Kazakhstan's 'Green Economy' Strategy: What barriers are hindering the success of Renewable Energy transition goals?

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Abstract

This report will examine the policies implemented by Kazakhstan's government to move toward renewable energy sources (RES) in the nation's electric power production. These policies reflect the country's commitment to the goals outlined within the Paris Agreement to cut back on greenhouse gas emissions and support the use of clean energy technologies. While Kazakhstan is currently largely dependent upon coal and natural gas for generating electrical power, the government has taken steps to encourage the use of RES. Specifically, the country introduced feed-in tariffs for RES in 2014 and competitive renewable energy auctions in 2018. Using Painuly's (2001) hierarchical barrier model, this research identified twelve key obstacles limiting the growth of RES in Kazakhstan. Based on the responses from stakeholders, which were measured on a Likert scale ranging from one to five, this research evaluated how each obstacle was perceived. A qualitative methodology based on semistructured interviews with eleven different stakeholders utilized grounded theory to analyze their perspectives. The data indicates that technical barriers, specifically outdated energy infrastructure, are viewed as being the greatest hurdles facing RES growth in Kazakhstan (average rating of 4.55/5). Finally, the paper outlines several policy options designed to address these barriers and ultimately contribute to the realization of the country's stated objective regarding its transition to a cleaner source of energy.

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Chapter 1. Introduction

Climate change is placing increasing pressure on countries around the world, and Kazakhstan has been particularly susceptible to climate-related risks. According to Kazhydromet (2024), over the last fifty years, the average annual temperature in Kazakhstan rose by almost twice the global average rate, with the average yearly temperature rising 1.72°C above the 1961-1990 mean in 2024. As a result of this urgent need to address climate change, Kazakhstan, in 2016, signed the Paris Agreement. As part of its commitment to reduce greenhouse gases, the country agreed to lower greenhouse gas emission to be 15 percent less than they were in 1990 by 2030, with a more ambitious target of 25% conditional on external funding and technology (Poberezhskaya & Bychkova, 2021).

The majority of Kazakhstan's energy consists of hydrocarbon products. As of 2024, coal generated 63.2 percent of Kazakhstan's electricity. Next in line were natural gas and hydropower generating 21.9%, and 8.5% respectively. Renewable Energy Sources (RES), although making up the smallest portion of the country's energy mix at 6.4 percent, have seen a slight increase in their percentage of total energy production as of late 2025 reaching 7.17 percent (Qazaq Green, 2026). In terms of installed capacity of RES, they amount to a total of 3,537 megawatts with wind representing 55.7% or 1,909 MW of this number. Solar represents approximately 37.2 % or 1,313 MW of total installed Renewable Energy (RE) capacity while small hydropower accounts for 9% or 314 MW.

Kazakhstan has been a regional forerunner in implementing transition policies. The first major transition initiative occurred in 2009 when the government passed the RES Law. This law created the structure necessary for financial and regulatory support to be provided to RE projects (Petro Council, 2025). In 2012, the government released the Kazakhstan 2050 Strategy, which had a goal

to obtain at least 50% of all of its energy from alternative sources by 2050 (Nazarbayev, 2012). In 2013, the Concept on Transition to a Green Economy established specific targets: 3% from solar and wind by 2020, 30% from alternative sources by 2030, and 50% by 2050 (Republic of Kazakhstan, 2013). However, in 2024, these targets were revised downward, with the 2030 goal reduced from 30% to 15% (Republic of Kazakhstan, 2024).

An apparent gap exists between Kazakhstan's expressed goals concerning RE and its actions toward achieving them. A substantial number of policy initiatives have been implemented; however, the percentage of RE utilized as an alternative to fossil fuels for electricity production continues to be low. This disparity is particularly surprising considering that over the past few years, RE has continued to become increasingly competitive with traditional fossil fuels. Following the adoption of auctions in 2018, the cost per megawatt-hour of RE in Kazakhstan plummeted (Laldjebaev et al., 2021). Specifically, the tariffs for solar power had declined approximately 50% since auction implementation, while the annual decline in tariff price for wind energy was largely driven by increased competition within the marketplace (Darke & Karatayev, 2025).

To understand the gap between policy ambition and actual outcomes, this study employs a mixed-method approach guided by Painuly's (2001) hierarchical framework for barrier analysis. According to Painuly (2001), barriers can be understood as a multi-level hierarchy: the top level represents broad categories while lower levels provide greater detail and specificity. This decomposition clarifies the causes of a barrier and facilitates the identification of measures to overcome it.

The study draws on semi-structured interviews with 11 stakeholders representing diverse perspectives across Kazakhstan's RE sector, including government officials, representatives from the grid operator, auction operator, investment promotion agency, professional associations, as well as independent experts and academicians. The interview instrument consists of two parts: open-ended questions designed to capture stakeholder experiences, followed by a ranking exercise designed to capture their perceptions of 12 barriers, in which interviewees rate them on a scale from 1 to 5, where 5 represents the highest impact on hindering RE development. The analysis of interview data is guided by grounded theory, allowing themes to emerge from the data rather than being imposed by pre-existing frameworks, while Painuly's (2001) hierarchical framework provides an initial structure for organizing findings.

This study seeks to answer the following research questions. The central research question is: What barriers are hindering the success of Renewable Energy transition goals? The sub-questions are:

1. What policies and support mechanisms have been introduced, and what outcomes have they produced?
2. How do key stakeholders perceive these barriers?
3. How can Kazakhstan's renewable energy policy be further developed to reach the targets of the Green Economy strategy?

By capturing the perspectives of stakeholders directly involved in RE development, this study aims to provide evidence-based insights that can inform more effective policy design. The findings are intended to help policymakers identify priority areas for intervention and develop targeted measures to address the most critical barriers facing the sector.

The thesis is structured as follows. Chapter 2 reviews the literature on RE support mechanisms, project realization, and barriers in Kazakhstan, as well as international perspectives. Chapter 3 outlines the research methodology, including participant selection, interview design, and data analysis. Chapter 4 presents the findings from stakeholder interviews, including both qualitative narratives and the barrier ranking results. Chapter 5 discusses these findings in relation to the existing literature and theoretical framework. Chapter 6 concludes with policy recommendations, limitations, and directions for future research.

Chapter 2. Literature Review

2.1 Legal Definition of RES in Kazakhstan

The main policy document in Kazakhstan relating to RES is the 2009 Law "On Support of the Use of Renewable Energy Resources" (RES Law). This law defines RES as natural replenishment energy resources that include solar radiation, wind, hydro-dynamic water energy, and geothermal energy generated from soil and surface waters. Additionally, this definition captures man-made energy sources, such as consumption waste, biomass, biogas, and other waste-generated fuels that can be utilized for electricity or heat generation (Republic of Kazakhstan, 2009).

Notwithstanding, not all of the above-mentioned RES are eligible for support mechanisms established by the State, i.e., fixed tariffs and auctions. According to Article 2 of the Law, large hydroelectric power plants (HPP), defined as those with an installed capacity exceeding 35 MW, do not fall within those RE resource categories that may benefit from the support mechanisms.

It should be noted that large HPP are generally recognized internationally as a type of RE resource. In Kazakhstan, large hydro generates around 9% of the total electricity output in the country. If this figure were added to the current reported amount of electricity generated from RES, then it would almost double. Therefore, when the Government has excluded large HPP from the RES support framework, it has made a deliberate policy decision: rather than inflating RE figures with legacy hydro capacity, it prioritizes newer sources developed under its modern incentive schemes.

2.2 Overview of Support Mechanisms for RES projects

Feed-in tariffs (FiTs) were introduced in Kazakhstan in 2014 as the first systematic support mechanism for RE (KOREM & USAID, 2024). Under this system, producers were paid a fixed fee of 15 years for each kilowatt hour produced (Boute, 2020). Although it was successful in

attracting first investments in the sectors of solar and wind, there were several disadvantages associated with the program such as increased cost to consumers and potential overpayment of producers due to the fixed rates (Lan et al., 2023).

Therefore, in 2017, Kazakhstan introduced competitive auctions as a new support mechanism (Ministry of Energy, 2017). Currently under this system, the fixed tariff amounts established by the Ministry of Energy serve as the starting price (ceiling) for each auction. The successful bidders are selected based upon their lowest bid to reduce prices due to competition. For example, within the solar industry, the lowest winning bid submitted in the first round of auctions held in 2018 was 18.00 tenge/kWh (Table 1). This represents a decrease of approximately 48% compared to the previously established fixed tariff of 34.61 tenge/kWh. Additionally, wind and bioenergy projects experienced decreases of approximately 23% during the same time period (Darke & Karatayev, 2025).

Table 1

Fixed Tariffs and Auction Price Reductions

Technology	Fixed Tariff (pre-auction)	After Auctions (2018)	Reduction
Solar PV	34.61 tenge/kWh	18.00 tenge/kWh	~48%
Wind	22.68 tenge/kWh	17.39 tenge/kWh	~23%
Bio	16.71 tenge/kWh	12.80 tenge/kWh	~23%

Note. Data from Darke & Karatayev (2025).

Beyond auction mechanisms, a number of other supports were established to provide a more favorable environment for investment in the sector. RE projects have been added as priority investment areas in 2016, enabling the investors to benefit from an array of investment preferences stipulated by the Entrepreneurial Code (Republic of Kazakhstan, 2015). Specifically, among other

advantages, such as exemptions from customs duties, exemptions from value added tax (VAT) on imports, state grants in kind, and indexation of tariffs to reflect currency exchange rate fluctuations and inflation, the entrepreneurs are exempted from payment for electricity transmission (Boute, 2020). Moreover, a number of new benefits were introduced for RE investments in 2020, namely exemption from property taxes and land taxes, extension of power purchasing agreement (PPA) duration up to twenty years, and creation of a reserve fund to ensure provision of financial support upon the appearance of insolvency risks (Boute, 2020; KOREM, n.d.). Additional mechanisms that can be considered as supporting investments in RE include: first-priority dispatch of electric energy produced by renewable sources, reserving land plots and grid connection points for renewable generation facilities, flexible (maneuverable) generation capacity development requirements to ensure accommodation of RE variability (KOREM, n.d.).

2.3 Project Realization in the RE Sector

In Kazakhstan, RE projects are currently developed through auctions on the KOREM platform or through intergovernmental agreements negotiated directly between Kazakhstan and foreign countries.

2.3.1 Auctions

The majority of RE project development occurs via the auction mechanism. The Ministry of Energy announces the total volume of capacity to be auctioned through the Financial Settlement Center for Support of RES (FSC), which is a subsidiary of the national grid operator KEGOC. As such the FSC acts as the single point of contact for all purchasers of electricity produced from renewable sources. Upon successful completion of an auction, the investor enters into a PPA with the FSC. This PPA guarantees a fixed rate for 15 years, while ensuring the FSC purchases all of

the electricity produced and fed into the grid (Boute, 2020; Mouraviev, 2021). Each auction announcement details both the specific location and size of the proposed project.

Registration to participate in an auction occurs in a sequential manner. First, interested parties register on the KOREM website. Following registration, potential bidders provide all required documents and complete a participation agreement (KOREM, n.d.). Next, each participant is required to post a financial bid security. For projects sized less than 499 megawatts, the amount of this bid security is 2,000 tenge per kilowatt installed capacity. All larger projects require a bid security equal to 5,000 tenge per kilowatt installed capacity (Ministry of Energy, 2017). When each participant has fulfilled their respective bidding obligations they will enter the trading session. Participants will compete against one another in the trading session until the winner is determined by the lowest tariff.

After completing an auction and determining the winner, that party will receive approval to become classified as an energy producing organization. The winner must provide a performance guarantee equivalent to 10,000 tenge per kilowatt within 30 calendar days to ensure compliance with project performance obligations. Following these steps, the Ministry of Energy will add the project to its RE Facility Siting Plan and List of Energy-Producing Organizations (KOREM, n.d.).

All costs associated with preparing, constructing and operating a RE project fall upon the winner of the auction. Project construction timeframes vary depending on the type of RE technologies used: solar power stations must be constructed within 2 years of receipt of approval, wind and bioenergy facilities in 3 years, and hydroelectric facilities in 5 years (KOREM, n.d.). Thereafter, the approved party shall supply electricity at a predetermined price for no fewer than 20 years, during which it recovers investment.

2.3.2 Intergovernmental agreements

Alongside auctions, there also exists a second route for realizing RE projects through intergovernmental agreements (IGAs), which are primarily used for large-scale RE projects that have been developed in partnership with foreign investors. For example, Kazakhstan has entered into IGAs with many countries for large-scale RE projects. These IGAs provide for state guarantees and support for these types of projects. Several notable examples include a wind farm with a battery energy storage system that will be constructed by Total Eren (France), a similar project by Masdar (United Arab Emirates), and a solar park by China Energy (China). Additionally, an announcement was made concerning the signing of an IGA with Saudi Arabia regarding the construction of a one-gigawatt project by ACWA Power; however, it should be noted that the current status of this project is unknown (Serikov, 2025).

One of the most significant advantages of IGAs includes creating a clear legal framework for RE projects, including establishing benefits, guarantees, and protections for investors. They also formalize the government's commitment to support project development and adhere to the investment agreement and PPA. IGA usually outlines the terms of PPA, agreements related to electricity generation/supply/consumption, tariff agreements, technical dispatching agreements, land lease agreements, and other support measures. Once ratified by the parliament, the terms of IGA prevail over national law, thereby creating a stable and predictable legal environment for investors.

2.3.3 Land Acquisition for RE Projects

The most important part of executing a project is acquiring land. In regards to RE development in Kazakhstan, land will be obtained by investors in auctions. There are no "free" sites given to

investors by the government. However, there are many advantages for developers when purchasing or leasing a site.

Prior to bidding, local authorities hold open reservations for available sites suitable for the construction of RE projects. Once a developer has been awarded the right to develop the site after winning an auction, they can begin using the site immediately. Developers can obtain a site for either short term (up to 5 years), long term (5 to 49 years) or can buy the site directly, depending on the classification of the land and whether the developer is foreign.

Foreign developers are prohibited from buying land and therefore must enter into long term leasing agreements. Developers are also prohibited from acquiring land located along borders or land designated as agricultural lands (Republic of Kazakhstan, 2003). All expenses related to obtaining land include but are not limited to the purchase price or rental fee for the land, preparation of a land use plan, payment of compensation to farmers due to loss of farm production resulting from converting farm land to RE generation facilities and registration fees with the State.

The entire process of obtaining a site is very structured. The first step is the submission of a written request to the local authority where the developer intends to build his facility. This request then goes to a land commission that reviews the developers' request and makes a determination on the approval or denial of the request usually within 60 days. If the developer receives a positive response, they need to prepare a land use plan. Upon completion of this task, the local authority issues the developer a license allowing them to use the land, followed by a state registration.

2.4 Barriers to RE Development in Kazakhstan

We adapted Painuly's (2001) hierarchical framework for barrier analysis and adjusted it for our study. The headings of the following subsections constitute the six barrier categories we employ.

2.4.1 Market Barriers

The structure of Kazakhstan's energy market creates significant barriers to RE development. Howie and Atakhanova (2022) identify the dominance of large state-owned enterprises such as Samruk-Energy and KazMunayGaz, which control the majority of the country's energy resources. These vertically integrated companies benefit from fossil fuel subsidies estimated at between 16 and 20 percent of GDP, which artificially lower domestic electricity tariffs and reduce the price-competitiveness of RE (Howie & Atakhanova, 2022; Karatayev & Clarke, 2016). This market structure creates a challenging environment for RE projects to compete without substantial state support.

2.4.2 Economic and Financial Barriers

Beyond the structural market issues, economic and financial constraints present formidable obstacles. Zhakiyev et al. (2025) indicate that both high initial investment costs and limited availability of inexpensive capital represent the two main financial barriers. Furthermore, Darke and Karatayev (2025) provide evidence that local banks lack experience in providing project financing to RE projects, creating a gap in available funding sources.

Foreign investors face additional challenges related to foreign exchange risk, stemming from revenues being paid in tenge while borrowing is often in foreign currencies (Darke & Karatayev, 2025). An additional financial burden is the requirement to submit bid security and performance security to participate in auctions, which effectively freezes the bidder's funds in the Financial Settlement Centre account without accruing interest, tying up capital that could otherwise be deployed elsewhere (KOREM, n.d.; Ministry of Energy, 2017). The risk of investment is further heightened by these financial constraints, creating uncertainty for both domestic and foreign

developers. Both Darke and Karatayev (2025) and Zhakiyev et al. (2025) agree that governments will need to provide low-interest loans and other long-term financing mechanisms if they wish to encourage investment in the RE sector.

2.4.3 Institutional Barriers

Institutional factors play a critical role in shaping the RE landscape. Mouraviev (2021) argues that despite Kazakhstan's relatively comprehensive policy framework, progress is hampered by overly centralized governance, limited internal government expertise, and weak systematic engagement with investors, regional actors, and civil society. This centralization creates bottlenecks in decision-making and reduces institutional responsiveness.

Regulatory instability emerges as a particularly critical concern. Darke and Karatayev (2025) identify the instability and complexity of the regulatory framework as the main obstacle to auction effectiveness, noting that unpredictable tariffs, subsidies, and licensing procedures worsen the investment climate. Boute (2020) similarly finds that frequent changes to auction rules have created uncertainty for investors, undermining confidence in regulatory predictability. Zhakiyev et al. (2025) add that potential negative changes in RE legislation represent one of the most influential risks facing the sector. This regulatory uncertainty is especially damaging given the long-term nature of RE investments, which require stable policy signals over project lifetimes of 15 to 20 years.

Weak institutional capacity further compounds these challenges. Mouraviev (2021) emphasizes that limited internal government expertise and weak systematic engagement with stakeholders reduces the potential for even well-designed policies to have an effective impact. The absence of

coordinated mechanisms for stakeholder participation means that policy implementation often proceeds without adequate input from those most affected by or essential to the energy transition.

2.4.4 Technical Barriers

Technical barriers represent significant impediments to RE growth and adoption. Zhakiyev et al. (2025) identify three types of obstacles: a shortage of domestically manufactured RE equipment; outdated electricity generation infrastructure; and the absence of local experience with production and operation. Their risk probability model indicates that Kazakhstan's significant technological gap is the most influential risk facing the sector, surpassing even regulatory risks in importance.

Outdated energy infrastructure presents a particular challenge, as the existing grid was designed for centralized coal-fired generation and lacks the flexibility needed to accommodate variable RES. Karatayev and Clarke (2016) add inefficiency of technologies and low quality of scientific support to the list of barriers, suggesting that the gap between available technology and local capacity to deploy, operate, and maintain it remains substantial. Local manufacturing challenges further compound this issue, as the underdeveloped domestic production of RE equipment and components limits the development of local capabilities and creates dependence on imported technology (Zhakiyev et al., 2025).

2.4.5 Social Barriers

Social barriers, while less visible than economic or technical constraints, present significant challenges to RE adoption. Karatayev and Clarke (2016) identify awareness barriers as major hurdles, noting that limited public knowledge of RE technologies constrains both the demand for and acceptance of such technologies. Zhakiyev et al. (2025) similarly point to a low level of public interest in the development of energy-efficient technologies.

Public awareness and acceptance remain limited, particularly in regions where fossil fuel industries have long been the primary source of employment and economic activity. Additionally, the workforce skill gap presents a growing challenge, as the RE sector requires specialized expertise in installation, maintenance, and system integration that is not yet widely available in Kazakhstan (Karatayev & Clarke, 2016). This skills shortage affects not only project implementation but also the long-term sustainability of RE facilities

2.4.6 Environmental Barriers

Environmental factors introduce additional complexities to RE development in Kazakhstan. Geographical limitations constrain the siting of RE projects, as not all regions possess adequate solar irradiation, wind speeds, or water resources for hydropower. The most suitable locations for wind and solar development are often in remote areas with limited grid infrastructure, requiring additional investment in transmission capacity (Zhakiyev et al., 2025).

Climate variability presents another environmental challenge. The performance of solar and wind facilities depends on weather conditions that can fluctuate significantly from year to year, introducing uncertainty into energy generation forecasts. This variability affects not only project economics but also grid stability, requiring complementary investments in flexible generation capacity or energy storage systems (Karatayev & Clarke, 2016).

Beyond these, another significant barrier facing foreign investors in Kazakhstan is related to restrictive regulations concerning land use. Foreign-based RE companies find it difficult to locate sites to construct new power-generating facilities since land ownership restrictions complicate the site selection process and create additional legal uncertainty where suitable land exists in overlapping restricted categories (Republic of Kazakhstan, 2003).

Chapter 3. Methods

3.1 Description of Research Design and Approach

In order to answer the proposed research question within the scope of this study, we employed a qualitative research design. Qualitative research can effectively capture complex processes related to policy, institutional interactions, and various stakeholder views that could not be fully represented by a numerical-only analysis.

As the study relies on semi-structured expert interviews as the principal method for collecting data, it has adequate flexibility to allow for participants' perceptions and interpretations to be explored, while providing sufficient uniformity across interviews. Furthermore, due to the relatively low amount of empirical studies available on the practical application of renewable energy policies in Kazakhstan, the qualitative approach provided the opportunity to obtain context-specific information and reveal underlying causal mechanisms influencing policy outcomes.

Additionally, the study incorporates elements of grounded theory in the analysis of interview data. Specifically, rather than testing pre-defined hypotheses against the data, the emergence of themes and patterns from the data itself is encouraged. Grounded theory is particularly useful in the case of Kazakhstan's energy transition, since stakeholder views represent one of the critical factors to understand the gap between policy design and implementation. Therefore, overall, the qualitative methodology contributed toward an enhanced, contextualized understanding of how renewable energy policies operate in practice.

3.2 Participants and Sampling

The study is based on semi-structured interviews with 11 experts involved in Kazakhstan's renewable energy sector. Experts were selected utilizing a purposive sampling strategy, which focused on those with substantial professional experience in either developing, implementing or analyzing renewable energy policies. A decoding of interviewee identifiers and their corresponding professional backgrounds is provided in Appendix (Table 2) to ensure clarity and transparency in the interpretation of cited responses throughout the study.

Stakeholders were contacted via formal communications with governmental institutions, market operators, industry associations, financial institutions, technology suppliers and academic researchers. Additionally to formal contacts, experts were also accessed through snowball sampling by asking participants to recommend other experienced colleagues and associates.

The ultimate participant group consisted of diverse types of stakeholders and had considerable variation in years of experience among participants. This variability provided the study with a better understanding of differing views regarding barriers and policy effectiveness among different stakeholder groups.

3.3 Data Collection

Semi-structured interviews formed the basis of the data collection in this study. Interviews were divided into two distinct sections.

Section One of the interviews contained a structured assessment of barriers to renewable energy development. As stated previously, barriers were categorized into five separate areas: market, institutional, economic & financial, technical, social and environmental. Respondents were asked

to rank barriers using a Likert scale from 1 to 5 depending upon their perceived magnitude. Additionally, respondents were asked to provide justification for their assessment. This additional qualitative component was added to assist researchers in interpreting the ratings assigned by respondents.

Although Section One introduced a structured element into the interviews, they still fit well within a qualitative methodology. The primary objective of Section One was to collect respondents' opinions and assessments regarding barriers to renewable energy development as opposed to statistically evaluating them.

Section Two contained open-ended questions designed to elicit exploratory insights into respondent's views on Kazakhstan's energy transition.

Respondents were asked to describe their perception of the path forward for renewable energy development in Kazakhstan. Respondents were requested to evaluate the performance of key policy tools employed to promote renewable energy development including feed-in tariffs and auctions. Respondents were additionally asked to discuss institutional and regulatory challenges associated with transitioning to renewable energy sources. The focus of this section was primarily centered upon identifying reasons why there were revisions made recently to renewable energy targets and identifying gaps existing between policy design and implementation. In this manner, respondents were able to share their experiences and perceptions on renewable energy.

3.4 Data Analysis Procedures

Data collected from interviews were analyzed utilizing a thematic analysis methodology influenced by grounded theory principles. Prior to conducting thematic analysis, all interviews

were first transcribed and thoroughly reviewed so that we could become familiar with the data. After reviewing all interviews, thematic analysis progressed through multiple stages of coding.

Initially, we utilized open coding techniques to identify prominent ideas/concepts extracted from the data. Following identification of these codes, axial coding was applied to group similar codes together into larger categories that demonstrated relationships among theme(s). Selective coding was then applied to combine the categories into an overarching theme that represents major findings derived from this study.

Barriers ranked by respondents in the second part of the interviews were subsequently collapsed into an aggregate measure to determine which barriers were viewed as most significant by participants. Nevertheless, rather than treating barrier rankings as only numeric scores, researchers evaluated them in tandem with qualitative rationales offered by respondents. Ultimately, this dual approach facilitated greater comprehension of barrier perceptions among participants as well as reasons for perceiving barriers as more or less severe.

3.5 Validity and Reliability (Trustworthiness)

The study promotes trustworthiness through several methodologies. Credibility is promoted by selecting participants who possess professional and technical experience with regards to Kazakhstan's renewable energy sector and therefore possess relevant and informed perspectives on which data are collected. Additionally, employing semi-structured interviews facilitated consistency across participants while offering sufficient flexibility to allow participants to explore particular topics in depth.

Participants from multiple institutional backgrounds contributed to some degree of triangulation that resulted in varying perspectives across different sectors. Systematic transparency in coding

procedures was achieved to facilitate tracking of themes back to original data. Collectively, these methodologies increased reliability and validity of findings generated in this study.

3.6 Ethical Consideration

Throughout the research process, ethical considerations were followed. Participants were informed about the objectives of the study and their voluntary participation before conducting any interviews. Written consent was obtained from all participants assuring confidentiality and anonymity of all responses.

All collected data generated during this study was used exclusively for academic purposes and was stored safely. Participants were provided with options to discontinue their participation at any time during the study. Collective adherence to these ethics-related guidelines ensured respect for participant rights and confidentiality throughout the entire research process.

Chapter 4. Results and Findings

4.1 Section One

In the first part of the expert interviews, respondents were asked to rate the significance of 12 identified barriers to the RE development in Kazakhstan using a five-point scale from 1 (no impact) to 5 (critically high impact). The barriers were grouped into six categories: Market, Economic & Financial, Institutional, Technical, Social, and Environmental. The summary results based on evaluations of 11 respondents representing market participants, public sector organizations, regulators, financial institutions, and academia are presented in Table 3.

Overall, a moderate perceived impact of the identified constraints on renewable energy development has been discovered with the average score of 3.48. The outdated energy infrastructure received the highest average score of 4.55 among individual barriers, with standard deviation of 0.52, followed by geographical constraints (4.18, SD = 0.61).

The three evaluated barriers within the Institutional category demonstrated moderate average scores. While the regulatory uncertainty was rated the highest with an average score of 3.82 (SD = 0.98), the excessive centralization of governance and weak institutional capacity received average scores of 3.46 (SD = 0.93) and 3.27 (SD = 1.01), respectively.

Low fossil fuel-based electricity tariffs received the lowest score within the Market category (3.00, SD = 1.34).

In the Economic & Financial category, limited access to financing was rated 3.36, with SD of 1.29, while investment risks received an average score of 3.45 (SD = 1.13).

Table 3

Ranking of the Barriers

Barrier	Category	Average Score	Standard Deviation
Low Fossil Fuel-Based Electricity Tariffs	Market	3	1.34
Limited Access to Financing	Economic & Financial	3.36	1.29
Investment Risks	Economic & Financial	3.45	1.13
Regulatory Uncertainty	Institutional	3.82	0.98
Excessive Centralization of Governance	Institutional	3.46	0.93
Weak Institutional Capacity	Institutional	3.27	1.01
Outdated Energy Infrastructure	Technical	4.55	0.52
Local Manufacturing Constraints	Technical	3.455	1.04
Public Awareness and Acceptance	Social	2.36	1.03
Shortage of Qualified Personnel	Social	3.27	1.11
Geographical Constraints	Environmental	4.18	0.61
Climate Variability	Environmental	3.55	0.82

The Technical category produced the highest overall ratings among the barrier groups. Outdated energy infrastructure recorded the highest score across all evaluated barriers (4.55, SD = 0.52). Local manufacturing constraints received a lower but still high significance score of 3.45 (SD = 1.04).

Public awareness and acceptance was rated 2.36 (SD = 1.03), indicating a limited to moderate impact, while the shortage of qualified personnel, however, received a higher score of 3.27 (SD =

1.11), suggesting a moderate impact according to the expert assessments. Overall, the perceived impact levels in the Social category were comparatively lower.

Finally, both barriers in the Environmental category were rated relatively high. Geographical constraints received an average score of 4.18 with SD of 0.61, indicating a significant impact, while climate variability received a score of 3.55 (SD = 0.82).

Table 4 presents the aggregated evaluation of barrier categories correlated with the expertise of the interviewees, it is clear that there is a discrepancy in the views of different stakeholder groups on the impact of various forms of restrictions on the development of renewable energy.

Table 4

Correlation Between Barrier Categories and Expert Groups

Category	Academic	Public Sector	Market Players	Regulator	Financial Market	Average per Barrier Category
Institutional	3.5	4.17	3.67	3.83	2.5	3.52
Market	4.5	2.5	1.5	3.5	3	3
Economic & Financial	4	4	2.25	4.75	2.5	3.41
Technical	4	4.5	4	4.5	3.5	4
Social	2.5	3.5	3	2.5	2.25	2.82
Environmental	3.5	4	4	3.75	3.75	3.86
Average per Expert Group	3.53	3.93	3.33	3.78	2.93	

The results show notable variation across sectors. For instance, regulatory representatives evaluated the economic & financial barriers as one of the impactful (4.75), while market players

rated the same category considerably less (2.25), indicating a limited perceived impact from the perspective of project developers and industry participants. Technical and environmental barriers (both 4.0) were rated the highest by market players implying greater concern on the limitation of infrastructure and geographical location. Public sector representatives also rated technical barriers highly (4.5) and assigned comparatively strong scores to institutional barriers (4.17). Unlike most other groups, public sector and NGO representatives assessed social barriers at a moderate level of impact (3.5), while they have a limited impact according to averages. Meanwhile, financial market representatives provided lower evaluations for institutional (2.5) and economic and financial barriers (2.5) compared to other groups, illustrating how perceptions of barriers differ depending on stakeholders' professional perspectives.

In general, the ranking exercise gives a quantitative summary of perceptions of stakeholders and expert opinion on barriers to the development of RE in Kazakhstan.

4.2 Section Two

Section Two of the interview contained open-ended questions that addressed both broader perspectives related to the RE transition and provided detailed insights into policy-related challenges. Thus, this second part was complementary to Section One and provided additional detail regarding the issues that had been discussed in both parts.

Specifically, at the beginning of the analysis phase, both sections of the interview transcript were coded using an open-coding technique, which are presented in Table 5 in Appendices. In total, 48 coded responses reflecting similar viewpoints expressed by the interviewees were identified. These codes were taken from evidence (quotes) subsequently grouped and categorized based on the common ideas discussed by the experts.

To enhance analytical rigor, the results were carefully structured and adapted by Painuly's (2001) barrier framework in Table 6.

Table 6

Barriers to RETs Penetration

Category	Barriers	Remarks
Market	Low Fossil Fuel-Based Electricity Tariffs	Some interviewees mentioned that low fossil tariffs can affect market incentives; however others respondents stated that they are not directly comparable to renewable pricing under the auction system
Economic & Financial	Limited Access to Financing	Financing is limited and generally does not have good terms, especially when it comes to long term financing in local currencies; which increases the cost of the development project
	Investment Risks	Perceived risk of investing has increased due to instability in regulations, volatility in currency, and changing system obligations
Institutional	Regulatory Uncertainty	Respondents consistently noted that post award regulatory changes negatively affected the predictability of finances and investors' confidence in their investments
	Excessive Centralization of Governance	Factors affecting coordination and the flexibility of implementing a renewable energy project include centralization of decisions made regarding the project
	Weak Institutional Capacity	Delays in interagency coordination and gaps between the policies developed and implemented at a practical level have been cited as significant problems by experts
Technical	Outdated Energy Infrastructure	Constraints to integrating renewable energy into existing grids include grid limitations and old age of the current grid infrastructure
	Local Manufacturing Constraints	Costs and risks associated with developing renewable energy projects are increased because there are high levels of dependence on foreign technology and limited capacity domestically to produce this technology
Social	Public Awareness and Acceptance	Limited knowledge about renewable energy opportunities is another constraint limiting wider adoption of renewable energy including at small scale applications
	Shortage of Qualified Personnel	Limited availability of specialized skills for implementing renewable energy projects continues to depend on outside assistance

Category	Barriers	Remarks
Environmental	Geographical Constraints	Grid connection costs and complexity of the project have both increased due to distance of the resource location from where it will be used
	Climate Variability	Additional balancing capacity and flexibility within systems are needed to address the issues caused by intermittency and seasonality associated with renewable energy sources

Rather than employing the Painuly (2001) framework as a strict classification mechanism, it was utilized as a conceptual anchor. Categories may have required modification or expansion when they did not adequately reflect the empirical realities found in Kazakhstan's context. The end-product therefore included six major categories and twelve individualized barriers.

Constraints were constructed based on both its theoretical significance and its empirical relevance across the interviews. A focus on the frequency, consistency and degree of discussion of each barrier by various stakeholders was given to improve the overall validity of the analysis. Additionally, qualitative evidence was incorporated through participant remarks that were consistently connected to each respective barrier. Participant remarks served as illustrative examples to demonstrate how each barrier materializes in practical terms and how each barrier is viewed by each expert involved in the RE sector. Ultimately, the final categories represent both a theoretical construct and a data-driven portrayal of how stakeholders view and experience identified barriers.

Nevertheless, the overall situation of the RE sector was assessed as evolutionary, as the government has gradually moved from strategic declarations toward the implementation of concrete support mechanisms. These mechanisms include FITs, auctions, PPAs, FSC, and the single-buyer model, which together form the institutional framework supporting RE deployment.

However, an unexpected finding was that approximately all interview participants were not aware of the legislative changes to RE targets in ‘Green Economy’ Strategy Concept introduced in 2024. This policy revision is often interpreted as evidence that RE development in Kazakhstan has not progressed as initially planned. At the same time, several experts expressed surprise that this law was revised, as in their view the development of RE had been generally meeting expectations.

In addition, interview participants agreed on the efficiency of the auction mechanism. They emphasized that auctions have increased transparency and contributed to reducing costs in the renewable energy sector. However, six respondents also highlighted potential drawbacks of the auction system, noting that the lowest-price bidding logic may weaken project margins, affect implementation quality, and reduce bankability under conditions of currency volatility and regulatory uncertainty.

Respondents mentioned that RE projects in Kazakhstan face several structural economic barriers. In particular, RE must compete with low, regulated coal tariffs, which reduce the price competitiveness of renewable generation. In addition, developers face currency risks, limited access to affordable capital, and strong dependence on imported equipment and technologies. Respondents also noted that midstream regulatory changes create additional uncertainty for investors and may complicate long-term project planning and financing.

Interview participants highlighted physical integration limits - grid connection limitations, insufficient balancing capacity, lack of energy storage, reverse power flows, outdated rural distribution networks, and the need for expanded transmission infrastructure, which form the core implementation bottleneck.

The main challenges arise not at the stage of strategy formulation, but rather during project implementation, system integration, and the alignment of policy targets with technical capabilities and actual electricity demand growth. In other words, while strategic goals for RE are clearly defined, difficulties emerge when translating these goals into practical projects and reliable system operation.

Interview participants discussed unresolved governance issues. They assumed that B2B PPAs, green finance, local manufacturing, distributed generation, storage, and better planning might serve as potential solutions, while also raising opacity concerns around IGAs and ownership structures.

Chapter 5. Discussion

This section of this document presents research-based conclusions that are based on categorization of identified impediments into six thematic areas of analysis. A qualitative review of expert opinions as expressed during interview sessions, a quantitative assessment of each obstacle based on their respective rankings, literature reviews regarding these same issues, and an evaluation of how these may affect Renewable Energy (RE) development within Kazakhstan is presented.

5.1 Institutional Barriers (Regulatory Uncertainty, Excessive Centralization of Governance, Weak Institutional Capacity)

The research conducted here found that institutional obstacles within Kazakhstan's renewable energy (RE) industry were viewed by participants as moderately influential barriers to long term investments and policy credibility. The qualitative results demonstrate that the regulatory environment in Kazakhstan has developed sufficiently to support RE development during the last ten years. Although there exists a formal regulatory framework for the growth of the RE sector, the effectiveness of this regulation appears to be impeded by regulatory uncertainty; an increasingly centralized structure for decision-making authority; and uneven institutional capacity.

The qualitative results demonstrated that the country has effectively created a formal institutional architecture supporting RE development. Interviewee 2 described the process of developing a formal architecture as follows:

"The path of development was logical: Feed-in Tariffs followed by Auctions"

Thus demonstrating both a methodical and thoughtful approach to policy design. However, this institutional maturation is paired with concerns related to both consistency and predictability. A number of respondents pointed out that mid-stream regulatory changes add complexity to long-term planning. Interviewee 8 provided insight into how implementation can depend on numerous factors. "Implementation is contingent upon market conditions, infrastructure, and institutional cooperation."

These findings are consistent with previous literature. Darke & Karatayev (2025), like Boute (2020) have pointed out that numerous regulatory changes and complex administrative processes lead to decreased investor confidence. These same conclusions were reached in this study. Despite formal progress, institutional reliability continues to represent a major challenge.

In addition to institutional reliability, another important aspect of this topic is increased governmental centralization. In particular, after the Single Buyer Model was introduced. Regulators see the Single Buyer Model as providing greater levels of coordination and improved system stability. However, private sector participants expressed concern over the loss of market flexibility due to the Single Buyer Model. Interviewee 11 made the following comment about the new market arrangement.

"All electricity is now purchased exclusively by the single buyer."

This shows that there is a transition toward tighter state control over pricing and transaction issues.

Transparency also emerged as an issue throughout many of the interviews. The following anecdotal evidence of overlapping corporate entities presented by Interviewee 3, expert in electricity supply represents potential governance shortcomings and risks of market concentration:

"Five or six sites, but one director."

Although it has not been substantiated, examples such as those above raise questions about gaps in monitoring systems.

The implications of these findings are significant. Institutional obstacles do not inherently stop RE development but rather determine the rate at which development occurs; costs associated with development; and level of risk associated with development. Therefore, future policy initiatives need to place a priority on establishing stable regulatory environments; improving transparency within regulatory environments; and coordinating among regulatory agencies. If these types of governance shortcomings are not addressed, then even well designed policies may ultimately fail to provide desired outcomes.

5.2 Market Barriers (Low Fossil Fuel-Based Electricity Tariffs)

The primary structural hindrance to renewable energy being competitive in the Kazakhstani energy market is primarily related to historical prices that have been artificially depressed by government policies and regulatory actions relating to fossil fuels. According to several of the respondents interviewed during this study, renewable energy cannot reasonably compete with the very-low-cost, heavily subsidized coal-based electricity generated over many decades in Kazakhstan. The Interviewee 1 stated,

"Electricity from coal remains cheaper due to existing infrastructure and legacy pricing."

The above cited quote illustrates how renewable energy has no reasonable opportunity to compete in a distorted marketplace. Therefore, renewable energy projects will need some form of additional assistance to be economically viable. The literature supports this conclusion. For example, Boute

(2020), describes why Kazakhstan transitioned its procurement mechanism from fixed-price contracts to auction-based mechanisms. In part, the rationale behind the transition was to reduce the financial burden of the subsidy provided to generators of renewable energy; however, even after the transition to an auction-based system, the distorting effect of fossil-fuel based electricity tariffs persists. Furthermore, Darke & Karatayev (2025), conclude that the structure of the Kazakhstani wholesale electricity market does not currently provide adequate incentives for the development of renewable energy technologies.

In addition to varying perspectives regarding the nature of barriers to entry and/or expansion of renewable energy, there are significant variations among stakeholders. While regulators perceive the barriers to entry into the renewable energy space as largely driven by market conditions, market participants generally do not see market conditions as much of an impediment to developing renewable energy technologies. This difference in perception likely relates to fundamentally different points-of-view or paradigms. Specifically, regulators focus upon whether or not the market provides equitable and transparent prices which reflect real economic costs; conversely, developers are focused upon gaining access to the physical grid systems necessary to deliver electricity from new generation facilities.

5.3 Financial & Economic Barriers (Limited Access to Financing, Investment Risks)

On an average, respondents perceived financial and economic barriers as moderate; however, the financial and economic hurdles also had strong ties to the state of the overall economy, which also impacted how feasible it was to develop certain types of projects.

Respondents identified multiple interconnected factors that impeded their ability to successfully execute their plans. They stated there were numerous costly expenses associated with developing projects due to currency fluctuations, and respondents had difficulty accessing long term funding.

One respondent from the public sector further elaborated upon this stating,

"Projects remain sensitive to macroeconomic dynamics and financing conditions" (Interviewee 10).

This statement is indicative of the potential vulnerability of RE based investments to exogenous shock events. Another respondent referenced exchange rates as a source of risk that could result in project owners generating revenue in local currency while having incurred foreign denominated debt.

Zhakiyev et al. (2025), in addition to Darke & Karatayev (2025), provided substantial evidence supporting the responses obtained during interviews. Both authors found that the primary impediments to RE-based development in Kazakhstan were high initial costs and inadequate sources of funding.

Additionally, the authors both noted that local commercial banks lacked sufficient experience in providing project financing, and foreign investors experienced difficulties due to the lack of understanding regarding project financing and the general lack of knowledge about project financing among Kazakhstani banks. To mitigate some of the risks posed by these impediments, various policy tools such as long-term Power Purchase Agreements (PPAs) and indexation mechanisms can provide additional assurances to developers. The expert in RE financing described early support mechanisms as follows,

"Early support mechanisms helped ensure predictability of income streams and allowed the first projects to come into production" (Interviewee 8).

In reality, the degree of financial sustainability exhibited by the industry will increasingly depend on broader economic conditions beyond those established by policy instruments. Financial and economic barriers therefore cannot be resolved through policy specific to the sector. The resolution to financial and economic barriers will occur when there are developed financial systems, greater access to green finance, and mechanisms to manage risks associated with currencies and investment. Without implementation of these solutions, the growth of renewable energy will continue to be inhibited despite positive developments within institutions.

5.4 Technical Barriers (Outdated Energy Infrastructure, Local Manufacturing Constraints)

Technical barriers have been found to be the largest obstacles to the adoption of RE, based upon both qualitative and quantitative research. More specifically, outdated energy infrastructure has been rated as the greatest obstacle to the integration of RE into the grid, which reflects its dominant role in limiting the integration.
Respondents frequently stated that Kazakhstan's electrical grid was built around centralized fossil fuel-based generation and is therefore ill-equipped to accommodate the variability inherent in renewable energy sources. The interviewee representing the system operator also illustrated the technical difficulties associated with integrating distributed generation when he said, "Networks were not built for reverse flows."
An expert in RE production stated,

"Renewable energy does not align with consumption patterns, creating imbalances in supply and demand" (Interviewee 11).

Both of these statements support existing literature related to the adoption of RE. Specifically, Eleftheriadis & Anagnostopoulou (2015) cite both grid capacity and infrastructure as major barriers to the adoption of RE technology, similar to what has occurred throughout Central Asia. In addition to limitations created by the electrical grid, several respondents pointed out that limited local manufacturing capability increased costs and reliance on foreign countries for materials. Respondents mentioned that much of the necessary equipment would need to be imported from abroad and many times at a higher cost than locally manufactured goods. Therefore, this limits an industry's ability to be competitive. Currency fluctuations create further difficulty and link technological and financial barriers together. Therefore, there will be significant implications. Technical barriers pose a structural bottleneck that can not solely be addressed via policies. It is required that large scale investment be made toward upgrading the electric grid, developing local industrial capabilities and implementing storage systems. If this does not occur then any further increase in renewable capacity may result in inefficient use of resources and/or system instability.

5.5 Social Barriers (Public Awareness and Acceptance, Shortage of Qualified Personnel)

Although there was general agreement on the perception that social barriers were a low influence compared to other categories, this did vary depending on which category stakeholders were being evaluated against. Most respondents ranked both public awareness and acceptance as relatively low ranking influences, whereas NGO and Public Sector representatives reported greater importance associated with those same variables. Public awareness was also determined by interview findings to be an issue at present related to RE development in Kazakhstan. Conversely, workforce issues were considered to have significantly more relevance to RE development.

Interviewee 6 stated it to be a moderate barrier to RE deployment in Kazakhstan:

"There is a shortage of skilled employees."

This indicates a need for developing capacity in both technical and management areas in order to develop a workforce that will support large scale RE projects.
This finding is somewhat consistent with recent international literature regarding the role of social acceptance and trust in renewable energy transitions. Lopez et al. (2025); and Beheshtinia et al. (2025) found social acceptance and trust to be significant contributors to successful renewable energy transitions. However, social factors in Kazakhstan appear to be far less limiting than structural and economic constraints associated with the transition from traditional fossil fuels-based power generation systems to renewable energy based power generation systems. Even though social barriers do not appear to presently be constraining RE development, social barriers are likely to have increasing importance as the sector continues to grow. This is particularly true concerning the growth of the RE workforce and public involvement in RE development.

5.6 Environmental Barriers (Geographical Constraints, Climate Variability)

The majority of respondents viewed climate and geographic characteristics as major limitations to their ability to develop renewable energy due to the vast geography of Kazakhstan and its extreme climates. Several respondents identified a large disparity in the location of "resource rich" areas from the "consumption centers." This has resulted in high transmission costs and complex project implementations.

Interviewee 9, an expert in market regulation stated:

"The renewable energy project is built mostly in areas with low demand, therefore there should be an investment into the new transmission line or another type of infrastructure for connection."

The authors' findings agree with prior research. In addition to many others, Laldjebaev et al. (2021) found that both geographical and data-related obstacles can greatly impact the ability of countries in Central Asia to adopt renewable energy resources. Likewise, researchers have found similar environmental barriers limiting the adoption of renewable energy globally.

As such, while it is impossible to eliminate these barriers completely they will need to be proactively addressed via strategic planning, new infrastructure development and technology upgrades to ensure the sustainability of renewable energy systems in Kazakhstan over time.

Chapter 6. Policy Recommendations & Conclusion

Our study has shown that RE development in Kazakhstan is progressing. However the most significant barriers to progress are not based upon policy making, but rather upon creating consistent policies for RE projects which would be financially viable and integrated into existing power systems. Therefore the barriers to RE project implementation, especially technical, financial and institutional, require both sequenced and targeted responses from government or other regulatory bodies.

Based on our findings we propose recommendations across three time horizons.

The short-term goal is to address regulatory uncertainty and institutional inefficiencies, which were frequently mentioned in interviews and confirmed by other studies. The proposal to develop a 5-year tariff and auction transparency plan stems from the desire to create a predictable and stable flow of opportunities for investors, thereby eliminating some of the uncertainties associated with current policy. Furthermore, the creation of an institutional "single window" for permitting is proposed to reduce or eliminate delays arising from the lack of a clear structure of responsibility in what may otherwise appear to be a relatively simple administrative task. Finally, the creation of a Renewable Energy Development Agency is intended to strengthen the technical capacity of institutions and improve communication among all stakeholders, as the results of this study indicate a current gap in how well each stakeholder group monitors and fulfills their respective roles.

Separate auctions for energy storage systems are proposed, based on the understanding that grid stability and variability represent the greatest technological barriers to the expansion of renewable energy production. Separating storage and generation systems will increase transparency regarding

the exact amount of storage required to stabilize the grid and ensure grid balancing during periods of calm or no wind. A National Renewable Energy Day on July 4th is also proposed as a low-cost way to gradually increase public awareness and adoption of renewable energy, as social barriers are identified as less significant than financial and technological barriers.

Medium-term recommendations aim to address those financial and market barriers that have been shown to have a significant impact on investment decisions and, ultimately, project viability. Concessional financing options at 3-5% interest rates are proposed to address the very high cost of capital and limited availability of long-term financing in Kazakhstan, two common barriers to renewable energy investment.

A currency hedging program, providing protection against currency risk for up to 10 years, is proposed to protect foreign investors operating in an environment where their revenues are paid in local currency and project financing is provided with funds borrowed in foreign currency. To eliminate existing market distortions, as artificially low coal-fired electricity prices have been found to undermine competition from renewable energy sources, a reform of fossil fuel tariffs is also necessary so that they accurately reflect economic values. The introduction of educational programs specifically focused on renewable energy and an increase in the number of Bolashak scholarships for students interested in studying renewable energy are also proposed to help alleviate the serious shortage of specialists trained in renewable energy fields. At the same time, a 30% local content requirement is recommended to promote the growth of local renewable energy equipment manufacturers and reduce dependence on imported renewable energy technologies. Importantly, reducing dependence on imports reduces project costs and enables greater local value creation.

The long-term recommendations identify structural and systemic barriers to further progress in developing Kazakhstan's renewable energy sector, which cannot be addressed solely through isolated policy changes. Thus, long-term efforts to modernize and expand the electricity grid are necessary, as the current electricity delivery infrastructure across Kazakhstan was designed primarily for use with centralized fossil-fuel-fired power plants, not for the delivery of electricity generated from decentralized, intermittent sources. Unless significant upgrades are made, further expansion of renewable energy capacity will face increasingly complex integration challenges. The creation of renewable energy zones (REZs)—that is, areas rich in renewable energy sources but remote from population centers where electricity loads exist—will help better align infrastructure investments with consumer locations. This will better manage regional differences between renewable energy sources and consumers and thus help prevent increased power losses.

This study aimed to evaluate how effective renewable energy (RE) policies were in Kazakhstan and to identify the key obstacles that limit the successful accomplishment of the targets established under the "Green Economy" Strategy. Through application of qualitative research methodology using semi-structured expert interview data in combination with a structured ranking, this study offers a comprehensive empirical evaluation of the structural, institutional, and market-related factors shaping Kazakhstan's transition towards a sustainable energy supply.

Results show that Kazakhstan has progressed significantly in developing an official institutional structure supporting the development of renewable energy. Introduction of successive policy tools (i.e., feed-in tariffs, auctions, power-purchase agreements (PPAs) and the single-buyer model) has provided the base for the formation of a renewable energy market, enhanced transparency and accountability in procurement, and decreased costs. Thus, the transitional pathway followed by the government represents a process of incremental, step-wise evolution, whereby the government has

moved progressively from high level commitments regarding strategy to the development of specific mechanisms for implementing those strategies. Therefore, the policy structures and systems that exist are sufficient to facilitate continued growth in renewable energy capacity.

Nevertheless, while the existence of policy tools is necessary for effective implementation of those policies and their achievement of intended outcomes, it is not sufficient. Both qualitative data collected through interviews with experts and ranking exercises provide evidence of widespread identification of technical barriers as being among the most critical constraints. More specifically, outdated energy infrastructure, limited flexibility of the grid, and inadequate system capacity for accommodating intermittent renewable energy resources were cited frequently as the major impediments to successful integration. Findings from this research are reflective of the structural features of Kazakhstan's existing energy system that was originally designed primarily around centralized fossil-fuel based generation (coal). Consequently, existing energy infrastructure is poorly suited to accommodate decentralized, variable renewable energy resources and as a result, faces increasing integration problems as renewable energy scales increase.

While institutional factors also had a strong effect on whether renewable energy policies are successfully implemented, findings from this research demonstrate that institutions play a pivotal role in determining the success or failure of renewable energy policies. Despite having developed formally over time and presently consisting of a variety of mechanisms to support RE development, there are still several issues related to institutional quality that impede consistency and credibility in policy. These include institutional instability; excessive centralization of decision making authority; and unevenness in institutional capability among agencies. It is worth noting that the study demonstrates that problems associated with renewable energy policies do not occur when designing policies, but rather when implementing them. Problems experienced in

coordinating activities among agencies; slow administrative processes; and differences between the intent behind policy actions and actual experience with executing those policies all contribute to what could be referred to as an "implementation gap." This gap reduces the effectiveness of otherwise well-developed policies; and erodes investors' confidence in the long term viability of the sector.

Technical and institutional constraints aside, economic and financial barriers were identified as other key limitations to the development of renewable energy. Respondents reported difficulties accessing long-term funding; high levels of risk associated with capital costs; and sensitivity to currency fluctuations as key barriers to achieving project viability. These financial barriers are exacerbated by structural market conditions (notably the influence of low-regulated fossil fuel prices on electricity pricing); and further complicate matters by distorting price signals in the market; thus reducing the relative competitiveness of renewable energy projects and increasing the difficulty for project developers to achieve financial feasibility. Although various types of policy mechanisms (e.g., PPAs/indexing) have been created to mitigate some of these risks; the investment environment remains highly susceptible to broader macro-economic conditions.

Social barriers were found to be less impactful than economic and/or institutional barriers to renewable energy development. However, respondents did report that social factors did present some degree of constraint, albeit relatively minor. Specifically, respondents indicated that shortages in skilled staff presented one of the greater constraints in terms of expanding the sector. As a consequence, while social factors do not appear to be a major constraint at present; it is possible that social factors will become increasingly relevant as the renewable energy sector continues to grow and develop into a more specialized industry.

Environmental barriers (geographical constraints/climate variability) were recognized as significant constraints. Nevertheless, since these constraints were viewed as largely external/exogenous variables; it is believed they can be addressed through long-term planning; targeted investments in new infrastructure; and adoption of appropriate technologies.

One of the principal contributions of this research relates to identifying how each of the barrier categories identified above are linked; and that each category reinforces others. For example, technical limitations make projects more costly and complex; and therefore amplify financial risk. Weak institutions reduce policy certainty; which impacts investment decisions. Finally, market distortions reinforce these challenges by reducing the competitive advantage of renewable energy options. Because these linkages illustrate that solutions require addressing interdependent system-wide relationships; an integrated approach must be taken to design policy.

The study indicates that while Kazakhstan has a clear goal-oriented vision for its renewable energy transition; it lacks a well-coordinated relationship between policy design, institutional capacity, financial conditionality, and technical system readiness. While Kazakhstan has put forward adequate foundations for transitioning to renewable energy, further advances will rely on the ability to resolve these structural interdependencies synergistically. Failure to align these aspects will likely cause future transitions to be characterized by incrementalism and discontinuity - despite favorable policy environments continuing to exist.

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Appendices

Table 2

Decoding of Interviewees' Expertise

Interviewee	Category
Interviewe 1	Academic
Interviewe 2	Public Sector
Interviewe 3	Market Participant
Interviewe 4	Market Participant
Interviewe 5	Academic
Interviewe 6	Regulator
Interviewe 7	Financial Market
Interviewe 8	Financial Market
Interviewe 9	Regulator
Interviewe 10	Public Sector
Interviewe 11	Market Participant

Table 5

Open-coding of Interviewees Results

Interviewee	Evidence	Open codes	Categories
1	“The "gradually developing" process of moving from declaratory principles to an effective regulation and market structure	gradual transition; policy institutionalization	Institutional
1	The FIT (feed-in-tariff) model created a new form of project funding; The auctions that followed drove down costs and increased participation in renewable energy projects	FIT market creation; auctions reduce tariffs	Economic & Financial
1	Focusing on lowest price may lead to dumping and failure to implement	dumping bids; non-implementation risk	Economic & Financial
1	Coordination of multiple government departments at national level with local authorities is important	interagency coordination; regional-central coordination	Institutional
1	The low cost of coal in china requires additional guarantees and long-term contracts	low coal tariffs; need long-term contracts	Market
1	Grid connection is perhaps the biggest issue facing new renewable energy projects	grid integration bottleneck; weak local manufacturing	Technical
1	System planning, energy storage, green financing, localization, distributed generation, and net metering	integrated planning; green finance; net metering	Institutional
2	Transition is seen as evolutionary; 162 RES facilities have been commissioned	evolutionary transition; capacity growth	Institutional
2	No disputes, a large amount of digitalization has occurred and it is regarded as an important source of transparency	digitalized auctions; transparency	Institutional/ Economic & Financial
2	Unexpected financial burdens were placed in April 2025 due to the amendments regarding balancing markets	regulatory instability; imbalance penalties	Institutional/ Economic & Financial
2	The lack of flexible generation will lead to limitations at auctions, additional obligation for energy storage and increased tariffs	insufficient flexible generation; storage requirement	Technical
2	PPA’s from suppliers to B2B industrial consumers are needed	PPAs	Institutional
3	policy tools are available, however, a majority of energy still comes from coal, and these policies have had very little success	coal dominance; constrained implementation	Institutional/ Market

3	The low price of the bids puts additional stress on the financial viability of the projects due to currency and regulatory risks	bankability pressure; currency risk	Economic & Financial/ Institutional
3	Grid built around northern coal plants creates technical integration limits	coal-centered grid design	Technical
3	This downward adjustment represents a reasonable position given some previous upward adjustments to policy, but could be perceived as reducing overall consistency of policy direction	pragmatic target revision; investor signal risk	Institutional
4	The current types of support (regional quota's, tariffs blended together, and the Single Buyer Model) will continue to influence how new renewable energy resources are developed and supported	regional quotas; tariff blending; single buyer	Institutional
4	Estimated cost increase of about $1,000 per kW for the battery requirements, it can also incur up to 20% loss	storage CAPEX; storage losses	Economic & Financial
4	Old, Soviet era equipment remains cheap and difficult to compete	cheap legacy assets	Market
4	Outdated rural distribution systems require developers to build connections at 35 kV, and construct substations	technical conditions; costly substations	Technical
4	2030 reduction seen as realism under demand growth and peak shortages	demand growth; peak shortages; pragmatic revision	Institutional
4	ownership concentration / same directors across multiple	ownership concentration concern	Institutional
5	five-year auction plan gives investors a forward view of volumes and prices	long-term auction schedule	Institutional
5	auctions more effective because they are transparent; PPA and indexation support confidence	auction transparency; PPA bankability; tariff indexation	Economic & Financial
5	second mechanism can add gigawatt-scale projects but terms are more negotiable and less transparent	IGA mechanism; opacity concern	Institutional
5	storage is important for unstable generation but adds costs	storage for load smoothing; extra costs	Economic & Financial/ Market
6	strategy translated only partially and remains fragmented	fragmented policy translation	Institutional
6	interagency coordination and alignment of energy, tariff, and industrial policy are decisive	policy alignment; interagency coordination	Institutional
6	low fossil tariffs, weak access to long-term capital, and high risk shape feasibility	low fossil tariffs; limited capital; risk	Market

6	largest gaps appear at grid connection, technical conditions, and financial close	execution gap; technical conditions; financial close	Economic & Financial
7	evolutionary development constrained by coal share and grid readiness	evolutionary transition; grid readiness	Technical
7	effective for price optimization but need adaptation to market conditions	price optimization; adaptation needed	Economic & Financial/ Institutional
7	grid capacity and flexibility are key constraints; transmission upgrades needed	grid capacity; flexibility; transmission upgrades	Technical
7	storage, financial support, and risk reduction are priorities	storage; financial support; risk reduction	Economic & Financial
8	green agenda and renewables developing well; country is expanding in all directions	positive trajectory; multi-direction energy development	Institutional
8	private consumers lack motivation for small-scale renewables	weak incentives for small-scale RES	Market
8	constraints not seen as significant at early stages	infrastructure downplayed	Technical
9	20-year purchase guarantees, indexation, and fee exemptions make conditions favorable	20-year guarantees; indexation; preferences	Economic & Financial
9	steady tariff decline and strong international participation confirm effectiveness	tariff decline; international interest	Economic & Financial/ Institutional
9	sector has exceeded earlier intermediate targets and aligns with development plans	implementation success narrative	Institutional
10	strategic direction was right, but implementation was uneven and readiness lagged	uneven implementation; readiness lag	Institutional
10	lowest-price focus can hurt long-term attractiveness; project value should include system value	lowest-price bias; system value	Economic & Financial
10	institutional bottlenecks often slow projects more than technology	institutional bottlenecks	Institutional
10	grid readiness and imported equipment are major constraints	grid readiness; import dependence	Technical
10	align renewables with long-term grid planning, storage, and stable contracts	integrated planning; storage; contractual stability	Institutional
11	the legislation does not provide for direct negotiations for large projects outside auctions	evolving regulatory framework;	Institutional

11	The Ministry of Energy regulates the auction system, final decisions are made by president; centralized government works well in Kazakhstan	centralized government	Institutional
11	financing for renewable energy exists; high interest rates;	High interest rates	Economic & Financial