

Institutional Transmission into Project-Finance Cash Flows: Evidence from Chinese-Invested Renewable Energy in Kazakhstan

Hao Zhen^{1*}, Nizamdinova Arzigul Kamirdinovna², Lutpulla Amurullamovich Omarbakiyev³

Abstract

Why do renewable energy projects in the same country, using similar technology and identical export credit insurance, end up with realised investment ranging from 15.7 percent below budget to 15.0 percent above? This study examines ten Chinese-invested utility-scale wind and solar projects in Kazakhstan that reached financial close between 2018 and 2026, representing a near-complete set of observable cases with full contractual and audited financial records. The variation is not explained by technology. It arises from how the host-country institutional regime enters project contracts and reshapes cash flows. Three channels are identified. Lender-conditioned loan architecture affects the cost of debt: under identical China Export & Credit Insurance Corporation coverage, direct commercial-bank Chinese-yuan loans carry a 153-basis-point rate advantage and include a six-month principal grace period relative to development-bank re-financing. Dynamic fiscal upgrading alters capital commitments, as investment incentives are renegotiated through supplementary agreements that require 29–57 percent additional capital. Balancing-market asymmetry redistributes operating revenue, with under-generation penalised at roughly 2.8 times the rate of over-generation rewards. Drawing on contract text, audited accounts, and settlement files, the analysis shows that cost variation is partly structured at the contract-design stage rather than arising solely during execution. The findings carry implications for project sponsors, for Kazakhstani policymakers calibrating balancing-market and development-bank rules, and for research on institutional effects in emerging-market project finance.

Keywords: project finance, institutional transmission, renewable energy, Kazakhstan, balancing market

Introduction

Central Asia has become one of the most active frontiers of Chinese outbound energy finance. The 2025 Belt and Road engagement report records Central Asia among the top regions for investment, with Kazakhstan among the principal regional destinations for clean-energy investment (Nedopil, 2026). In parallel, Kazakhstan's auction-based renewable-energy regime — launched in 2017 to replace feed-in tariffs — has brought more than 2.8 GW of installed capacity online and has drawn sustained academic attention to its tariff design, legislative architecture, and project-level effectiveness (del Río & Kiefer, 2023; Khamzina, Mukan, & Tormosov, 2025; Khamzina, Ten, et al., 2025; Lan et al., 2024). For Kazakhstani policymakers calibrating the next phase of the energy transition, the question is no longer whether foreign capital will arrive but on what institutional terms it will operate once it has.

A puzzle sits at the micro level of this investment surge. Among ten Chinese-invested utility-scale wind and solar projects in Kazakhstan for which full contractual and audited financial records are available, realised investment costs diverge from pre-investment budgets by between minus 15.7 and plus 15.0 percent. The projects share a narrow turbine-platform family, overlap substantially in engineering, procurement, and construction (EPC) contractor, insurance regime, and financing template. The technological homogeneity that would ordinarily bound cost dispersion does not do so here. Something else intervenes between identical technology and divergent cash flows.

What intervenes is the host-country institutional regime — and, further, it does so through identifiable, contract-level channels rather than through diffuse environmental friction. Three channels emerge from the cases. Lender-conditioned loan architecture shapes financing costs through interest rates, grace periods, and disbursement structures. Dynamic fiscal upgrading alters capital expenditure through supplementary agreements that link incentive status to investment commitments. Balancing-market asymmetry redistributes operating revenue by penalising under-generation more heavily than it rewards over-generation. Each channel is traceable in primary documents — loan agreements, insurance schedules, investment agreements and their

^{1*} Al-Farabi Kazakh National University, Almaty, Kazakhstan, haozhen@mail.ru (corresponding author)

² Al-Farabi Kazakh National University, Almaty, Kazakhstan, anizamdinova@mail.ru; ORCID: <https://orcid.org/0000-0003-3507-5216>

³ Turan University, Almaty, Kazakhstan, lomarbakiyev@turan-edu.kz; ORCID: <https://orcid.org/0000-0002-3474-6244>

addenda, monthly balancing-market invoices — and each produces a directionally predictable effect on the project's budget-to-actual variance.

The purpose of this study is to explain why technologically similar Chinese-invested renewable energy projects in Kazakhstan diverge so widely in realised cost, and to identify the specific, contract-level channels through which the host-country institutional regime enters project cash flows. The object of the study is the population of Chinese-invested utility-scale renewable energy projects in Kazakhstan that reached financial close between 2018 and 2026; its subject is the transmission of the host-country institutional regime into project-finance cash flows through contract structures.

To achieve this purpose, the study pursues four tasks: (1) to identify the channels through which host-country institutions enter project contracts and cash flows; (2) to trace the transmission of each channel in primary loan, investment, and settlement documents; (3) to assess the direction and magnitude of each channel's effect on the budget-to-actual cost variance; and (4) to derive implications for project sponsors and for Kazakhstani policymakers. The tasks are addressed through a multiple-case comparative design with process tracing, and the results are of direct practical significance for sponsors structuring Chinese-financed renewable investments and for Kazakhstani institutions calibrating balancing-market and development-bank rules.

The paper's scientific novelty and working hypotheses are set out in the next section. The remainder of the paper is then organised as follows: the literature review and conceptual framework; the materials and methods; the results for each channel; a discussion of implications and boundary conditions; and the conclusion.

Main provisions

Central hypothesis

Among technologically similar Chinese-invested renewable energy projects in Kazakhstan, the observed cost variance is driven not by technology but by how the host-country institutional regime enters project contracts and reshapes cash flows.

Scientific novelty

First, the study reconceptualises host-country institutions not as country-level distance but as structured inputs that enter project contracts and reshape cash flows, specifying three transmission channels: lender-conditioned loan architecture, dynamic fiscal upgrading, and balancing-market asymmetry.

Second, drawing on a near-complete universe of Chinese-invested utility-scale wind and solar projects in Kazakhstan — ten of approximately fourteen that reached financial close in 2018–2026 (more than 70 percent) — together with confidential loan agreements, investment agreements, and twelve months of balancing-market settlement files, it provides the first project-level, contract-based evidence on the cash-flow consequences of Kazakhstan's post-2023 balancing-market reform.

Third, it shows that lender identity continues to price project debt even under identical coverage from the China Export & Credit Insurance Corporation (Sinasure), extending the project-finance literature on cross-border renewable lending.

Working hypotheses

Guided by the central hypothesis, the study advances three working hypotheses, each corresponding to one transmission channel and tested in the Results:

H1 (loan architecture). Under identical Sinasure coverage, lender identity — direct Chinese commercial-bank lending versus host-country development-bank refinancing — systematically affects the cost and structure of project debt.

H2 (fiscal upgrading). Investment-incentive status is not fixed at signing but renegotiated upward through supplementary agreements that raise committed capital within a predictable range.

H3 (balancing-market settlement). Kazakhstan's post-2023 balancing market is asymmetric, penalising under-generation more heavily than it rewards over-generation, thereby redistributing operating-revenue risk to generators.

Literature Review and Conceptual Framework

Institutions as transmission, not distance

Institutional theory in international business has been dominated by the construct of institutional distance: the greater the regulatory, normative, or cognitive gap between home and host environments, the higher the transaction cost and the higher the likelihood of underperformance (Kostova et al., 2020; Meyer et al., 2009; North, 1990; Scott, 2014). The construct has generated a large empirical literature, but it has a recurrent weakness: distance is measured at the country-pair level and treated as exogenous to the contract, so

when it correlates with performance it does so without specifying how the effect was transmitted. A parallel literature characterises emerging markets by missing intermediaries — institutional voids — where firms substitute internal or contractual solutions for absent market infrastructure (Khanna & Palepu, 2010; Peng, 2003). Useful as that framing is, it still treats institutions as exogenous conditions to be worked around.

Rather than treating institutions as distance between countries, this study focuses on how they enter contract structures and shape project cash flows. The repositioning follows the call by Kostova and colleagues (2020) for micro-level, mechanism-based accounts and aligns with the emerging-market focus of Meyer et al. (2009) on firm-level entry and operating strategies.

Project finance and cost variance

Project finance separates the special-purpose vehicle from its sponsors and loads the risk onto ring-fenced assets and cash flows (Esty, 2004; Gatti, 2013; Sufi, 2007). The classic project-finance literature focuses on three sources of cost variance: commercial risk (demand, price), construction risk (schedule, EPC performance), and political risk (expropriation, currency transfer). Steffen (2018) shows that, for renewable energy specifically, the dominant driver of the levelised cost of electricity is the cost of capital, which in turn is sensitive to the financing structure rather than to technology choice once the technology has matured — a pattern that Hirth and Steckel (2016) document at the system level for decarbonising electricity sectors more broadly. Flyvbjerg (2014) provides a large-N overview of megaproject cost overruns, documenting their ubiquity but leaving the institutional mechanisms underspecified.

What the literature has under-theorised is the inverse case relevant here: projects that share technology, contractor, and insurance yet diverge on cost because their contracts transmit different institutional inputs. The three-channel framework offered in the next section treats institutions as structured inputs to the project's financial architecture — loan pricing and grace periods, tariff status and tax treatment, balancing-market exposure — rather than as environmental friction.

Export credit agencies and lender identity

Export credit agencies (ECAs) underwrite political and commercial risk to support national exporters; their coverage reduces the lender's loss-given-default and compresses the risk premium embedded in the loan margin (Chin & Gallagher, 2019; Stephens, 1999). Sinosure, the Chinese ECA, has become the largest single provider of ECA coverage in emerging-market infrastructure lending (Chen & Liu, 2023; Dreher et al., 2022; Horn et al., 2021). A common assumption in this literature is that once ECA coverage is fixed, the remaining dispersion in loan pricing is driven by sponsor-specific credit characteristics. The cases examined here show that lender identity — direct Chinese commercial bank versus host-country development-bank intermediary — persists as a pricing determinant even after ECA coverage is held constant. This finding speaks to a gap in the project-finance literature on how institutional context enters cross-border lending once conventional credit risk has been insured away.

Kazakhstan as a setting

The Kazakhstani electricity sector occupies an unusual analytic position. The 2009 renewable energy law (Law of the Republic of Kazakhstan No. 165-IV, 2009), the 2017 transition to auctions, the 2023 amendments to the electricity market rules, and the post-2022 expansion of the Damu interest-rate subsidy programme have together produced a layered institutional regime within which a near-complete cohort of Chinese-invested projects has been built (Mouraviev, 2021; Shakeyev et al., 2023; Zhakiyev et al., 2025). Recent analyses have begun to document the distinctive role of the Development Bank of Kazakhstan (DBK) as a sovereign intermediary in cross-border infrastructure finance (Khamzina, Mukan, & Tormosov, 2025; Lan et al., 2024), and the broader literature on Chinese investment in Central Asia has paid increasing attention to project-level outcomes and to the country's transition risks more broadly (De Miglio & Bakdolotov, 2024; O'Neill, 2014; Sulaimanova et al., 2023; Xenarios et al., 2024; Zeng, 2025). What has remained largely outside this literature is the contract-level view: how the Kazakhstani institutional regime appears in the loan agreement, the supplementary investment contract, and the monthly settlement file. That is the gap this paper addresses.

Materials and Methods

This study employs a multiple-case comparative design with process tracing. Its inferential logic is analytical generalisation rather than statistical inference: the aim is to identify institutional transmission mechanisms that can be traced in contract text and settlement files and that are expected to operate wherever their preconditions hold. The analysis combines general scientific methods (comparison, analysis and synthesis)

with a case-based comparative method — a matched-pair comparison for Channel 1 and cross-case pattern matching for Channels 2 and 3.

Research design and case selection

The ten projects analysed here are not a sample drawn from a larger unknown population. Between 2018 and 2026, approximately fourteen Chinese-invested utility-scale wind and solar projects reached financial close in Kazakhstan according to public records of the Kazakhstani Ministry of Energy and the Financial Settlement Centre for Renewable Energy (IEA, 2024; Ministry of Energy of the Republic of Kazakhstan, 2023). Four of the fourteen are excluded for reasons of data completeness rather than research-design choice: two because their feasibility-study financial models were not made available; one because audited completion accounts were not released; one because the project was suspended prior to commercial operation. The remaining ten cases — labelled A through J throughout the paper to preserve commercial confidentiality — therefore represent more than 70 percent of the universe of observable projects of this type. This constitutes a near-complete enumeration of observable cases rather than a sample, and the generalisation claim that follows is conditional on the universe so defined.

Table 1 summarises the analytical role of each case. Cases A and B are the matched comparison at the heart of Channel 1: they share developer nationality, technology, EPC contractor, power-purchase-agreement (PPA) signing date, and Sinasure buyer-credit coverage at the 95/95 dual-cover level; they differ primarily in lender identity (direct Chinese commercial bank for A, host-country development-bank refinancing for B), while also differing in nameplate capacity (100 versus 50 MW), which we cannot fully control for. Cases C through G extend the institutional variation across tariff regime (feed-in tariff versus auction), construction period, and year of commercial operation, and provide the variance needed to test Channel 2. Case H provides the primary documentation for Channel 3, being the only project in the set for which complete monthly balancing-market settlement files covering a full operational year were made available for this study. The purpose of Case H is mechanism identification rather than population representativeness. Cases I and J are utility-scale solar projects included as within-technology heterogeneity checks.

Table 1. The universe of ten Chinese-invested utility-scale renewable energy projects in Kazakhstan (2018–2026).

Case	Capacity (MW)	Technology	Lender structure	Tariff regime	Role in the analysis
A	100	Wind	Direct ICBC (Industrial and Commercial Bank of China)/BOC (Bank of China) CNY loan; Sinasure 95/95	Auction	Channel 1 (matched pair)
B	50	Wind	Development Bank of Kazakhstan CNY refinancing; Sinasure 95/95	Auction	Channel 1 (matched pair)
C	50	Wind	Development Bank of Kazakhstan refinancing	Feed-in (initial) / Auction (later)	Channel 1 robustness; Channel 2 (initial phase); currency variation
D	100	Wind	Mixed syndicate	Feed-in tariff	Channel 2 (fiscal upgrade)
E	50	Wind	Mixed syndicate	Feed-in tariff	Channel 2 (fiscal upgrade)
F	50	Wind	Development Bank of Kazakhstan (DBK) refinancing	Feed-in tariff	Channel 2 (fiscal upgrade)
G	50	Wind	Development Bank of Kazakhstan refinancing	Feed-in tariff	Cost-deviation outlier; Channel 2
H	20	Wind	Domestic commercial	Auction	Channel 3 (balancing market, direct evidence)
I	100	Solar	Direct ICBC/BOC CNY loan	Auction	Technology-heterogeneity check
J	30	Solar	Mixed syndicate	Auction	Technology-heterogeneity check

Note – Compiled by the authors based on project loan agreements, PPAs, investment agreements, and public registry data. Sinasure = China Export & Credit Insurance Corporation.

Data sources

Primary data comprise project-company documents made available under confidentiality agreements: investment agreements with the Kazakhstani government and any supplementary agreements; PPAs with the Financial Settlement Centre for Renewable Energy; loan agreements, disbursement schedules, and repayment schedules; insurance certificates from Sinasure and Kazakhstani insurers; feasibility-study financial models; audited completion accounts; and, for Case H only, twelve months of balancing-market settlement files identifying scheduled generation, actual generation, imbalance volumes, imbalance prices, and monthly net settlement amounts. Secondary data are drawn from the Ministry of Energy's public registry, the Financial Settlement Centre's publications, and peer-reviewed analysis of the Kazakhstani regulatory framework (Khamzina, Mukan, & Tormosov, 2025; Lan et al., 2024; Mouraviev, 2021; Shakeyev et al., 2023).

Analytical strategy: process tracing

We use process tracing in the causal-mechanism sense as the inferential technique: for each proposed channel the analysis identifies the institutional input (a clause, a rule, a price formula), traces its transmission through the project's contractual stack, locates the point at which it enters the cash-flow statement, and documents the resulting variance (George & Bennett, 2005; Yin, 2018).

Ten cases limit the kinds of inference the paper can pursue; the study does not claim statistical generalisability. Two features of the design mitigate the small-N concern.

The first is a matched-pair comparison. Cases A and B share developer, turbine platform, EPC contractor, power purchase agreement (PPA) signing date, and Sinasure coverage — the commercial variables ordinarily expected to drive financing cost. They differ primarily in lender identity, while also differing in nameplate capacity (100 versus 50 MW), which cannot be fully controlled for in a two-observation comparison. Given the identical EPC arrangements, PPA counterparty, and Sinasure cover, however, lender identity remains the most plausible driver of the observed pricing differences. Case A is financed directly by a syndicate of Chinese commercial banks led by the Industrial and Commercial Bank of China (ICBC); Case B is refinanced through the Development Bank of Kazakhstan (DBK), acting as intermediary to the same Chinese commercial pool. The pairing isolates lender-identity effects on loan pricing with unusual cleanliness for a project-finance setting. We use the term matched comparison in preference to quasi-experimental, which in econometrics implies a stronger assignment mechanism than two observations can support.

The second feature is pattern matching across institutionally heterogeneous cases. For Channels 2 and 3, the analysis traces the same mechanism across cases that differ on tariff regime (feed-in versus auction), lender (DBK versus direct commercial), and wind-variability profile (high versus low). When the predicted directional effect appears across this variation, the evidence for the mechanism strengthens even with a small N. Where a pattern appears in only a subset of cases — most notably for Channel 3, which is directly documented for Case H and inferred from structural exposure for Cases A and B — the limits are stated explicitly.

Validity and reliability

Construct validity is supported by triangulation (Figure 1): each numerical claim is verified against at least two of contract text, feasibility-study model, audited accounts, and settlement files. Internal validity for Channel 1 rests on the matched comparison; for Channel 2, on the direction and consistency of the pattern across five cases in the feed-in tariff cohort; for Channel 3, on rule-based uniformity of the balancing-market pricing formula, documented in the Financial Settlement Centre methodology that applies identically to all renewable generators. External validity is bounded: the findings apply cleanly to Chinese-originated capital, ECA-backed infrastructure, and the Kazakhstani institutional regime as it stood between 2018 and 2026. How far the framework extends to other Central Asian jurisdictions, to non-Chinese capital, or to liberalised electricity markets is a question for replication rather than assertion. Reliability is supported by a full case-protocol database maintained by the author and available on reasonable request, subject to the disclosing parties' written consent.

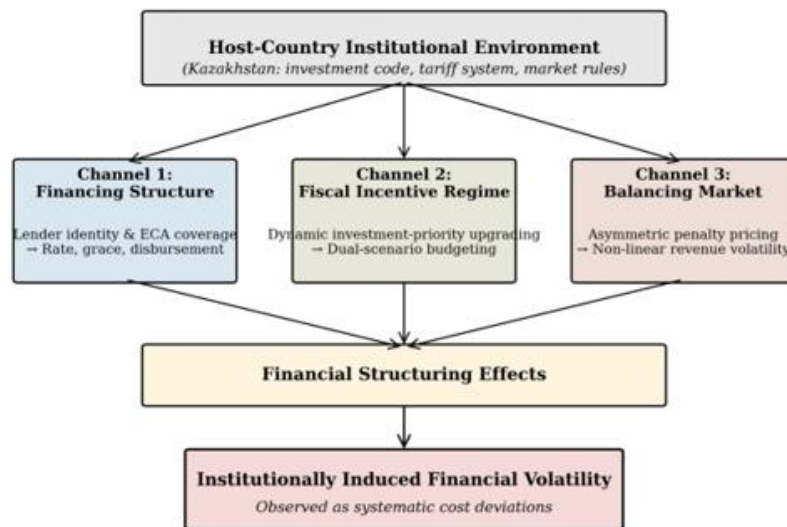


Figure 1. Three institutional transmission channels from the host-country regime into project-finance cash flows.

Note – The host-country institutional environment is transmitted to project-level cash-flow outcomes through three parallel channels, which jointly produce institutionally induced financial volatility observable as cost deviation.

Results

Cost deviation across the ten projects

Fig. 2 plots realised investment cost as a percentage deviation from the pre-investment budget for each of the ten cases. The range is from minus 15.7 percent (Case A) to plus 15.0 percent (Case G). Case G is the outlier: a feed-in-tariff era project whose cost deviation carries both the fiscal-upgrade effect of Channel 2 and a construction-schedule delay that is outside the institutional scope of this paper. Setting Case G aside, the under-budget cases are disproportionately concentrated in the auction-era cohort (A, B, C, H), while the over-budget cases cluster in the feed-in-tariff cohort (D, E, F) — a pattern consistent with the argument developed across the three channels below.

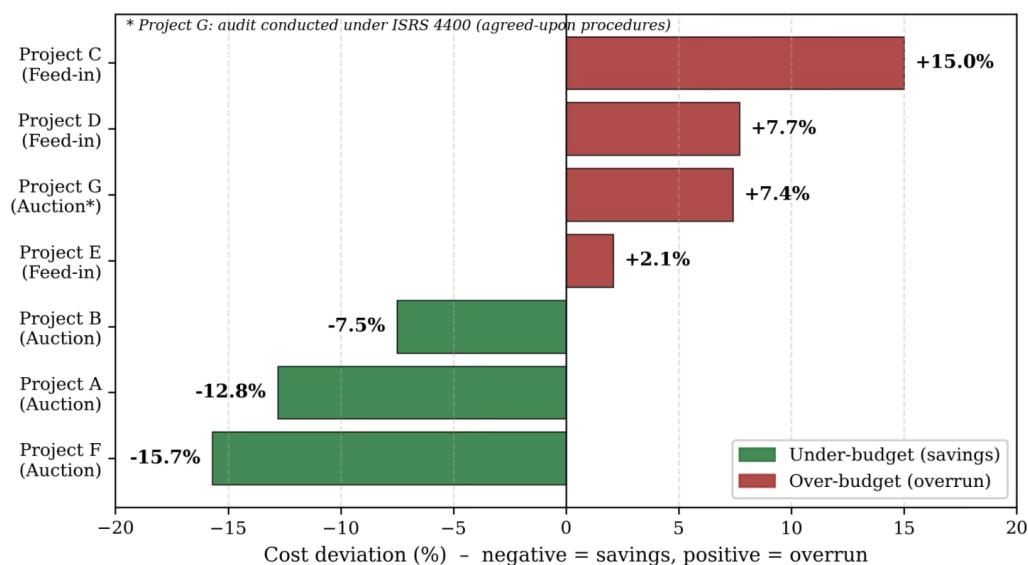


Figure 2. Cost deviation (realised vs. budgeted investment), ten projects, ranked.

Note – Negative values indicate savings relative to contractual budget; positive values indicate overruns. Auction-era projects (three of four) realise savings; every feed-in-tariff project overruns.

Channel 1: Lender-conditioned loan architecture

This channel tests H1. The matched comparison of Cases A and B isolates lender identity under identical Sinosure coverage.

Channel 1 is the most isolable of the three. Cases A and B are closely comparable across the major commercial dimensions, while differing primarily in lender identity and, to a lesser extent, project scale (100 versus 50 MW). Table 2 isolates lender-identity effects by holding the major commercial parameters — EPC contractor, PPA counterparty, and Sinasure coverage — constant.

Table 2. Matched comparison: direct Chinese commercial lending versus host-country development-bank refinancing, under identical Sinasure cover.

Feature	Case A	Case B
Capacity	100 MW	50 MW
Technology	Wind (3.6 MW platform)	Wind (3.6 MW platform)
EPC contractor	Chinese EPC-1	Chinese EPC-1
PPA counterparty	Financial Settlement Centre for Renewable Energy	Financial Settlement Centre for Renewable Energy
Sinasure coverage	95 % political / 95 % commercial	95 % political / 95 % commercial
Lender structure	Direct ICBC/BOC CNY syndicate	DBK CNY refinancing (ICBC pool)
Loan currency	CNY	CNY
Interest rate	2.90 % fixed	4.43 % floating (LPR+spread)
Grace period	6 months post- commercial operation date (COD)	None
Drawdown	3 tranches tied to milestones	Single drawdown at refinancing
Cost deviation	–15.7 %	–9.1 %

Note – Compiled by the authors based on loan agreements and audited completion accounts of Cases A and B. LPR = Loan Prime Rate; COD = commercial operation date; DBK = Development Bank of Kazakhstan.

Three differences follow from lender identity and together account for the observed cost gap. The interest rate differs by 153 basis points despite identical Sinasure cover. The direct ICBC syndicate prices the loan against the People's Bank of China benchmark with a thin credit spread, reflecting the strategic-industry status of Chinese outbound renewable investment. DBK, acting as intermediary, applies a commercial spread over the Loan Prime Rate plus an intermediation margin, and the resulting 4.43 percent floating rate locks in the institutional cost of routing capital through a host-country development bank rather than accepting it directly.

A second difference lies in repayment timing. The six-month principal grace period in Case A (Fig. 3) shifts the onset of repayment to a point at which the wind farm is producing stabilised revenue, whereas in Case B repayment begins at drawdown. Case A's cumulative debt service in the first post-COD year is approximately 38 percent of Case B's, freeing cash flow for contingency absorption. The third difference is in disbursement structure: the three-tranche drawdown in Case A — with each tranche released against EPC-milestone evidence — compresses interest during construction by approximately 110 basis points over a two-year build, relative to the single drawdown in Case B. Taken together, these features account for the bulk of the 6.6-percentage-point cost gap between A and B.

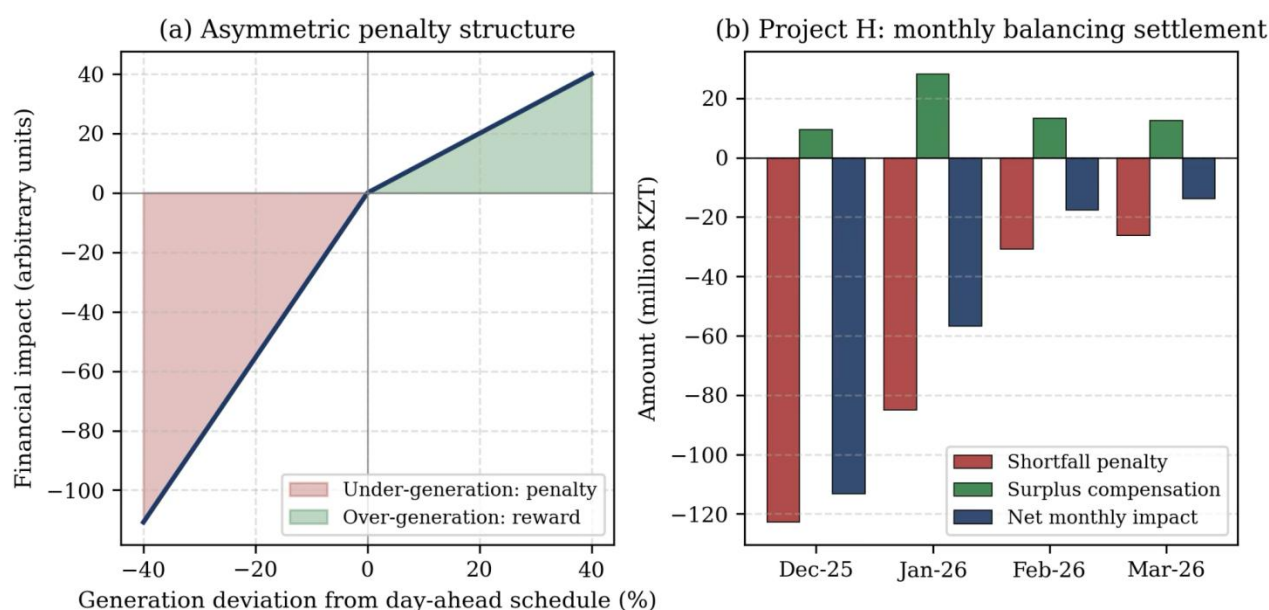


Figure 3. Cumulative debt-service burden in the first post-COD year: Case A (six-month grace, tranced drawdown) versus Case B (no grace, single drawdown).

Note – Repayment profiles under identical Sinasure coverage. Case A (ICBC syndicate) enjoys a six-month grace window aligned with the generation ramp-up. Case B (DBK refinancing) faces repayment immediately after commercial operation.

Channel 2: Dynamic fiscal upgrading

This channel tests H2. The five feed-in-tariff-era cases trace how investment-incentive status is renegotiated after signing.

The second channel operates on the capital-investment schedule through the negotiation structure of Kazakhstani investment-incentive status. The country's Investment Promotion Law and its implementing regulations establish a multi-tier incentive regime — reduced corporate income tax, land-tax exemption, customs-duty relief on imported equipment, and, at the priority investment tier, eligibility for in-kind state grants. Formal eligibility thresholds are specified in terms of minimum capital commitment. In practice, the thresholds are anchors for a negotiation rather than bright lines.

Across the five feed-in-tariff-era cases (D, E, F, G, and the earlier phase of C), the pattern is consistent: the initial investment agreement secures the base tier; six to eighteen months later, the project company negotiates a supplementary agreement that upgrades the incentive status in exchange for committing an additional 29 to 57 percent of budgeted capital. The additional commitment is substantial but is recouped over the project's operating life through the upgraded tax treatment. Table 3 documents the magnitude and consistency of these uplifts across cases.

Table 3. Capital-commitment uplifts associated with supplementary-agreement tax-incentive upgrades in feed-in-tariff-era cases.

Case	Initial tier	Upgraded tier	Capital uplift	Tax relief secured
C (phase 1)	Standard	Priority	+39 %	corporate income tax (CIT) 15 % → 0 %, land-tax waived
D	Standard	Priority	+57 %	CIT 15 % → 0 %, customs waived
E	Standard	Priority	+44 %	CIT 15 % → 0 %, customs waived
F	Standard	Priority	+29 %	CIT 15 % → 0 %
G	Standard	Priority	+53 %	CIT 15 % → 0 %, customs waived

Note – Compiled by the authors based on investment agreements and supplementary agreements.

The institutional meaning of the pattern is that the investment agreement is not a final commitment but the opening move in a sequence. Sponsors that budget the base scenario are surprised by the supplementary requirement and record it as a cost overrun; sponsors that budget the upgraded scenario from the start treat the same figure as on-plan. While reverse causality cannot be fully ruled out — sponsors planning a larger capital programme might independently seek priority status — the consistent sequencing across cases, in which the initial agreement precedes the upgrade-linked capital commitment by six to eighteen months, supports the interpretation of institutional inducement rather than sponsor-led redesign. The observed +29 to +57 percent capital variation is therefore not random; it is a predictable negotiation feature of the Kazakhstani investment-incentive regime, and it constitutes the second contract-level channel through which institutions enter cash flows.

A note on the contrast with the auction cohort. In the auction-era cases (A, B, H, and the later phase of C), the incentive structure is largely pre-set by the auction protocol and the associated Investment Contract template; the supplementary-agreement dynamic is muted. This difference is part of the reason that the auction cohort clusters under budget while the feed-in-tariff cohort clusters over budget.

Channel 3: Asymmetric balancing-market settlement

This channel tests H3. Case H provides the direct settlement evidence; for Cases A and B the channel is inferred from the uniform market rule.

The third channel is the most consequential for operational cash flow and the one for which the evidence is most concentrated in a single case. Direct monthly settlement files are available for this study only for Case H; for Cases A and B, the channel is inferred from structural exposure to the same market rule rather than directly observed. This is a genuine limit on the cross-case generality of the Channel 3 finding. The balancing-market rule, however, is uniform across all renewable generators by regulation; the documented asymmetry in Case H is a product of that rule rather than of plant-specific idiosyncrasy. The relevance of the Case H finding to Cases A and B therefore rests on rule-based similarity rather than on cross-case replication.

Since the 2023 amendment to the electricity market rules, Kazakhstan operates an asymmetric balancing-market pricing regime: under-generation (scheduled volume exceeding actual delivery) is charged at a penalty price, while over-generation is rewarded at a price that is set structurally below the reference balancing price. Figure 4 sketches the rule schematically and displays the realised monthly settlement balance for Case H over one operational year.

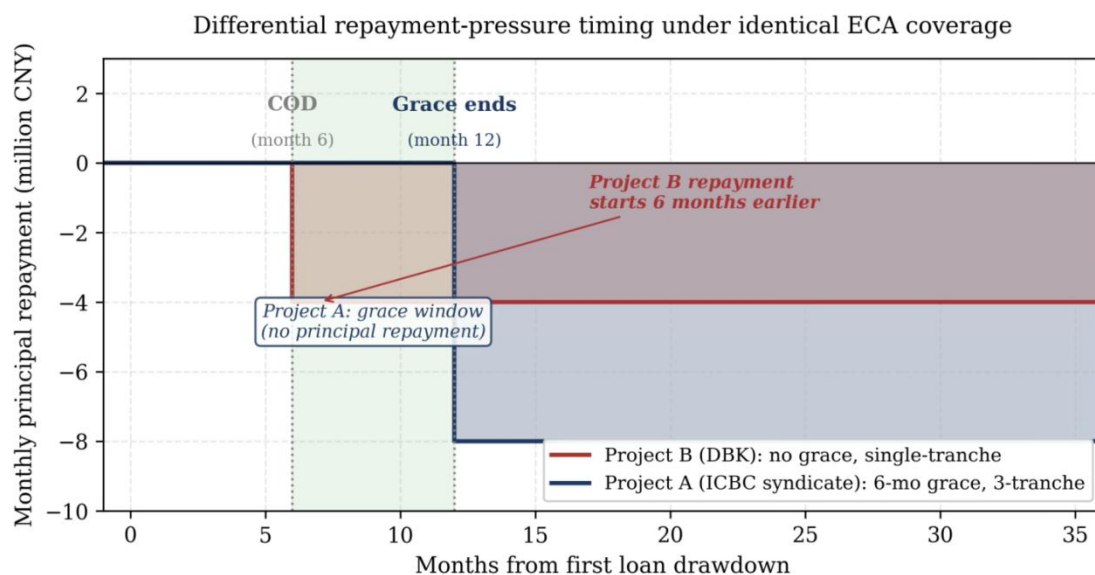


Figure 4. Balancing-market asymmetry (schematic) and Case H monthly settlement, one operational year.

Note – (a) Schematic asymmetry: the slope on the penalty side is 2.77 times the slope on the reward side. (b) Four months of balancing settlements for a 20 MW wind project; December 2025 produced a monthly net impact exceeding the project's PPA revenue for that month.

Table 4 presents the monthly settlement numbers. In December 2025, Case H was charged a shortfall penalty of Kazakhstani tenge (KZT) 122.8 million against monthly PPA revenue of KZT 118.4 million, pro-

ducing a negative operating cash flow for the month. Across the twelve-month period, the ratio of the unit penalty for under-generation to the unit reward for over-generation is approximately 2.8 to 1. The ratio is calculated from the monthly settlement data in Table 4 as the average unit penalty per GWh of under-generation divided by the average unit reward per GWh of over-generation across the twelve months. For a wind generator with forecast variance in the 20 to 30 percent range — a profile documented in Case H and consistent with the wind-resource characteristics of the relevant region (Mouraviev, 2021) — the expected annual net balancing charge exceeds 5 percent of PPA revenue.

Table 4. Case H monthly balancing-market settlement (anonymised illustrative reconstruction from source files).

Month	Scheduled (GWh)	Actual (GWh)	Imbalance (GWh)	Net settlement (KZT mn)
Jan	6.2	5.1	−1.1	−14.6
Feb	5.8	6.9	+1.1	+8.2
Mar	5.4	4.0	−1.4	−19.8
Apr	4.9	5.2	+0.3	+2.1
May	4.2	3.1	−1.1	−15.9
Jun	3.8	4.4	+0.6	+4.3
Jul	3.5	2.8	−0.7	−10.8
Aug	3.9	3.2	−0.7	−11.2
Sep	4.6	5.8	+1.2	+9.1
Oct	5.7	4.9	−0.8	−12.5
Nov	6.1	4.2	−1.9	−29.7
Dec	6.5	2.1	−4.4	−122.8

Note – Compiled by the authors from monthly balancing-market settlement files of Case H. Negative amounts = payment due from project.

The institutional meaning of Channel 3 is that Kazakhstan’s balancing-market design is asymmetric in a way that transfers forecasting risk from the system operator to the generator. For projects that were financially modelled on the assumption of symmetric balancing or pre-2023 rules, the realised revenue falls short of the projected PPA revenue by an amount that scales with wind-forecast variance. Projects financially modelled after the rule change embed a balancing-exposure contingency in the revenue stream from the outset. Channel 3 is therefore the third contract- and rule-level pathway through which the Kazakhstani institutional regime enters the project’s cash flows.

Discussion

An integrated picture

Taken together, the three channels affect different components of project cash flow. Financing costs are shaped by lender structure; capital expenditure is adjusted through fiscal upgrading; operating revenue is influenced by balancing-market rules. Viewed jointly, these mechanisms provide a coherent explanation for the cost-deviation range observed across the ten cases, and no alternative technological or commercial factor accounts for the pattern. Table 5 maps each channel to the cash-flow line item it affects, the direction of the effect, and the cases in which it is documented.

Table 5. Integrated mapping of the three transmission channels.

Channel	Institutional input	Cash-flow line item	Direction	Documented in
1	Lender identity under identical ECA cover	Interest expense; debt-service schedule	Lower cost for direct lending	A, B, C, I
2	Supplementary-agreement upgrade dynamic	Capital expenditure	Higher CapEx; upgraded tax status	C, D, E, F, G

3	Asymmetric balancing-market settlement	Operating revenue	Negative months in high-variance periods	H (direct); A, B (inferred)
<i>Note – Compiled by the authors based on the data summarised in Tables 1–4.</i>				

Assessment of the working hypotheses

H1 is supported. The matched comparison of Cases A and B shows that, under identical Sinosure coverage, lender identity alone is associated with a 153-basis-point rate difference and a six-month grace asymmetry — consistent with H1.

H2 is supported. Across the five feed-in-tariff-era cases, incentive status was renegotiated upward through supplementary agreements requiring 29–57 percent additional capital, consistent with the predicted upgrading dynamic in H2.

H3 is supported, with a stated scope limit. Case H confirms the post-2023 asymmetry directly (penalty-to-reward ratio $\approx 2.8:1$); for Cases A and B the channel is inferred from the uniform balancing-market rule rather than directly observed, so H3 holds directly for Case H and by rule-based extension elsewhere.

Positioning in the literature

The three-channel framework advances the institutional-theory conversation in a specific direction. Where the distance literature treats institutions as a country-pair scalar and the voids literature treats them as absent intermediaries, the framework here treats them as structured inputs that enter the contract. This repositioning is consistent with the call by Kostova and colleagues (2020) for micro-level, mechanism-based accounts of institutional effects and aligns with the emerging-market-focused strategic-management literature (Meyer et al., 2009; Peng, 2003) on how firms adapt to host regimes at the operational level.

For project finance, the findings extend the Esty (2004) and Gatti (2013) characterisation of project-specific risk allocation by showing that lender identity, even under identical ECA coverage, remains a pricing determinant in cross-border renewable finance — a result that dovetails with the recent documentation of coordinated credit spaces in Chinese outbound lending (Chin & Gallagher, 2019; Dreher et al., 2022; Horn et al., 2021). For the Central Asian renewable energy literature, the paper contributes the first project-level evidence on the cash-flow consequences of the 2023 balancing-market reform, complementing the regulatory and macro-level analyses of Khamzina, Mukan and Tormosov (2025), Lan et al. (2024), and Zhakiyev et al. (2025), and the political-economy reading by Zeng (2025) of Chinese-financed renewable assets in Kazakhstan.

Implications for sponsors

From a project-design perspective, three principles follow from the analysis for sponsors structuring Chinese-financed renewable investments in Central Asia. Under identical Sinosure buyer-credit coverage, direct commercial-bank CNY financing through ICBC or BOC delivered a 153-basis-point rate advantage and a six-month principal grace period relative to host-country development-bank refinancing; where project specifications permit, the direct commercial route should be the default. The Kazakhstani investment agreement is best treated as the start of a negotiation sequence rather than a final commitment — budgeting the supplementary-agreement upgrade from the outset, including the additional 29 to 57 percent capital requirement, converts what currently appears as adverse deviation into deliberate design. Balancing-market exposure should be quantified and reserved against at financial close, with a contingency reserve in the range of 5 to 10 percent of annual PPA revenue defensible for sites with wind-variability profiles similar to those documented in Case H, and scaled accordingly for lower-variability sites.

Implications for Kazakhstani policymakers

For the Kazakhstani policy community — the Ministry of National Economy, the Ministry of Energy, the Financial Settlement Centre for Renewable Energy, the Damu Entrepreneurship Development Fund, DBK, and the Baiterek holding more broadly — the three channels point to specific reforms that would materially reduce the documented distortions while preserving the policy intent of the existing regime.

On the financing channel, extending the Damu interest-rate subsidy programme to foreign-currency facilities, or permitting DBK to offer principal grace periods matched to project ramp-up, would narrow the structural gap between direct Chinese commercial lending and DBK refinancing. The current structure is asymmetric in a way that is rarely articulated in the policy debate — Damu's tenge-denominated subsidy expires part-way through a typical 12-to-15-year project loan, leaving foreign-currency-borrowing developers without a comparable instrument once their grace runs out. Closing that gap would reduce the incentive

for sponsors to bypass domestic financial intermediaries, retain a larger share of intermediation value within the Kazakhstani financial system, and align with the broader strategic objective of building deeper sovereign infrastructure-finance capacity at DBK and Baiterek.

On the fiscal-upgrade channel, codifying the supplementary-agreement upgrade trigger in the Investment Promotion Law's implementing regulations — with a published schedule of capital-commitment thresholds and corresponding tier outcomes — would convert what is now a negotiation into a transparent contracting environment. Sponsors would be able to budget the upgrade scenario at financial close; the state would retain the leverage that the supplementary-agreement device provides; and the observed cost-overrun pattern in the feed-in tariff cohort would be largely eliminated. The reform aligns with the Concept for the Transition to a Green Economy and with the 2023–2030 renewable energy development plan (Ministry of Energy of the Republic of Kazakhstan, 2023).

On the balancing-market channel, introducing forecast-error tolerance bands — under which no balancing charge applies within plus or minus 10 percent of schedule, with symmetric pricing beyond — would preserve the system-stability rationale of the 2023 reform while eliminating the punitive asymmetry documented in Case H. Tolerance bands of this kind are standard in European balancing-market design and would transmit to the Kazakhstani context with minor adjustment. The reform would reduce a recurring source of revenue volatility for renewable generators that currently propagates back into the cost of equity demanded at financial close.

Strengths and limitations

Strengths. The design has unusual strengths for a project-finance setting. The matched comparison of Cases A and B isolates lender identity with unusual cleanliness, holding EPC contractor, PPA counterparty, and Sinasure coverage constant. The ten cases constitute a near-complete enumeration — more than 70 percent of the observable universe — rather than a sample, and each numerical claim is triangulated against at least two of contract text, feasibility-study model, audited accounts, and settlement files.

Limitations. Three limits discipline the reach of the findings. First, the small N supports analytical, not statistical, generalisation (H1–H3 are traced mechanisms, not estimated effects). Second, H3 is documented directly only for Case H and inferred for Cases A and B from the uniform balancing-market rule. Third, Cases A and B differ in nameplate capacity (100 versus 50 MW), which cannot be fully controlled in a two-observation comparison, though the identical EPC, PPA, and Sinasure terms leave lender identity the most plausible driver.

Boundary conditions. These findings apply to Chinese-originated capital, ECA-backed infrastructure, and the Kazakhstani regime as it stood in 2018–2026; extension to other jurisdictions, non-Chinese capital, or liberalised markets is a question for replication.

Conclusion

Ten Chinese-invested renewable energy projects in Kazakhstan exhibit cost deviations ranging from 15.7 percent below budget to 15.0 percent above it, despite sharing a narrow turbine-platform family and a small circle of contractors. Technology does not explain the spread. The host-country institutional regime does, through three transmission channels that enter the project's financial architecture and reshape cash flows from the inside.

Lender identity, under identical Sinasure coverage, drives a 153-basis-point rate wedge and a six-month difference in repayment onset. Investment-incentive status, rather than being pre-committed at signing, is negotiated upward through supplementary agreements that demand 29 to 57 percent additional capital commitment, and the negotiation dynamic pushes budgeting toward the conservative scenario. The balancing market, for its part, penalises under-generation at roughly 2.8 times the rate at which it rewards over-generation, producing episodic negative monthly revenue for wind projects with high forecast variance. Together, these channels provide a coherent explanation for the observed range, and no alternative technological or commercial factor accounts for the pattern.

The analytical move is to describe institutions in this setting not as distance from the home environment but as structured inputs to the contracts foreign investors sign. That repositioning sharpens the institutional-theory toolkit, deepens the project-finance literature on ECA-covered cross-border lending, and equips the growing Central Asian renewable-energy literature with project-level evidence on the cash-flow consequences of recent regulatory reform. For Kazakhstani policymakers, the framework identifies three concrete reform levers — Damu/DBK financing instrument design, codified investment-incentive thresholds, and bal-

ancing-market tolerance bands — each tractable within the existing institutional architecture and each capable of materially reducing the institutionally induced volatility that the analysis has documented.

Data availability statement

Primary documents underlying the analysis are project-company confidential. Aggregated data and non-confidential extracts are available from the corresponding author on reasonable request and subject to the disclosing parties' written consent.

References

- Chen, Y., & Liu, Z.Z. (2023). Hedging belts, de-risking roads: Sinosure in China's overseas finance and the evolving international response. *odi.org*. Retrieved from <https://odi.org/en/publications/hedging-belts-de-risking-roads-sinosure-in-chinas-overseas-finance-and-the-evolving-international-response/>
- Chin, G.T., & Gallagher, K.P. (2019). Coordinated credit spaces: The globalization of Chinese development finance. *Development and Change*, 50(1), 245–274. DOI: 10.1111/dech.12470
- De Miglio, R., & Bakdolotov, A. (2024). A 'risk-induced' emission mitigation pathway for Kazakhstan. *Energy Strategy Reviews*, 52, 101332. DOI: 10.1016/j.esr.2024.101332
- del Río, P., & Kiefer, C.P. (2023). Academic research on renewable electricity auctions: Taking stock and looking forward. *Energy Policy*, 173, 113305. DOI: 10.1016/j.enpol.2022.113305
- Dreher, A., Fuchs, A., Parks, B., Strange, A.M., & Tierney, M.J. (2022). Banking on Beijing: The aims and impacts of China's overseas development program. Cambridge: Cambridge University Press. DOI: 10.1017/9781108526166
- Esty, B.C. (2004). Why study large projects? An introduction to research on project finance. *European Financial Management*, 10(2), 213–224. DOI: 10.1111/j.1354-7798.2004.00247.x
- Flyvbjerg, B. (2014). What you should know about megaprojects and why: An overview. *Project Management Journal*, 45(2), 6–19. DOI: 10.1002/pmj.21409
- Gatti, S. (2013). *Project finance in theory and practice*. City: Academic Press.
- George, A.L., & Bennett, A. (2005). *Case studies and theory development in the social sciences*. City: MIT Press.
- Hirth, L., & Steckel, J.C. (2016). The role of capital costs in decarbonizing the electricity sector. *Environmental Research Letters*, 11(11), 114010. DOI: 10.1088/1748-9326/11/11/114010
- Horn, S., Reinhart, C.M., & Trebesch, C. (2021). China's overseas lending. *Journal of International Economics*, 133, 103539. DOI: 10.1016/j.jinteco.2021.103539
- Khamzina, A., Ten, A., Mukatov, B., Assylkhan, A., Omirgaliyev, R., Mankovska, N., & Zhakiyev, N. (2025). Critical analysis of tariff policy and legislative measures for renewable energy development: Medium-term challenges and prospects of Kazakhstan. *ES Energy & Environment*, 28, 1560. DOI: 10.30919/ee1560
- Khamzina, A.S., Mukan, M., & Tormosov, R.Y. (2025). Renewable energy auctions in Kazakhstan: Institutional constraints and project delivery success factors (a review). *Central Asian Economic Review*, 6, 129–141. DOI: 10.52821/2789-4401-2025-6-129-141
- Khanna, T., & Palepu, K.G. (2010). *Winning in emerging markets: A road map for strategy and execution*. City: Harvard Business Press.
- Kostova, T., Beugelsdijk, S., Scott, W.R., Kunst, V.E., Chua, C.H., & van Essen, M. (2020). The construct of institutional distance through the lens of different institutional perspectives: Review, analysis, and recommendations. *Journal of International Business Studies*, 51(4), 467–497. DOI: 10.1057/s41267-019-00294-w
- Lan, S.F., Issabayev, M., & Oskembayev, Y. (2024). Renewable energy technology, feed-in-tariffs and auctions in Kazakhstan. *Smart Grids and Sustainable Energy*, 9(4). DOI: 10.1007/s40866-023-00185-y
- Law of the Republic of Kazakhstan No. 165-IV (2009). [On support for the use of renewable energy sources]. *adilet.zan.kz*. Retrieved from https://adilet.zan.kz/eng/docs/Z090000165_
- Meyer, K.E., Estrin, S., Bhaumik, S.K., & Peng, M.W. (2009). Institutions, resources, and entry strategies in emerging economies. *Strategic Management Journal*, 30(1), 61–80. DOI: 10.1002/smj.720
- Ministry of Energy of the Republic of Kazakhstan (2023). National renewable energy development plan 2023–2030 [National renewable energy development plan 2023–2030]. City: Publisher. *gov.kz*. Retrieved from <https://www.gov.kz/memleket/entities/energo>
- Mouraviev, N. (2021). Renewable energy in Kazakhstan: Challenges to policy and governance. *Energy Policy*, 149(112051). DOI: 10.1016/j.enpol.2020.112051
- Nedopil, C. (2026). China Belt and Road Initiative (BRI) investment report 2025 [China Belt and Road Initiative (BRI) investment report 2025]. City: Griffith Asia Institute and Green Finance & Development Center. *greenfdc.org*. Retrieved from <https://greenfdc.org/china-belt-and-road-initiative-bri-investment-report-2025/>
- North, D.C. (1990). *Institutions, institutional change and economic performance* [Institutions, institutional change and economic performance]. City: Cambridge University Press. DOI: 10.1017/CBO9780511808678
- O'Neill, D.C. (2014). Risky business: The political economy of Chinese investment in Kazakhstan. *Journal of Eurasian Studies*, 5(2), 145–156.

- Peng, M.W. (2003). Institutional transitions and strategic choices. *Academy of Management Review*, 28(2), 275–296. DOI: 10.5465/amr.2003.9416341
- Scott, W.R. (2014). *Institutions and organizations: Ideas, interests, and identities* [Institutions and organizations: Ideas, interests, and identities]. City: SAGE Publications.
- Shakeyev, S., Baineyeva, P., Kosherbayeva, A., Yessenova, G., & Zhanseitov, A. (2023). Enhancing the green energy revolution: Analyzing the impact of financial and investment processes on renewable energy projects in Kazakhstan. *Economics*, 11(s1), 165–182. DOI: 10.2478/eoik-2023-0057
- Steffen, B. (2018). The importance of project finance for renewable energy projects. *Energy Economics*, 69, 280–294. DOI: 10.1016/j.eneco.2017.12.001
- Stephens, M. (1999). *The changing role of export credit agencies* [The changing role of export credit agencies]. City: International Monetary Fund.
- Sufi, A. (2007). Information asymmetry and financing arrangements: Evidence from syndicated loans. *Journal of Finance*, 62(2), 629–668. DOI: 10.1111/j.1540-6261.2007.01219.x
- Sulaimanova, B., Overland, I., Sabyrbekov, R., & Vakulchuk, R. (2023). Energy transition in Central Asia: A systematic literature review [Energy transition in Central Asia: A systematic literature review]. In R. Sabyrbekov, I. Overland, & R. Vakulchuk (Eds.), *Climate change in Central Asia — Climate change in Central Asia* (pp. 69–82). Springer. DOI: 10.1007/978-3-031-29831-8_6
- Xenarios, S., Sembayeva, A., Tsani, S., Orazgaliyev, S., & Ansaganova, Z. (2024). Clean energy challenges and innovation opportunities in Kazakhstan. *Environmental Research Communications*, 6(11), 115009. DOI: 10.1088/2515-7620/ad87b5
- Yin, R.K. (2018). *Case study research and applications: Design and methods* [Case study research and applications: Design and methods]. City: SAGE Publications.
- Zeng, W. (2025). Green energy and state power: The case of the Zhanatas wind power project in Kazakhstan. *Development and Change*, 56(3), 510–538. DOI: 10.1111/dech.12880
- Zhakiyev, N., Burkhanova, D., Nurkanat, A., Zhussipkaliyeva, S., Sospanova, A., & Khamzina, A. (2025). Green energy in grey areas: The financial and policy challenges of Kazakhstan's energy transition. *Energy Research & Social Science*, 124, 104046. DOI: 10.1016/j.erss.2025.104046