstan (2/3)

Law on Energy Saving and Energy Efficiency

The **Law on Energy Saving and Energy Efficiency** of Kazakhstan aims to reduce energy consumption across all sectors and promote sustainable use of energy resources.

It requires **energy audits** and the development of **energy-saving action plans** for major energy consumers. New buildings, equipment, and technologies must meet **minimum energy efficiency standards**, and energy-intensive enterprises must be included in the **State Energy Register**.

The law encourages:

- Use of **energy-efficient technologies and materials**;
- **Monitoring** of energy use through automated systems;
- Public awareness and promotion of energy-saving practices.

It also supports the development of **ESCOs** and **energy performance contracting** to stimulate investment in energy efficiency.

Specific elements

- Construction projects utilizing energy resources are **required to incorporate energy-saving materials and install meters** for monitoring energy and water usage, along with automatic systems for regulating heat consumption.
- Buildings and structures must adhere to **energy efficiency standards** encompassing energy consumption metrics, architectural and engineering solutions, and the implementation of energy-saving technologies and materials.
- All electrical equipment must feature an **energy efficiency class label** in compliance with Eurasian Economic Union technical regulations.
- Entities with high energy usage (1,500+ tons of standard fuel annually), including specific government and quasi-public organizations, must be listed in the State Energy Register and **provide annual reports detailing energy consumption and energy-saving strategies**.
- Registered entities are **obligated to undergo energy audits** every five years, with the exception of state institutions.
- Comprehensive **external expertise is mandatory** for energy-saving projects at facilities with high energy consumption (500+ tons of standard fuel annually) or unique construction projects.
- The law facilitates energy service contracts to encourage improvements in energy efficiency. Additionally, large energy consumers can voluntarily commit to reducing their energy consumption by 15% over five years through agreements with state authorities.

Sources: Official documents

Appendix 3. Analysis of regulatory requirements on energy transition in Kazakhstan (3/3)

Law on Support for the use of Renewable Energy Sources

- Enacted in 2009**, the Law of the Republic of Kazakhstan "On Support for the Use of Renewable Energy Sources"** (No. 165-IV, July 4, 2009) aims to stimulate the production and consumption of energy from renewable sources.
- It establishes state support mechanisms, including **fixed tariffs and auction pricing for electricity generated from renewables**, along with guaranteed purchase of this energy by the grid.
- The law regulates the connection of renewable energy facilities to the power grid, their design and construction processes, and defines the responsibilities of market participants for accounting and reporting generated energy.
- It also sets forth penalties and liabilities for violations of renewable energy legislation.

Recent legislative changes in June 2024 now permit individuals, SMEs, and farms to generate and sell electricity from renewable sources with capacities of up to 200 kW, without requiring business registration.

Specific elements

- All electricity produced by RE facilities is **purchased by the Settlement and Financial Center**, with "conditional consumers" required to buy all renewable-generated electricity.
- Since 2018, **tariffs set through auctions are indexed**, initially for construction periods and annually for inflation. Projects with foreign currency obligations receive further annual indexation based on currency exchange rates or consumer price index.
- Renewable facilities have **assured access to the nearest connection points**, with no refusal by energy transmission organizations if the network is technically ready.
- Renewable energy producers **receive priority during electricity transmission**, especially when grid capacity is limited.
- Auctions are held online, with reserved land and network connection points; winners are determined by the **lowest price bid**. Electricity **purchase agreements last 20 years** for facilities commissioned from January 1, 2021, with guaranteed periods not less than the payback period.
- **Heat energy** from renewable sources supplied to centralized systems is purchased by local heat supply organizations and included in their tariffs.
- **Imbalances** in RES are **financially settled** by the Settlement and Financial Center per balancing market rules.
- Certain categories, including renewable energy facilities selling via the Settlement and Financial Center, are **exempt from electricity transmission fees**. This includes HPPs supplying flood electricity and post-2022 facilities using renewable energy for their own needs. Facilities selling heat energy are exempt from heat transmission service fees.

Sources: Official documents

Appendix 3. Analysis of regulatory requirements on energy transition in Uzbekistan (1/3)

Law on Electric Power Industry

The Law of the Republic of Uzbekistan on Electric Power Industry, adopted on 8 August 2024, lays down a unified legal framework for all activities in the electricity sector. It defines the scope of regulation – from generation and storage to transmission, distribution, trade and consumption – and specifies which facilities are exempt from the system-wide regime.

Central to the new regime is a clear division of roles among market participants: producers of electric energy; suppliers and traders; system operators for transmission, distribution and balancing; the central purchaser; and consumers with varying rights depending on their status. At the same time, it sets out the licensing requirements and technical, financial and organizational criteria that each category of participant must meet.

The law entrusts the Cabinet of Ministers, the Ministry of Energy, the Agency for Energy Market Development and Regulation, the Inspection for Fuel and Gas Use, and regional authorities with specific regulatory, supervisory and enforcement powers. It also establishes an independent market operator to organize competitive wholesale and retail markets under rules approved by the Government.

Specific elements

- The Law introduces a competitive wholesale and retail electricity market, defining rights for market participants (producers, suppliers, traders, large and authorized consumers, and market/system operators) to buy, sell, and choose suppliers under non-discriminatory conditions.
- All electricity market participants are granted access to transmission and distribution networks, subject only to technical capability, with connection and refusal procedures strictly regulated and publicly disclosed.
- Until the full launch of the competitive market, a Centralized Buyer (Central Procurement Entity) manages all electricity purchases and sales, acting as the market operator and guaranteeing electricity offtake from producers.
- Key electricity sector activities (generation, storage, transmission, distribution, supply, trading, and centralized procurement) are subject to mandatory licensing by the Energy Market Regulator, with transparent licensing criteria and rights.
- Transmission and distribution system operators must be legally, functionally, and financially separate from other electricity businesses. The transmission system operator remains 100% state-owned and is not subject to privatization.
- The Energy Market Regulator sets regulated tariffs for all essential services (generation, supply, transmission, distribution) based on transparent, non-discriminatory methodologies reflecting reasonable costs, and periodically publishes and revises them.
- The System Operator has the authority to manage real-time system balancing, issue binding instructions, and access all network assets to ensure security, reliability, and restoration during emergencies.
- Electricity enterprises are obligated to provide "social services" to vulnerable or protected consumer categories, with terms, financing, and tariffs for these services set by the government.

Sources: Official documents

Appendix 3. Analysis of regulatory requirements on energy transition in Uzbekistan (2/3)

Law on Saving Energy, Its Rational Use and Increasing Energy Efficiency

The Law of the Republic of Uzbekistan on Energy Saving, Its Rational Use, and the Improvement of Energy Efficiency, adopted on 7 August 2024, establishes a comprehensive legal framework for regulating activities aimed at increasing energy efficiency and promoting responsible energy consumption across the country.

The law defines key terms and concepts related to energy resources, energy management, and efficiency standards, and sets forth the responsibilities and powers of government bodies at various levels, including the Cabinet of Ministers, the Ministry of Energy, regional authorities, and inspection agencies. It mandates the development and enforcement of national energy efficiency standards for equipment, devices, and processes, and introduces mandatory certification and labeling requirements.

The law requires large energy consumers to undergo regular energy audits, adopt energy management systems, and develop measures to reduce consumption in line with progressive standards. It also encourages the formation and accreditation of energy service companies, regulates energy service contracts, and introduces mechanisms for financing energy-saving projects through state funds and international support.

Specific elements

- All devices, equipment, products, and technologies sold or imported in Uzbekistan must comply with national energy efficiency standards.
- Legal entities consuming ≥500 tons of standard fuel and/or ≥250 tons of motor fuel annually are included in the State Energy Register and must undergo mandatory energy audits at least every five years.
- Annual and five-year progressive benchmarks are established for energy/resource use, requiring gradual reduction of energy intensity based on audit results and best available technologies.
- Manufacturers, importers, and sellers are required to test, measure, and certify products for compliance with national energy efficiency standards; energy efficiency labels (categorization) are mandatory for household appliances.
- Only accredited energy service companies may enter into ESCO contracts for providing comprehensive energy-saving services, including installation and operation of renewable energy equipment.
- Public sector organizations are permitted and encouraged to enter into ESCO contracts under terms defined by law, with financial incentives based on verified energy savings.
- Entities included in the State Energy Register must implement energy management systems and assign certified energy managers responsible for monitoring and optimizing energy use.
- All new and reconstructed buildings, especially multi-apartment and non-residential, must have individual energy meters installed, with billing based on actual consumption.
- Violations (such as selling non-compliant products or failure to perform mandatory audits) are subject to significant fines, but first-time offenders may avoid sanctions by voluntarily correcting violations and compensating damages.

Sources: Official documents

Appendix 3. Analysis of regulatory requirements on energy transition in Uzbekistan (3/3)

Law on the use of renewable energy sources

The Law of the Republic of Uzbekistan on the Use of Renewable Energy Sources, adopted on 21 May 2019 and subsequently amended, establishes the legal framework for the development, production, and use of energy from renewable sources such as solar, wind, geothermal, hydro, and biomass. The law defines key concepts and sets out the main directions of state policy, which include promoting the use of renewables, supporting research and innovation, and ensuring energy security and diversification.

The law provides for state support and incentives, including tax and customs benefits, guaranteed grid connection, and favorable tariffs for renewable energy producers. It sets out the technical, environmental, and safety requirements for installations and operations, and introduces a system of “green energy” certificates to confirm the origin of electricity generated from renewables. Special provisions simplify the use of renewables for self-consumption, exempting small-scale producers from certain permitting requirements. The law also regulates the procedures for connecting to the grid, defines the obligations of producers, and establishes mechanisms for state accounting, tariff setting, and certification.

Specific elements

- Renewable energy installations have the right to be connected to the unified power system, with the connection process regulated and guaranteed by law. Costs for network reconstruction/expansion up to the connection point are borne by the renewable energy producer.
- Production of electricity, heat, or biogas from renewable sources for own use does not require any permits or licenses.
- Tariffs for electricity generated from renewable energy are determined through competitive bidding (auctions), ensuring market-based pricing for new projects.
- State support is provided through tax, customs, and other incentives for producers and manufacturers of renewable energy installations, including import duty exemptions for certain equipment.
- Producers of renewable energy have the legal right to construct their own local electric, thermal, or gas distribution networks and to contract directly with consumers.
- Renewable energy installations with a capacity of 300 kW or more must be registered with the designated government authority before grid connection.
- An electronic “green energy” certificate is issued for electricity generated from renewable sources, confirming its origin and allowing for market recognition.
- All renewable energy produced and consumed is subject to mandatory separate metering and reporting for state statistical and regulatory purposes.
- Local electricity grid companies, with the consent of the unified buyer and local authorities, are allowed and encouraged to sign purchase agreements directly with renewable energy producers.

Sources: Official documents

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