

# MONITOR

SUSTAINABILITY NO. 02 / 2024

## Kazakhstan's Energy Transition

### Tackling the Challenges on the Path to Carbon Neutrality

*Tatiana Lanshina, Yana Zabanova*

- › Kazakhstan is Central Asia's energy transition pioneer. It was the first country in the region to set renewable energy targets, develop a functioning support mechanism for wind and solar, launch an emissions trading system, and establish a carbon neutrality target.
- › To date, Kazakhstan's approach to the energy transition has mainly consisted of adding new wind and solar capacity in the power generation sector. However, the country is not yet pursuing a fully renewables-based power sector.
- › In many key sectors, the transition has yet to begin. These include energy-intensive industries, transport, and residential heat. Clear sectoral reduction targets and roadmaps, coupled with effective support mechanisms, are essential in these areas.
- › Carbon pricing can be a key pillar in incentivising economy-wide industrial decarbonisation in Kazakhstan. For this to be effective, a comprehensive reform of the national emissions trading system is essential.
- › Securing access to affordable financing and streamlining the fragmented national climate and energy policy framework for the energy transition remain significant challenges.
- › Moving forward, Kazakhstan will need to address sensitive and challenging issues such as planning a just coal phaseout, raising energy tariffs, and phasing out fossil fuel subsidies.

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### Background

Kazakhstan is the largest economy in Central Asia and ranks among the highest in the world in energy intensity.<sup>1</sup> The country heavily depends on the export and use of its extensive natural resources, particularly fossil fuels. In the first half of 2024, oil and petroleum products accounted for 56% of the nation's export revenues,<sup>2</sup> underscoring their dominant role in the economy. While the share of the oil and gas sector in the GDP declined from over 25%<sup>3</sup> in the early 2010s to 16.2%<sup>4</sup> in 2023, it remains a significant contributor. Since the beginning of the 21st century, Kazakhstan's revenues from fossil fuel exports have surged,<sup>5</sup> complicating efforts to shift towards renewable energy and to reduce carbon emissions.

In addition to the oil and gas sector, coal mining, metallurgy, agriculture, and manufacturing are key sectors of Kazakhstan's economy. The country is a leading global producer of metals and minerals, including uranium (46% of the total global production<sup>6</sup>), copper, zinc, lead, iron, and gold. Agriculture also plays an important role, with Kazakhstan being a major producer of wheat, barley, and other cereal grains. Fossil fuels contribute to the competitiveness of other sectors of the economy, including the metallurgical sector which benefits from the supply of low-cost domestic coke.

Kazakhstan finds itself in a situation of carbon lock-in, with a strong reliance on the exports of oil and, to a lesser extent, gas. Its domestic economy is fuelled by cheap hydrocarbons, including abundant coal resources that are used to produce electricity and heat. There are also substantial subsidies for the consumption of fossil fuels, which amounted to 6% of the GDP in 2021, according to IEA data. As a result, there are currently few incentives to invest in industrial decarbonisation, a gradual phase-out of coal, or energy efficiency.<sup>7</sup>

Despite these challenges, Kazakhstan has undertaken a number of measures to develop renewable energy and to diversify its economy away from fossil fuels. There is also an understanding in the country that in the near future, the world will see growing demand for minerals needed for the energy transition, such as copper, lithium, cobalt, and manganese, while demand for fossil fuels (primarily coal) will decline.<sup>8</sup> However, progress in ensuring the supply of these minerals has been modest.

## Kazakhstan's Climate and Decarbonisation Policy

### Climate Policy

Kazakhstan was one of the first post-Soviet countries to openly acknowledge the looming end of the hydrocarbon era and the need for a green structural transformation. In May 2013, Kazakhstan adopted the Concept of the Transition to a Green Economy, a pioneering strategic document which called for a 30% share of renewable and alternative (nuclear) energy in total power generation by 2030 and 50% by 2050. For a country with virtually no low-carbon generation capacity at the time other than the Soviet-built hydropower plants, these were very ambitious targets.

While Kazakhstan was quick to sign and ratify the Paris Agreement in 2016, its commitments under the treaty remain limited. Kazakhstan's First Nationally Determined Contribution (NDC) sets the goal of a 15% unconditional reduction in greenhouse gas (GHG) emissions by 2030 (from the 1990 level), as well as a conditional 25% reduction target contingent on receiving external assistance like concessional financing or technology transfer. However, since Kazakhstan experienced a prolonged severe economic downturn after gaining independence in 1991, its GHG emissions at the time of signing the Paris Agreement were already lower than in 1990, further reducing the scope of the ambition.

Despite this, in 2020, Kazakhstan became the first post-Soviet republic to announce plans to reach carbon neutrality (by 2060). In February 2023, after intense discussions and multiple revisions, the government issued the corresponding strategy.<sup>9</sup> The Strategy to Achieve Carbon Neutrality by 2060 assigns renewable energy a central role in decarbonising Kazakhstan's economy. In addition, it lists measures such as developing nuclear power and Carbon Capture and Storage (CCS) technologies, increasing energy efficiency, using carbon sinks – with a special emphasis on sustainable forest management –, and improving waste management practices and circularity. Low- and zero-emission hydrogen is expected to play a supporting role. The strategy emphasises the importance of effective carbon pricing and outlines plans for progressively reducing the number of free emission allowances as well as introducing a carbon tax for sectors outside of the national emissions trading system. However, the document lacks clear reduction targets for the energy and transport sector and industry. An implementation roadmap is currently under development.

In addition to focusing on CO<sub>2</sub>, Kazakhstan is also stepping up its efforts to reduce methane emissions, a highly potent greenhouse gas. The country has experienced some of the world's largest

methane leaks, including a significant one detected by satellites in the summer of 2023 at an oil well near the Caspian Sea. In the same year, Kazakhstan joined the Global Methane Pledge, a joint US and EU initiative aiming for a 30% reduction in methane emissions by 2030. A national methane strategy is expected to be finalised in 2025, in time for COP30.

### Carbon Pricing

Kazakhstan introduced a national emissions trading system as early as 2013, inspired by the EU's scheme. It covers CO<sub>2</sub> emissions from power generation, the oil and gas industry, mining and metals, the chemical industry, as well as cement, gypsum, brick and lime production.<sup>10</sup> However, from the outset, the system has been exposed to pressure from stakeholders from energy-intensive industries. This has led to an overallocation of free allowances and the application of excessively high emissions benchmarks, which undermine market mechanisms and hinder the development of an adequate carbon price. In early September 2024, the CO<sub>2</sub> price stood at a mere 397 KZT (0.73 EUR/0.81USD)<sup>11</sup> per ton, compared to 66.7 EUR (74 USD)<sup>12</sup> per ton in the EU.

With such low domestic CO<sub>2</sub> prices, exports from Kazakhstan will not be exempt from payments required under the EU's Carbon Border Adjustment Mechanism (CBAM). From 2026 onwards, the mechanism will gradually impose the EU ETS CO<sub>2</sub> price on a range of energy-intensive imported goods, including iron and steel, aluminium, fertilisers, cement, electricity, and hydrogen. However, the CBAM's initial impact on Kazakhstan is expected to be minimal, affecting only about 1% of the country's total exports.<sup>13</sup> This is due to the fact that Kazakhstan exports a larger share of products in these categories to non-EU markets, such as China, Russia, and Central Asian countries. Nevertheless, if the CBAM is extended to include oil and petroleum products in the future, its impact on Kazakhstan could increase significantly.

### Clean Hydrogen Ambitions

Despite its vast renewable energy potential, Kazakhstan has been relatively hesitant to join the global hydrogen race, with the government and the business community viewing the future of this new energy carrier as speculative. Consequently, most hydrogen-related developments in the country have been initiated externally. In 2021, the German-Swedish energy company Svevind announced plans for HyrAsiaOne, a large green hydrogen project to be located in western Kazakhstan on the shores of the Caspian Sea. In November 2022, the EU and Kazakhstan signed a strategic cooperation agreement on green hydrogen and critical raw materials, and in March 2023, Germany opened a hydrogen diplomacy office in Astana. HyrAsiaOne has been strongly motivated by a vision of supplying customers in the European Union, although local demand has been viewed as important as well. However, the prospects for implementing these projects remain uncertain due to the lack of infrastructure for transporting hydrogen to Europe and the absence of offtakers in Central Asia.

As an alternative to exports, locally produced green hydrogen could play an essential role in decarbonising Kazakhstan's hard-to-abate sectors, such as the chemical and refining industry and steel production. However, neither the Carbon Neutrality Strategy of February 2023 nor the Hydrogen Development Concept adopted in September 2024 strongly prioritise industrial end uses. In the absence of support mechanisms – such as mandatory quotas, production subsidies, or carbon contracts for difference – domestic demand for clean hydrogen has been largely non-existent.

## Decarbonising the Power and Heat Sector

Kazakhstan's deeply coal-dependent electricity and heat sector accounts for more than half of the nation's total energy-related CO<sub>2</sub> emissions.<sup>14</sup> The sector is dominated by coal-fired combined heat and power plants (CHP), a technology that is ubiquitous in many former Soviet republics. To date, the energy transition in Kazakhstan has almost exclusively focused on electricity generation, consisting mainly of the deployment of new solar and wind facilities. By contrast, there is almost no heat production from renewable energy sources, aside from traditional biomass such as firewood. The biogas sector remains very underdeveloped.

## The Role of Coal for Kazakhstan

Coal is the backbone of Kazakhstan's energy sector, generating 66% of all electricity<sup>15</sup> and 80% of thermal energy.<sup>16</sup> It also plays an important role in industry, most prominently in steel production. Kazakhstan fully meets its domestic demand for thermal coal. About 30% of the coal mined in Kazakhstan is exported, with two-thirds of the exports going to Russia,<sup>17</sup> generating some further revenue.

Coal has economic advantages over other energy sources in Kazakhstan. The country has vast coal reserves (29.4 billion tons) which can last for another 300 years.<sup>18</sup> Much of Kazakhstan's coal lies close to the earth's surface and is cheap to extract. Almost all of Kazakhstan's coal-fired generation capacity was constructed during the Soviet era and has long since been fully amortised. Thus, the costs of coal-fired power generation consist mainly of fuel, repairs, and maintenance, with very low capital expenditures. As a result, coal is extremely cheap and, in addition to its natural low price, is also subsidised by the state. Since the carbon price in Kazakhstan is among the lowest in the world, it does not increase the cost of coal combustion either. Economically, coal's overall significance is relatively minor, with the World Bank estimating Kazakhstan's coal rents<sup>19</sup> at about 0.8% of GDP.<sup>20</sup> However, there are entire cities in Kazakhstan built around the coal industry, which plays an important role in their economies, creating both direct and indirect jobs.

However, coal also has significant disadvantages: it is responsible for about 40% of Kazakhstan's total GHG emissions.<sup>21</sup> Coal combustion in large urban centres is a major cause of severe air pollution, with Almaty, Kazakhstan's largest city with a population of 2.3 million, being among worst affected.<sup>22</sup> To mitigate this problem, there are plans to convert the city's thermal power plants from coal to gas.

Almost all of Kazakhstan's coal power plants were built before 1990<sup>23</sup> and require capacity replacement. The entire energy infrastructure, built around coal back in Soviet times, is aging. Moving forward, electricity from new coal-fired power plants will no longer be as cheap as it was from Soviet-era plants, as the cost will now include capital expenditures. The gradual replacement of coal generation with renewable energy is thus the most important and straightforward way to reduce GHG emissions in Kazakhstan. Economic considerations support this pathway: according to a study by the German think tank Agora Energiewende, reducing the share of coal in electricity generation to 45% by 2030 could also lead to lower costs for electricity generation and transmission.<sup>24</sup>

At present, however, there is no commitment in Kazakhstan to significantly reduce coal-fired power generation, although several official strategic documents, including the Strategy for Achieving Carbon Neutrality by 2060, do indicate the need for such a reduction.<sup>25</sup> The share of coal in

the electricity mix may decline due to the expansion of renewable energy sources and possibly the construction of nuclear power plants. However, a significant reduction in coal-fired power generation in absolute terms is not being discussed.<sup>26</sup> Instead, Kazakhstan plans to build new coal-fired power plants with a combined capacity of 4.7 GW in cooperation with Russian partners by 2035.<sup>27</sup>

### Renewable Energy Development

Renewable energy development has received a high level of political support in Kazakhstan due to its potential to bolster the country's international standing and attract foreign investment. Kazakhstan adopted the Law on Support for Renewable Energy Sources in 2009, yet it took several years for renewable energy development to gain momentum. In 2013, Kazakhstan introduced renewable energy targets: by 2020, 3% of electricity was to be generated from solar, wind, small hydro-power, and biogas – a target that was met on time. By 2030, the goal is to reach 15%. There is also an interim target of 6% by 2025, which Kazakhstan is on track to achieve.

Kazakhstan's support framework for renewables was developed in close cooperation with the European Bank for Reconstruction and Development (EBRD) and later also with USAID's Power Central Asia Program. The first decisive step was the introduction of generous feed-in tariffs for wind- and solar-generated electricity in 2014, which included long-term (15-year) offtake contracts and annual indexation to account for inflation and, if applicable, for exchange rate volatility. The tariffs sparked a relatively rapid development of wind and solar facilities across the country. In 2018, in an attempt to reduce the costs of renewable energy projects and to gain more control over the siting of new installations, the government introduced renewable energy auctions. These auctions resulted in a swift and substantial reduction in tariffs, down to \$0.02 per kWh for wind and \$0.04 per kWh for solar in 2023-2024.<sup>28</sup> As of August 2024, Kazakhstan had installed 1.2 GW of solar capacity and 1.4 GW of wind capacity. In the first six months of 2024, solar and wind energy contributed 5.5% to Kazakhstan's total power generation.<sup>29</sup>

More recently, Kazakhstan has shown a growing interest in intergovernmental agreements for constructing gigawatt-scale wind power plants with integrated storage. In 2023-2024, Kazakhstan signed deals with Saudi Arabia's ACWA Power, the UAE's Masdar, France's TotalEnergies, and China International Power Holding for the construction of a combined 4 GW of wind power capacity. Unlike the transparent auction process, however, these negotiations are usually conducted behind closed doors, with little public information available on tariff-setting.

Despite good progress, renewable energy development in Kazakhstan is facing several challenges. The most pressing issue is the slow modernisation of the transmission network and the lack of connections between the gas-rich western energy zone and the northern and southern ones. Another obstacle is the lack of flexibility in the energy system. Although the share of wind and solar energy in the Kazakh power system is still relatively low, grid integration issues are already becoming a concern. This is because the output of old coal-fired power plants, unlike that of hydro-power or gas-fired power plants, cannot be flexibly regulated. Therefore, during periods of abundant electricity production from solar and wind, it is not possible to shut down coal-fired power plants. As a result, the higher the share of variable renewables in the grid, the greater the likelihood of curtailing solar and wind power plants. Another challenge is the improvement of the accuracy of solar and wind generation forecasts, as electricity production from renewable sources

depends on the weather. While accurate forecasts are technically feasible and used in countries like Germany, they are not yet available in Kazakhstan.

To maintain grid stability – especially in view of the rapidly increasing electricity demand – Kazakhstan increasingly relies on electricity imports from Russia. There is a strong push on the part of the national grid operator, KEGOC, to make integrated storage facilities mandatory for new projects. However, Kazakh companies active in the renewable energy sector have opposed such a requirement, arguing that it would significantly increase the costs of new projects, making them unprofitable. Other flexibility mechanisms for grid stabilisation, such as sector coupling, demand management, and larger energy flows within the Central Asian regional grid remain largely untapped.

### Other Decarbonization Avenues

Apart from developing renewables, Kazakhstan is exploring other potential solutions to reduce and compensate for CO<sub>2</sub> emissions. These include expanding the use of natural gas as a transition fuel by promoting gasification and, as mentioned earlier, converting some coal-fired power plants to gas. More controversial and costly are proposals for nuclear power development. Although Kazakhstan is the world's largest producer of uranium, it currently does not operate any nuclear power plants of its own. There is widespread social scepticism about nuclear power in Kazakhstan, rooted in the country's history as a Soviet nuclear testing site.<sup>30</sup> Safety concerns play a prominent role as well. However, the country's political leadership has made it clear that it is interested in developing nuclear power, which is included in most power sector development and decarbonisation scenarios. Currently, two blocks with a capacity of 1400 MW each are under discussion.<sup>31</sup> A national referendum on the issue was held on October 6, 2024, with a 63.66% turnout. According to the official results, 71.12% voted in favour of the nuclear power plant construction.<sup>32</sup> At present, it is still unclear who would build the reactors, with the contenders including leading nuclear companies from Russia, China, South Korea, and France.<sup>33</sup>

Another contested decarbonisation pathway is the expected use of CCS in the remaining coal-fired thermal plants beyond 2035, as stated in the Carbon Neutrality Strategy. CCS and CCU (Carbon Capture and Utilization) technologies remain underexplored in Kazakhstan, although the country has a massive CO<sub>2</sub> storage potential. According to research conducted at the Nazarbayev University, storage capacity at four best selected sites was estimated at 306 Gt, equivalent to 917 years of annual national GHG emissions.<sup>34</sup>

### Regional Power Trade

Interconnectivity – both within Kazakhstan and with other countries in the region – is becoming increasingly crucial for Kazakhstan. The growing electricity generation from renewable energy sources makes transmission capacities in the interconnected grid even more important. With rising electricity demand and an aging power plant fleet, grid expansion becomes even more crucial for balancing fluctuations.

Grid connectivity in Kazakhstan needs significant improvements. As the Kazakh energy grid was originally designed and built as part of the integrated Soviet system, its different regional energy zones are connected to the Russian grid. What is missing, however, is a connection between the Western zone, where the country's entire oil and gas industry and many flexible gas-fired power plants are located, and the Northern and Southern zones. In September 2024, the national

System Operator, KEGOC, approved the long-awaited investment project to connect the Western zone to the rest of the country by December 2027, with financing from the EBRD.<sup>35</sup> There are also plans underway to strengthen the connection between the Northern and Southern zones by 2030.<sup>36</sup> Kazakhstan's power grid operates in parallel with the Russian grid. The national grids of Uzbekistan and Kyrgyzstan are also part of the Central Asian United Power System (CA UPS), which operates in synchronous mode. However, the power grids of Tajikistan and Turkmenistan are currently not synchronised with the CA UPS, making cross-border electricity trade for balancing fluctuations difficult.<sup>37</sup>

Kazakhstan has been covering peaks in electricity demand by importing growing volumes of electricity from Russia.<sup>38</sup> In 2023, Kazakhstan imported a record of 5 billion kWh from Russia, equivalent to 4.3% of its total electricity consumption.<sup>39</sup> Until a few years ago, Kazakhstan had also imported electricity from Kyrgyzstan and Tajikistan, but they can no longer meet their own needs. Since 2023, Russia has been supplying Kyrgyzstan with electricity in transit through Kazakhstan. However, Kazakhstan plans to resume importing electricity from Tajikistan via Uzbekistan once all units of the large-scale Rogun hydropower plant, which has been under construction since 2016, are put into operation.

## Industrial Transformation Pathways First Steps Towards the Energy Transition

Kazakhstan's industry, a major GHG emitter, is at a very early stage of the green transformation. Access to cheap hydrocarbons provides a central competitive advantage for energy-intensive industries, such as metals, mining, and the chemical industry. Kazakhstan's negligible CO<sub>2</sub> prices and the lack of sector-specific decarbonisation targets weaken incentives to invest in costlier climate-friendly technologies. Overcoming this carbon lock-in will require significant efforts, including targeted sectoral policies, support measures, and access to affordable financing.

Two categories of companies in Kazakhstan are emerging as first movers in the energy transition. These include export-oriented companies, especially those targeting markets with stricter climate policies like the EU, and local subsidiaries of foreign companies bound by corporate decarbonisation strategies. As in many hydrocarbon-rich countries, international oil companies active in Kazakhstan, most of which have adopted net-zero targets, have been at the forefront of these efforts.<sup>40</sup> Kazakhstan's national energy companies are now following suit, albeit with lesser ambition. The national oil and gas company, KazMunayGas (KMG), has set a reduction target of 15% by 2031 (from the 2018 baseline) covering direct and indirect emissions,<sup>41</sup> while the state-controlled gas company QazaqGas aims for a 10-12% reduction of its carbon footprint by 2032.<sup>42</sup>

Companies in Kazakhstan's oil and gas sector are now increasingly investing in renewable energy. In 2019, Total Eren, an affiliate of TotalEnergies, commissioned two solar farms, Nomad (28 MW) and M-Kat (100 MW). Currently, TotalEnergies, in partnership with KMG and the national sovereign wealth fund Samruk Kazyna, is planning the construction of a 1 GW onshore wind farm, Mirny, with integrated battery storage (600 MWh).<sup>43</sup> Eni is another important actor. In 2020 and 2022, its local subsidiary ArmWind LLP launched two wind power plants, Badamsha 1 and 2 (48 MW each) in the Aktobe Region in western Kazakhstan. This was followed by a 50 MW solar power plant inaugurated in September 2023 by Plenitude, an Italian electricity and gas retail company fully controlled by Eni. More recently, KMG and Eni have announced plans to build a 247 MW hybrid power plant in Zhanaozen, combining solar, wind, and gas generation capacity.



In other industry sectors, progress has been more modest. In 2019, Kazakhstan's copper company, Kazakhmys, launched a 10 MW solar farm, Kengir, followed by the 50 MW Balkhash solar farm in 2023, which is to be expanded to 100 MW by 2025. KAZ Minerals is planning to invest in expanding the installed capacity of small hydropower plants to 106 MW. The large mining holding ERG, which is responsible for 9% of Kazakhstan's total GHG emissions, may demonstrate the highest ambition. In 2022, ERG introduced an internal carbon price for assessing investment projects, and in mid-2024, it issued a corporate decarbonisation strategy aiming to reduce the carbon footprint of its key product categories (ferrochrome, aluminium, and iron ore pellets) by 30% by 2035 and achieving net zero by 2050.<sup>44</sup> ERG is also in the process of constructing a 155 MW wind farm at its large mining and processing plant in Khromtau. Some industrial processes cannot be decarbonised through electrification, however, requiring zero-emission feedstocks or high-temperature heat that can be supplied by clean hydrogen, which remains underdeveloped in the country.

### Moving up the Value Chain in the High-Carbon Segment

Like many petrostates facing the challenges of the energy transition,<sup>45</sup> Kazakhstan is intent on capturing more value from its oil and gas reserves. It primarily plans to achieve this by developing a domestic petrochemical industry and expanding oil refining and gas processing capacities. In the petrochemical sector, Kazakhstan Petroleum Industries (KPI) set a milestone in 2022 by launching the country's first large polypropylene plant. Currently, KMG, in collaboration with Sibur, Russia's largest integrated petrochemical company, and China's Sinopec, is developing a polyethylene plant scheduled to be operational in 2027–2028.

Expanding oil refining and gas processing capacities is another priority. The country's three major refineries struggle to meet the rising domestic demand driven by population growth, leading to significant fuel imports from Russia. Demand for gas-based fuels has been rising as well. Illegal exports of commercial gas, especially to Russia, where prices are significantly higher than in Kazakhstan, further limit the quantities available domestically. If a common market for oil and petroleum products is introduced within the Eurasian Union as planned in 2025, the issue is likely to worsen. To address this, Kazakhstan's national company QazaqGas plans to launch four new gas processing plants between 2026 and 2030, including two plants in Kashagan in partnership with Qatar's UCC Holding. The government is also promoting the use of natural gas-based motor fuels, such as compressed natural gas (CNG) and liquefied natural gas (LNG), and QazaqGas is constructing an LNG plant in Rudny in northern Kazakhstan to meet domestic demand.

Coal chemistry has been attracting a growing interest in Kazakhstan as well.<sup>46</sup> Key coal chemical processes include coal gasification, liquefaction, and the production of valuable by-products such as coke for metallurgical industry, tar, and chemicals for the petrochemical industry. Many coal mining companies are hopeful that the demand for coal chemicals will complement or even replace the demand for coal from power plants and boiler houses in a few decades.

However, switching from coal combustion to coal chemistry does not solve the problem of GHG emissions and leads to other negative environmental impacts, such as high water consumption and discharging toxic wastewater, as well as pollution from coal mining. Nevertheless, companies are convinced that coal chemistry could become a new engine of economic growth in Kazakhstan and make the country a world leader in this field. Currently, China is the only country successfully implementing large-scale coal conversion, transforming coal into products like coke, fertilisers, and various chemicals.<sup>47</sup> Kazakhstan is increasingly looking to China's experience and seeking to

attract Chinese partners and investors. However, even in China's case, the future prospects of the coal chemical industry in the global energy transition are highly uncertain.<sup>48</sup>

### Key Challenges and Solutions

To achieve carbon neutrality, Kazakhstan needs to address several cross-sectoral challenges, both technical and systemic in nature. A fundamental restructuring of the energy system and the entire economy is required, which cannot be done painlessly. Especially challenging is the diversification of the regional economies that depend on coal mining. This requires significant investment in the expansion of renewable energy, as well as in the development of new industrial sectors, sustainable agriculture, and the service sector. Any energy transition strategy will need to account for the risk of significant job losses. Coal mining, electricity generation at coal-fired power plants, and related industries employ tens of thousands of workers. Without the support of the government, development banks, and international organisations, a structural change of this magnitude cannot succeed. The energy transition must be gradual and fair, necessitating special institutions and financing instruments.

For a just energy transition, Kazakhstan must set ambitious but achievable emission reduction targets in all key sectors of the economy, including electricity and heating, transport, and energy-intensive industries. These sectoral targets should be included in Kazakhstan's Second Nationally Determined Contributions (NDC) under the Paris Climate Agreement as well as in national and regional strategic documents.

The financing of the energy transition can be secured through a combination of domestic and international sources. Effective means include the issuance of green bonds, an increase in the carbon price, and access to funds provided by international organisations, development banks, and private investors. A reorientation of investment flows away from traditional sectors toward low-carbon ones can play an important role as well. A favourable investment climate is a must for unlocking these financial flows.

To integrate growing shares of renewable energy, it is necessary to modernise the Kazakh power grid and improve connectivity between different regions of the country, as well as with neighbouring countries. In addition, it is important to explore and develop other flexibility options, such as energy storage solutions, smart grids, demand management, and sector coupling.

In expanding renewable energy sources and related sectors (such as energy storage or electric vehicles), a high share of local value creation should be promoted, without imposing strict local content requirements. A successful energy transition would generate positive spillover effects, fostering domestic value creation and creating new jobs. It could also potentially lower the costs of renewable energy development, especially in the wind power sector, which is characterised by the expensive logistics of importing and transporting heavy wind turbine components.

Any initiatives to diversify the economy should be supported, especially in coal-dependent regions. To reduce coal mining, other industries (e.g., production of consumer goods) should be established in these areas, agriculture and the service sector should be expanded, and infrastructure must be modernised. The structural change must be accompanied by education and retraining programs as well as early retirement programs for coal miners.

Kazakhstan's efforts to move up the value chain in the oil and gas sector through the development of the petrochemical industry and the expansion of oil and gas processing should be linked to a clear vision for decarbonising these hard-to-abate sectors. This includes electrifying processes wherever technically feasible, substituting parts of fossil feedstocks with bio-based feedstocks or green hydrogen, applying CCUS, and putting a strong emphasis on circularity.

Kazakhstan should capitalise on its strong green hydrogen potential. While exports to Europe are unlikely in the short- to mid-term, green hydrogen can and should be developed to decarbonise the country's hard-to-abate sectors, such as refineries, the chemical industry, and steel production. This would also allow Kazakhstan to specialise in producing higher-value green industrial products, which are expected to command higher premiums in international markets in the future.

In all of this, from financing to technology transfer to trade, international cooperation plays a central role. It is also essential to involve the relevant stakeholders at all levels – regions, cities and municipalities, companies, universities, think tanks, and non-governmental organisations. A successful energy transition would not only help Kazakhstan reduce its GHG emissions and environmental pollution, but it would also elevate the country's economy to a new level of development.

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## Imprint

### The Authors

**Dr. Tatiana Lanshina** is a Project Lead in the Power System Transformation team at Agora Energiewende\*, focusing on cooperation with Kazakhstan. Lanshina also serves as the CEO of the Goal Number Seven Association, which promotes voluntary corporate demand for renewable energy in Russia. She holds a PhD in Economics from the Moscow State Institute of International Relations.  
*\*The views expressed here may not necessarily reflect those of Agora Energiewende.*

#### **Yana Zabanova**

Yana Zabanova is a Research Associate at the Research Institute for Sustainability-Helmholtz Centre Potsdam (RIFS Potsdam), where she focuses on the geopolitics of the global energy transformation, including its implications for the hydrocarbon-rich states in post-Soviet Eurasia, as well as on EU hydrogen policy. Zabanova is also a PhD candidate at the University of Groningen and is completing a dissertation comparing advocacy coalitions for renewable energy development in Russia and Kazakhstan.

*Coordination of the publication series:*

#### **Lina Rühl**

Policy Advisor Climate, Agriculture and Environment  
Analysis and Consulting Division  
T/p +49 30 / 26 996-3502  
[lina.ruehl@kas.de](mailto:lina.ruehl@kas.de)

#### **Gisela Elsner**

Global Sustainability Officer  
Analysis and Consulting Division  
T/p +49 30 / 26 996-3759  
[gisela.elsner@kas.de](mailto:gisela.elsner@kas.de)

Published by: Konrad-Adenauer-Stiftung e. V.  
Design and typesetting: yellow too Pasiek & Horntrich GbR

This publication was published with financial support of the Federal Republic of Germany.

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