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Institutional Budgeting, Technological Constraint and Relational Stabilisation: A Critical Realist Study of Investment Deviation in Renewable Energy Projects in Kazakhstan

A. K. Nizamdinova[1], Hao Zhen[2]* Yang Zhuoshan[3], L. A. Omarbakiyev[3]

Chittagong University, Bangladesh[123], Al-Farabi Kazakh National University, Almaty, Republic of Kazakhstan[4] ,Turan University, Almaty, Republic of Kazakhstan

* Corresponding author: arzigulnizamdinova164@gmail.com

Abstract

This study investigates the generative mechanisms underlying investment deviation and operational performance in renewable energy projects, moving beyond behavioural accounts toward a structural explanation grounded in critical realism. The methodology used a multiple-case retroduction design is applied to nine renewable energy projects (seven wind, two solar) in Kazakhstan, 2020–2025. Evidence is triangulated across business plans, completion audit reports, financial statements, monthly generation records, tariff schedules and ESG disclosures. Projects are anonymised as A–I. Data are analysed by retroduction and process tracing. The findings indicate three interacting mechanisms shape deviation and performance. First, performative budgeting practices, institutionalised safety margins attached to investment preference claims, pre-configure what is later recorded as "saving" or "overrun". Second, differential predictability conditions arising from technological architecture explain why the solar case achieves near-zero deviation while wind cases disperse widely. Third, ESG practices operate as a dual-function relational mechanism, stabilising stakeholder relations while also imposing coordination costs. Apparent forecast accuracy in two recently commissioned projects reflects offsetting tariff and generation deviations rather than predictive precision. The patterns cannot be fully explained by behavioural accounts; they point to structurally embedded processes within open socio-economic systems. The study reframes investment deviation as an emergent outcome of interacting mechanisms within open socio-economic systems. It contributes to critical realist accounting research by integrating Choudhury's circular causation with Bhaskarian stratification at project level

Keywords: Critical realism; circular causation; investment deviation; renewable energy; performative budgeting; Kazakhstan.

Introduction

Global renewable-energy investment has moved past the point of niche ambition. The International Energy Agency (2024) reports roughly 560 GW of new renewable capacity added in 2023 — a 64 per cent year-on-year jump, with solar and wind accounting for most of that total. Levelised costs have continued to fall, and in many markets these technologies now undercut fossil alternatives outright (IRENA, 2023), while forecasting errors (Liu et al., 2024) and Kazakhstan›s tariff shifts (Khamzina et al., 2025) further affect investment stability. Kazakhstan sits squarely inside this trend. By the close of 2025 its renewable fleet delivered 8.62 billion kWh, a 13.7 per cent rise on the prior year, with installed capacity crossing 3.5 GW. National targets aim at 15 per cent renewable generation by 2030.

Yet a stubborn gap persists between the financial projections set out in project development and the outcomes that actually materialise. Business plans routinely assume stable tariffs, predictable generation profiles and controllable construction costs. Practice tends to deliver something rather different. Exchange rates drift. Supply chains break down at inconvenient moments. Policy shifts; community relations sour. The resulting divergence between forecast and realisation complicates capital allocation and, more quietly, complicates the governance of investment incentives that depend on pre-declared budgets.

The standard explanation draws on behavioural categories. Optimism bias and strategic misrepresentation, in Flyvbjerg, Bruzelius and Rothengatter's (2003) influential framing, account for much of the overrun pattern observed in megaprojects. That framing has proved productive, but it carries a limitation: it locates the source of deviation almost entirely inside individual cognition or the incentive architecture facing promoters. The conditions under which financial expectations are constructed in the first place — the institutional forms that budgets take when submitted for regulatory approval, the technological properties of the assets being built, the relational environments that surround them, receive less attention than they deserve.

This study approaches the same phenomenon from a critical realist angle. Following Bhaskar (1975, 1979) and Sayer (2000), it treats observed deviation as a surface appearance generated by deeper causal structures operating within open systems. Accounting representations are read as performative rather than descriptive: budgets do not simply forecast, they establish baselines, allocate resources and define what will later count as an acceptable outcome. Choudhury's (2022) account of circular causation is drawn upon to theorise how ESG and operational variables can bind together into reinforcing loops, not as metaphor, but as an analytical move with precedent in the socio-economic methodology this journal is built around.

The empirical setting is a portfolio of nine renewable-energy projects, seven wind, two solar, developed by a single corporate group in Kazakhstan between 2020 and 2025. The sample spans 50 MW and 100 MW capacities, five regional locations and six commissioning years. Three questions organise the analysis:

RQ1. What patterns of investment deviation and operational performance are observable across the nine projects, and how do these patterns vary by technology and commissioning period?

RQ2. What generative mechanisms, operating across institutional, technological and relational strata, help to explain those patterns?

RQ3. How do ESG-related practices interact with project operations, and under what conditions do those interactions bind into circular causal loops?

Three contributions follow. The paper relocates the analytical centre of gravity from behavioural bias to institutionally embedded accounting practice. It introduces differential predictability conditions as a concept that takes technology seriously without reifying it. And it reframes ESG as a dual-function relational mechanism whose net effect is contingent rather than linear — a reframing that draws on circular causation rather than linear regression logic.

Theoretical Framework

1. *Critical Realism and the Stratification of Reality*

Critical realism, in the formulation developed by Bhaskar (1975, 1979), rests on a stratified ontology. The *empirical* consists of what is observed or experienced. The *actual* comprises events whether or not they are observed. The *real* contains the generative mechanisms — structures, powers, tendencies — that produce actual events when triggered. The methodological consequence is that explanation cannot stop at empirical regularities; it proceeds by retroduction from observed patterns to the mechanisms that must exist for those patterns to be possible (Sayer, 2000).

Social systems are characteristically open. Several mechanisms operate at once, combining or cancelling, with the result that the same mechanism may produce different outcomes in different contexts, and different mechanisms may converge on similar outcomes. Investment deviation, viewed this way, is not a single-cause phenomenon. It is an emergent product of interacting powers — some institutional, some technological, some relational.

Modell (2009, 2015, 2017) has applied critical realism to management accounting, treating accounting systems themselves as causal mechanisms that constitute organisational reality rather than merely describing it. That move matters here: what a completion audit records as a "saving" or an "overrun" is partly a product of the accounting frame within which the project was first represented.

2. *Budgeting as performative practice*

Management accounting research has drawn on performativity studies, notably MacKenzie's (2006) argument that financial models act as "engines, not cameras" — to understand how accounting representations shape the realities they describe (Miller & Power, 2013). From this view, budgets are not neutral forecasts. They are institutionalised inscriptions that pre-configure expectations, lock in resource allocations and define what will count as acceptable deviation.

Budgetary safety margins, contingencies, planned profits, unallocated reserves — are the clearest instance. These margins are reinterpreted through the lens of execution. A saving in a completion audit may index superior managerial efficiency; equally, it may reflect the non-consumption of a margin that was institutionally required in the first place. An overrun may indicate poor control, or it may indicate that the embedded margins were calibrated against optimistic assumptions that execution later falsified. Kazakhstani investment regulation is directly relevant here. Projects seeking tax preferences, customs duty exemptions and guaranteed tariff access must submit detailed budgets that conform to regulatory expectations and are subsequently audited against those expectations.

3. *Technological constraint and predictability conditions*

Infrastructure projects are anchored in technological systems whose material properties constrain what financial models can credibly claim. The differences between solar and wind technologies are best understood as differential predictability conditions rather than as fixed ontological categories.

Solar photovoltaic installations are highly modular. A 50 MW site is functionally a large-scale repetition of small, identical units — panels, inverters, mounting structures — whose equipment prices are globally transparent and whose civil works are comparatively uniform. These features tighten the link between budgeted and actual cost. IRENA (2023), document solar›s modularity advantage and wind›s foundation variability.

Wind is different. Turbines are larger, more complex machines with longer lead times and heavier exposure to supply chain volatility. Foundation engineering is site-specific and sensitive to geotechnical conditions that are often imperfectly characterised at budgeting. Heavy lifts depend on weather windows. And wind resources exhibit seasonal and inter-annual variability that complicates the translation of resource assessments into revenue forecasts.

None of this determines outcomes. Under different procurement strategies or different supply chain configurations, the predictability gap between wind and solar could narrow. The point is simply that, for projects of the kind examined here, technology acts as a real constraint on the reliability of financial modelling.

4. *ESG as dual-function relational mechanism*

The literature on ESG and financial performance remains contested. Clarkson, Li, Richardson and Vasvari (2011) found that proactive environmental strategies correlate with superior financial outcomes, but subsequent work has complicated the linear reading. Meta-analyses and context-specific studies show that the direction and magnitude of the ESG–performance relationship varies with industry, institutional setting and the specific practices involved (Friede et al., 2015).

A critical realist reading reframes ESG not as an independent variable but as a relational mechanism. Local procurement, community engagement, transparency commitments and governance standards reshape the web of relations in which a project is embedded. Eccles et al. (2014) show ESG›s effect depends on stakeholder influence capacity (Barnett, 2007). They may reduce transactional frictions — fewer land disputes, smoother permitting, steadier access to sites. They may also add coordination costs — more complex supplier management, extra reporting, training burdens that would otherwise fall to established international supply chains.

Choudhury (2022) offers a useful theoretical vocabulary here. Circular causation, in his account, describes the endogenous binding of variables through knowledge-induced feedback. Applied to ESG, the concept captures the possibility that initial policy commitments, relational investments, operational stability and financial performance lock into reinforcing loops under favourable conditions — but remain capable of unwinding when those conditions fail. ESG is neither linear driver nor compliance cost. It is a mechanism whose effects are mediated and dual.

5. *Integrated framework*

The framework assembled here does not propose a closed set of variables. It identifies three interacting mechanisms — performative budgeting, differential predictability conditions, and ESG as dual-function relational mechanism — that, in combination, generate the patterns of deviation and performance observed across the nine cases. Figure 1 presents the framework schematically. The task of the empirical analysis is not to weigh the mechanisms against each other in a regression sense, but to trace how they interact, where they activate and where they fail to.

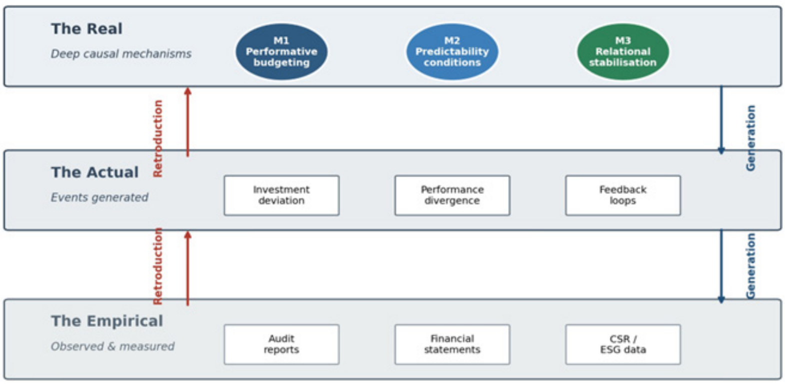

Figure 1. Three-layer critical realist framework with the three generative mechanisms identified in this study.

Source: developed by the authors, drawing on Bhaskar (1975, 1979) and Sayer (2000). Arrows between layers represent retroductive inference and generative tendencies rather than deterministic causal links.

Methodology

Research Design

The design is a multiple-case study within a critical realist framework, using retroduction as its core analytic procedure. Yin (2018) provides standard guidance on case research; Sayer (2000) grounds the retroductive logic. Nine projects — the full portfolio of one corporate group — are included to preserve comparability in ownership and strategic orientation while retaining theoretically relevant variation across technology (wind versus solar), capacity (50 MW, 100 MW), commissioning year (2020–2025) and deviation direction (saving, overrun, balanced). All projects are anonymised as A through I.

Case Overview

Table I summarises the nine projects. Seven are onshore wind installations; two are utility-scale solar photovoltaic. Capacities are either 50 MW or 100 MW. The sample spans five regional oblasts. Commissioning dates range from pre-2019 (Project H) to late 2025 (Projects E and F), providing variation that is useful for examining organisational learning and temporal effects.

Table 1. Project characteristics

Project	Technology	Capacity	Commissioned	Region
A	Wind	100 MW	November 2022	East Kazakhstan
B	Wind	50 MW	November 2022	Almaty
C	Wind	100 MW	June 2025	Ulytau
D	Wind	50 MW	March 2025	Kostanay
E	Wind	50 MW	December 2025	Akmola
F	Wind	50 MW	December 2025	Zhambyl
G	Solar	50 MW	2020	Almaty
H	Solar	100 MW	Pre-2019	Kyzylorda
I	Wind	50 MW	August 2021	Akmola

Notes. Project names have been anonymised. Source: compiled by the authors based on internal corporate project documentation and completion audit reports.

Data sources

Data were triangulated across six source types (Table II). The combination is deliberate. Business plans supply the *ex ante* forecasts that establish the forecasting baseline. Completion audit reports, prepared independently as a condition of investment preference compliance, contain the direct textual traces of institutional budgeting conventions, including explicit statements about the causes of deviation. Annual financial statements and monthly generation and tariff records provide the *ex post* picture against which forecasts are assessed. Group CSR reports and the Project D ESG action plan provide institutional evidence for the ESG mechanism.

Two points on data quality deserve flagging. First, 2025 financial figures for Projects C, D, E and F are unaudited management accounts, the most recent audited statements covering only 2024. Second, the monthly generation records, which were not available in the earlier iteration of this research, allow more precise annualisation of partial-year revenues than the annual accounts alone permit. This second point materially changed one of the study's findings regarding Project D, as discussed below.

Table 2. Data sources and analytical function

Data type	Projects covered	Analytical domain
Business plan financial models	C, D, E, F	Empirical: projected cost and revenue
Completion audit reports	A, B, C, D, E, F, G	Actual and Real: audited cost; textual traces of budgeting conventions
Annual financial statements	A, B, G, H, I (audited); C, D, E, F (management accounts)	Empirical: revenue, profit, assets
Monthly generation and tariff records	All nine	Actual: realised generation and tariff
Group CSR reports, 2022–2025	Group level	Empirical: social welfare indicators
ESG action plan, Project D	Project D	Real: institutionalised ESG mechanism

Source: compiled by the authors based on the data sources listed.

Analytical Strategy

Analysis proceeded iteratively. First, descriptive patterns of deviation and performance were established across the nine cases, including investment deviation rates, forecast-versus-actual revenue comparisons, and cross-sectional profitability differences. Second, candidate mechanisms were identified from audit report explanations, cross-case patterns and prior theory. Competing explanations — pure managerial skill, procurement randomness, market timing — were examined and progressively eliminated where they failed to track cross-case variation. Mechanisms were retained where they demonstrated explanatory reach.

Third, the retained mechanisms were refined to account for context-dependent variation. Cases where a mechanism appeared present but did not produce the expected outcome (Project F, for instance) were treated as productive anomalies rather than inconveniences. Process tracing was applied specifically to the ESG mechanism in Project D, following the sequence from the April 2025 ESG action plan through construction-phase local procurement to operational outcomes in the first ten months post-commissioning (Beach & Pedersen, 2019).

Findings

1. Investment Deviation: Empirical Patterns

The findings below are organised against the three research questions set out in Section 1. Sections 4.1 and 4.4 speak to RQ1 on patterns of deviation and operational performance; sections 4.2, 4.3 and 4.5 address RQ2 on the generative mechanisms; and section 4.6 addresses RQ3 on the ESG loop. Seven of the nine projects have completion audit data (Projects H and I are excluded because their audits pre-date the documentation available to the authors). Table III presents the deviation summary. Figure 2 visualises the same data.

Three projects recorded substantial savings between 12.8 and 33.6 per cent. Three recorded overruns between 2.1 and 7.7 per cent. The solar case sat effectively on budget. The pattern, however, is not uniform, and raises at least three questions. Why is wind so dispersed? Why does the solar case show near-zero deviation? And why does Project F, commissioned in the same year as the three savings cases, show an overrun?

Table 3. Investment deviation summary (seven projects with completion audit data)

Project	Tech.	MW	Budget (KZT bn)	Actual (KZT bn)	Deviation (bn)	Rate
C	Wind	100	303.50	264.70	–38.80	–12.8%
E	Wind	50	197.30	166.30	–31.00	–15.7%
D	Wind	50	200.70	133.30	–67.40	–33.6%
A	Wind	100	431.60	464.70	+33.10	+7.7%
B	Wind	50	216.30	220.80	+4.50	+2.1%
F	Wind	50	128.00	137.50	+9.50	+7.4%
G	Solar	50	100.75	100.76	+0.01	+0.01%

Notes. KZT bn = billions of Kazakhstani tenge. Rate = (Actual − Budget) / Budget. Projects H and I are excluded from this table because their completion audit reports pre-date the documentation available to the authors. Source: compiled by the authors based on project completion audit reports.

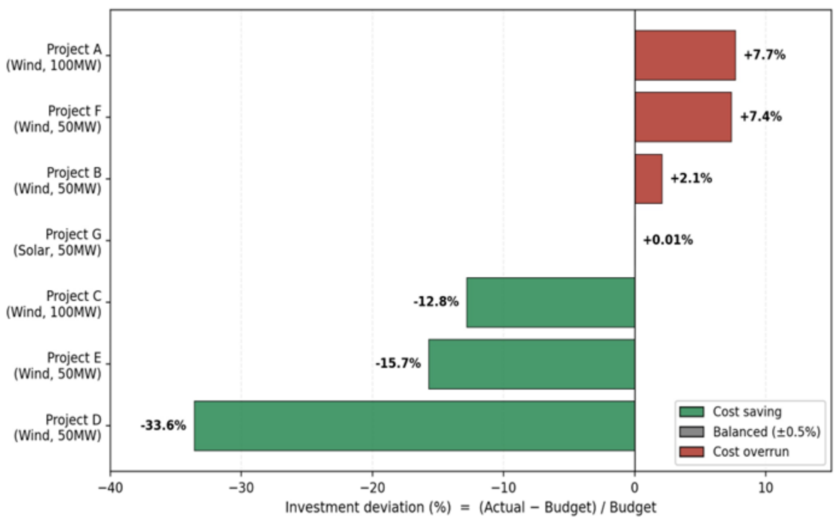

Figure 2. Investment deviation rate by project, sorted from largest saving to largest overrun.

Source: compiled by the authors based on project completion audit reports.

2. Performative Budgeting in the Seven Audited Cases

The Project C audit report gives the clearest textual trace of the performative budgeting mechanism. It states that the 12.8 per cent saving arose because the approved budget contained a 5 per cent planned-profit margin and a 3 per cent contingency that were not fully consumed during EPC execution. That is not a forecasting error in the ordinary sense. The budget was not wrong; it was constructed to incorporate safety margins that regulatory practice either requires or strongly encourages. Under an EPC arrangement with competitive procurement, actual costs compressed and the institutional margins remained partly unused. The audit then recorded what remained as a "saving".

Project D shows the same mechanism, amplified by a second force. Its audit notes favourable KZT–CNY exchange-rate movements during construction as a material contributor to the 33.6 per cent deviation. Two mechanisms — embedded safety margins and currency movement — interacted to produce the portfolio's largest saving. Project E's 15.7 per cent saving fits the same pattern, though with less explicit documentation of the currency component.

Projects A and B, both commissioned in November 2022, sit on the overrun side. Their audit reports do not offer the same detailed decomposition, but the timing matters. Budgets for these projects were formulated in 2020–2021, before the full extent of pandemic-era supply chain disruption and construction cost inflation was visible. The institutional safety margins that later shielded Project C from cost pressure appear to have been exhausted in the earlier pair.

Project F is the instructive anomaly. It was commissioned in December 2025, alongside Project E, yet it recorded a 7.4 per cent overrun rather than a saving. Its initial budget of 128 billion tenge was notably lower than the 197 billion and 201 billion budgets of comparable 50 MW wind projects E and D. The implication is that Project F's budget was either formulated with inadequate safety margins or structured against assumptions that execution then breached. The case usefully illustrates the contingency of the budgeting mechanism: institutional margins shape deviation, but only to the extent they are actually embedded at the outset.

The 33.6 per cent saving in Project D deserves closer attention, because a deviation of roughly one-third of an approved budget cannot plausibly be explained by execution efficiency alone. Beyond the institutional safety margins and the favourable KZT–CNY exchange-rate movements already noted, a third mechanism appears to operate. Wind projects in Kazakhstan procure a substantial share of their equipment from international markets, while approved budgets are anchored in local cost estimation benchmarks. When those benchmarks lag global price movements — and the regulatory framework for construction cost estimation has been undergoing ongoing reform since 2022 to align with market prices — budgeted costs diverge structurally from the prices encountered during execution. This institutional–market misalignment is less a specific deficiency of local estimation practices than a structural feature of cross-border infrastructure investment under fixed-budget regulatory regimes. Put differently, the Project D outcome is consistent with a budget that incorporated substantial structural slack at formulation: not a forecasting error in the ordinary sense, but a rational institutional response to an investment-incentive regime that rewards conservative budgeting (Taleb, 2007).

3. Technological Predictability Conditions

Project G, the 50 MW solar project, recorded a deviation of +0.01 per cent. That is effectively perfect alignment. The wind cases ranged from –33.6 per cent to +7.7 per cent. The contrast is not ornamental.

Solar projects benefit from conditions, high modularity, standardised civil works, transparent global equipment pricing, that tighten the coupling between budget and outcome. Wind projects operate under conditions that loosen it: site-specific foundations sensitive to geotechnical variation, weather-dependent heavy lifts, long turbine lead times, and resource variability that complicates both revenue and capacity factor forecasting.

This should not be read as a claim that solar is inherently more predictable in some absolute sense. Under a different institutional configuration — standardised foundation designs, diversified turbine supply chains, more conservative capacity factor assumptions — wind could narrow the gap. What the data show, within the conditions actually faced by this portfolio, is that technological architecture constrained the reliability of financial modelling in a way that is visible at the budget-versus-actual margin.

4. Operational Performance And The Solar–Wind Divergence

Table IV presents 2025 financial performance for all nine projects; Figure 3 compares the five projects with at least a full year of operation. The divergence between solar and wind is pronounced. Mature solar projects G and H deliver net margins in the 58–59 per cent range and ROA between 18 and 29 per cent. Mature wind projects A, B and I deliver margins in the 20–26 per cent band and ROA between 3 and 6 per cent.

This divergence reflects structural differences in operating cost profiles. Solar has no fuel cost, minimal moving parts, low routine maintenance, and straightforward wear characteristics. Wind requires significant maintenance of gearboxes and blades, is exposed to resource variability, and is more sensitive to local grid and transmission constraints. In Kazakhstan specifically, the southern regions where Projects G and H sit enjoy strong and consistent irradiation, reinforcing the technological advantage.

Projects E and F show losses in 2025. Commissioned in December, they operated for less than a month of the reporting year, carrying full-year depreciation against a handful of days of revenue. These figures are start-up artefacts, not signals of project failure. They will reverse in 2026 once a full operating year is captured.

Project D warrants separate comment. Its 61.1 per cent net margin and 8.3 per cent ROA, for ten months of operation, are notably strong. Construction-phase cost savings (the 33.6 per cent investment deviation above) lowered the depreciation base; the favourable tariff formation noted below supported strong revenue. The profile is what the theoretical framework would predict: a wind project where multiple mechanisms aligned in the same direction.

Table 4. Operational performance, 2025

Project	Tech.	Revenue (KZT bn)	Net profit (KZT bn)	Net margin	ROA	Months op.
A	Wind	83.72	17.33	20.7%	3.0%	12
B	Wind	43.59	11.40	26.2%	4.3%	12
C	Wind	23.41	7.92	33.8%	2.6%	6
D	Wind	22.41	13.68	61.1%	8.3%	10
E	Wind	0.90	–1.78	–197.8%	–0.9%	<1
F	Wind	0.77	–1.45	–188.3%	–0.9%	<1
G	Solar	33.44	19.49	58.3%	18.2%	12
H	Solar	94.48	56.08	59.4%	28.6%	12
I	Wind	45.48	11.75	25.8%	5.6%	12

Notes. Net margin = Net profit / Revenue. ROA = Net profit / Total assets. Figures for A, B, G, H, I are from audited financial statements; figures for C, D, E, F are from internal management accounts and are subject to adjustment in the 2025 audit. Source: compiled by the authors based on audited financial statements and internal management accounts.

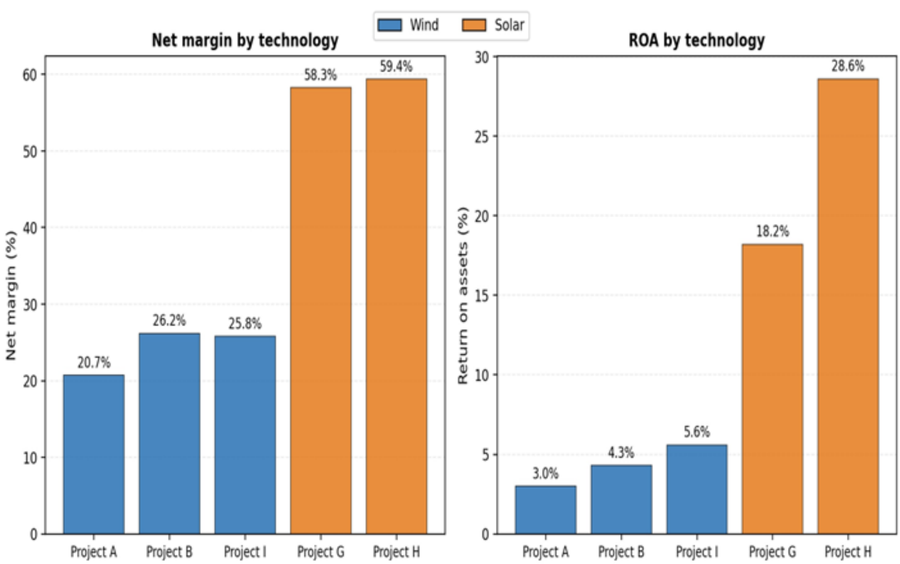

Figure 3. Net margin and return on assets by technology, for projects with at least twelve months of operation.

Source: compiled by the authors based on audited financial statements.

5. Forecast Accuracy and the Structure Of Error

The availability of monthly generation and tariff data, together with approved business plan models, permits a more granular comparison of forecast against outcome than annual financial statements alone would allow. Table V presents the comparison for the four projects with usable forecast data. Projects E and F are not directly comparable because they operated for less than one month.

Project C's business plan projected approximately 46 billion tenge of first-year revenue under an assumed tariff of 12.39 tenge/kWh. The project operated for six months in 2025 (June–December) and generated 23.41 billion tenge. Annualised, this works out to roughly 46.8 billion tenge — a deviation of +1.7 per cent from forecast.

That number looks like forecasting precision, but it isn›t. Underneath the aggregate agreement sits a pair of offsetting deviations. The realised tariff of 13.56 tenge/kWh was 9.4 per cent higher than the business plan assumption, reflecting the inflation- and exchange-rate-indexed auction tariff formation mechanism. Generation volume ran correspondingly below the modelled level. The two errors cancelled at the revenue line.

Project D shows the same structure. Its business plan forecast 30 billion tenge of first-year revenue at an assumed tariff of 14.51 tenge/kWh. Ten months of operation in 2025 (March–December) produced 22.41 billion tenge. Annualised, that is approximately 26.9 billion tenge, a deviation of roughly –10 per cent from forecast. The realised tariff of 15.94 tenge/kWh was 9.9 per cent above the business plan assumption; generation again fell short.

An earlier version of this analysis, based on annualising partial-year revenue without monthly disaggregation and without the tariff schedules, had read Project D's first-year performance as severe forecast underestimation. The monthly data correct that reading. The true story is the more interesting one: apparent aggregate accuracy in renewable project forecasting is routinely an artefact of offsetting parameter errors rather than predictive skill. Tariff realisation sits systematically above conservative business plan assumptions because the tariff formula indexes to inflation and currency; generation sits systematically below because wind resource assessment carries an upward bias under peer competition in auction-based procurement. The errors compensate, but they compensate for different reasons and they are not guaranteed to compensate in future years.

Table 5. Business plan forecast versus realised revenue, four projects

Project	BP revenue (bn)	BP tariff	Realised revenue (bn)	Realised tariff	Months op.	Annu alised (bn)
C	≈46.00	12.39	23.41	13.56	6	≈46.80
D	≈30.00	14.51	22.41	15.94	10	≈26.90
E	≈26.00	12.99	0.90	16.36	<1	n/a
F	n/a	n/a	0.77	14.16	<1	n/a

Notes. BP = business plan. Tariffs are in KZT/kWh. Annualised revenue = realised revenue × (12 / months operated); this assumes a stable intra-year generation distribution, which may not hold under seasonal wind variation and should be read with that caveat. Deviation is relative to BP first-year revenue. Projects E and F cannot be meaningfully annualised from less than a month of operation. Source: compiled by the authors based on project business plans and monthly generation and tariff records.

6. ESG and the Circular Causation Loop

Group-level indicators, reported in the corporate group's annual CSR disclosures (which are not subject to external audit and should be read with that caveat), show installed capacity, local employment and community investment growing together between 2022 and 2025. Headcount moved from roughly 1,000 in 2022 to over 4,000 in 2025; cumulative CO_2 avoidance reached approximately 8 million tonnes; local electricity tariffs in the regions served declined by roughly 45 per cent over the period; and community and charitable investment grew from about 2 million yuan annually in 2022 to nearly 100 million yuan in 2025.

Project D offers the best documented case of mechanism activation. The ESG action plan, formally approved in April 2025 but implemented as internal policy during the earlier construction phase, contains fifteen specific commitments across environmental, social and governance domains. Clause 2.5 requires preferential use of local and regional producers' services and products. ISO 37001 (anti-bribery) and ISO 45001 (occupational health and safety) certifications are referenced; local hiring and supplier development commitments are specified; stakeholder engagement processes are defined.

The mechanism these commitments activated is best described as relational stabilisation. Local procurement during construction built direct economic ties to communities adjacent to the site. Those ties reduced the friction that might otherwise arise during construction and early operations. The project was commissioned in March 2025 on schedule and operated for ten months without significant community opposition, land disputes or regulatory incident. Its financial performance in that period, the 61.1 per cent net margin noted above is consistent with a project that did not have to absorb the costs of operational disruption.

Project F provides an instructive contrast. Commissioned in the same December 2025 window, it operated under a formal ESG posture broadly similar to D's: group-level policies applied, standard certifications in place, stakeholder engagement nominally specified. Yet the implementation was thinner — a tighter initial budget constrained the scope of local procurement, and community engagement at the site had been less mature at the budgeting stage. F shows no equivalent stabilisation signature in its first weeks of operation. The contrast is instructive precisely because the formal ESG framework looks similar across the two projects; what differed was activation. This is consistent with a mechanism reading rather than a policy-compliance reading: formal ESG posture does not by itself produce stabilisation; it is the depth of activation within a specific relational environment that does.

This should not be read as a simple causal claim that ESG policy generates financial returns. Two qualifications matter. First, ESG practices imposed their own costs even in Project D. Local procurement is more complex to manage than procurement from established international suppliers; ISO certification requires documentation and audit work; stakeholder engagement takes management time. The net effect on margin is therefore dual — stabilisation on one side, coordination costs on the other — and the balance between the two depends on the maturity of the local supply chain and the quality of implementation. Second, the evidence here is not proof of mechanism; it is a plausible and documentable causal chain, which is what process tracing can credibly deliver (George and Bennett, 2005).

Viewed across the portfolio, the pattern appears consistent with circular causation in Choudhury's (2022) sense: ESG commitments shape relational environments; relational environments support operational stability; operational stability generates financial returns; financial returns underwrite expanded ESG commitments. Figure 4 presents the loop schematically. The loop is not automatic. Project F, as noted, did not activate it. Circular causation, properly specified, requires the loop to close; closure is a contingent empirical matter, not a theoretical guarantee.

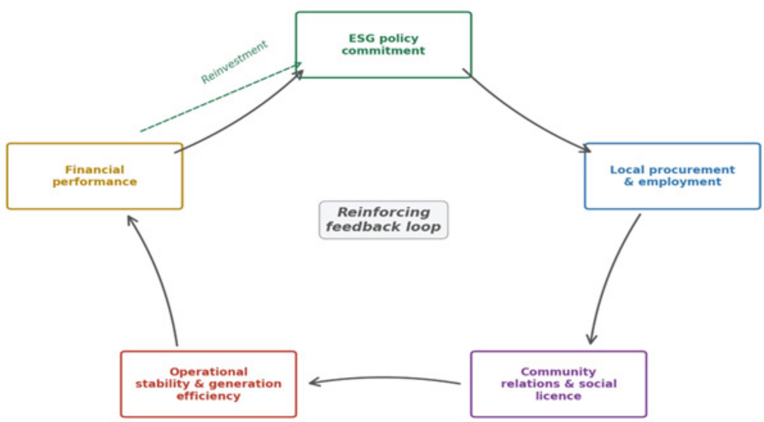

Figure 4. ESG practices as dual-function relational mechanism in a Choudhurian circular causation loop.

Source: developed by the authors, adapting Choudhury (2022). Arrows represent causal tendencies within a reinforcing loop; loop closure is contingent on context and activation, not automatic.

Discussion

1. *The Institutional Construction of Deviation*

Read across the nine cases, the evidence is difficult to reconcile with a purely behavioural account of investment deviation.

Institutional budgeting practices embed safety margins that become the baseline against which deviation is measured. When execution compresses cost within those margins, the audit records a saving. When execution exhausts them, the audit records an overrun. Optimism bias and strategic misrepresentation may still operate — they probably do — but they operate inside a structured institutional field that shapes what budgets can look like in the first place. A cost saving of 33.6 per cent on a 50 MW project is not, on this reading, primarily a story about superior managerial skill. It is a story about how budgets are constructed under an investment-preference regime.

That reframing changes the practical question. Less: how do we forecast more accurately? More: how do we evaluate performance against a baseline that is itself an institutional artefact? For regulators and investors both, the implication is that budget-versus-actual comparisons carry less evaluative weight than they appear to; the comparison worth making is between realised cost and an independently constructed benchmark, not between realised cost and a regulatorily mandated budget.

2. *Technology as constraint rather than cause*

The contrast between Project G's near-zero deviation and the wind projects' dispersion sits comfortably inside a predictability-conditions account. Solar's modularity, uniformity and pricing transparency reduce the range of plausible outcomes; wind's site specificity, supply chain complexity and resource variability widen it. The point to preserve, against a too-easy reading, is that these conditions are emergent rather than fixed. Different procurement strategies, supply chain configurations or resource assessment standards could narrow the gap. Technology constrains; it does not determine (Hirth, 2015).

3. *ESG as contingent relational mechanism*

The Project D evidence is consistent with ESG practices operating as a dual-function relational mechanism, stabilising on one dimension, cost-imposing on another. The balance is contingent. Strong local supplier ecosystems, mature institutional environments and competent implementation tilt the balance toward stabilisation.

Thin supplier ecosystems, weak institutional support and stretched management tilt it toward coordination cost without a compensating stabilisation benefit. This reading is consistent with Choudhury's (2022) circular causation framework and with Modell's (2009) broader argument that accounting practices do not merely describe social reality but participate in its constitution.

4. *Offsetting-error structure and investor implications*

The finding that apparent forecast accuracy in Projects C and D reflects offsetting tariff and generation deviations has a sharper implication than it first appears. Aggregate revenue accuracy can conceal sizeable component-level error. For investors, the practical risk is that offsetting errors may not persist: if inflation moderates and the tariff indexation weakens, while generation shortfalls relative to forecast persist, the current comfortable aggregate agreement will decompose into visible disappointment. This is less a prediction than a vulnerability worth naming.

A methodological caveat belongs here too. The offsetting-error structure is observed in only two cases in this study. It is analytically generalisable as a feature of auction-based tariff regimes operating under inflation and currency indexation, but its empirical scope requires further testing in larger samples and in other regulatory contexts. What the two cases establish is the plausibility of the mechanism, not its universal reach (Khamzina et al., 2025).

Theoretical contribution

The study contributes to critical realist accounting research in three respects. It demonstrates project-level retroduction as a tractable empirical procedure, showing how to move from audit report text, financial statement numbers and ESG disclosures to mechanism claims that can be refined against cross-case variation. It extends performativity scholarship into the context of investment incentive regimes, showing how regulatorily mandated budgets function as performative structures with downstream consequences for how outcomes are interpreted. And it integrates Choudhury's (2022) circular causation concept with a Bhaskarian stratified ontology, offering a project-level template for studies in this journal's intellectual tradition.

Conclusion

Nine renewable-energy projects developed by a single corporate group in Kazakhstan provide an unusually complete setting for studying how investment deviation and operational performance actually come about. The evidence does not support a conventional reading in which deviation is a forecasting failure to be corrected by better models or better-incentivised promoters. It supports a structural reading in which three interacting mechanisms, performative budgeting, differential predictability conditions, and ESG as dual-function relational mechanism, produce the observed patterns. One specific finding deserves a final mention. The apparent forecast accuracy of two recently commissioned projects, seen at the aggregate revenue level, was shown to be the result of offsetting tariff and generation errors rather than predictive skill. That finding is small in itself but methodologically significant: it demonstrates what critical realist retroduction actually buys, the ability to distinguish surface regularity from the interaction of mechanisms that happens to produce it. The claim is analytically generalisable; its empirical scope requires further testing.

For practitioners, the implications are practical. Distinguish technical forecasts from institutional safety margins when evaluating budgets. Calibrate financial models to the predictability conditions of the technology actually being deployed. Treat ESG as an investment in relational stability whose net benefit is contingent on local ecosystem maturity rather than as either guaranteed return or unambiguous cost. None of these recommendations is radical. They are, however, better supported by a stratified causal account than by a linear-causal one (Modell, 2017).

Several limitations warrant flagging. The nine cases share an owner and an institutional context; findings may not transfer cleanly to projects developed by different sponsors in different regulatory environments. Four of the 2025 financial statements are unaudited management accounts. Community-level mediating variables in the ESG mechanism were not directly measured, reducing what process tracing can claim. And four of the projects (C, D, E, F) have fewer than twelve months of operating data, limiting confidence in the operational performance findings for those cases. Three directions for future work follow. Replication in other emerging-market portfolios, particularly those under different investment incentive regimes, would test the performative budgeting claim. Longitudinal tracking of a single project across the full lifecycle, from business plan through commissioning through five operating years, would test the forecast-error structure claim. And primary data collection on community relations, ideally qualitative fieldwork at project sites, would firm up the relational stabilisation claim beyond what documentary evidence can achieve.

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References

Barnett, M. L. (2007). Stakeholder influence capacity and the variability of financial returns to corporate social responsibility. Academy of Management Review, 32(3), 794-816. https://doi.org/10.5465/amr.2007.25275520

Beach, D., & Pedersen, R. B. (2019). Process-tracing methods: Foundations and guidelines (2nd ed.). University of Michigan Press. https://www.press.umich.edu/9839094/process_tracing_methods

Bhaskar, R. (1975). A realist theory of science. Leeds Books. https://search.worldcat.org/title/2864747

Bhaskar, R. (1979). The possibility of naturalism. Harvester Press. https://search.worldcat.org/title/6142859

Choudhury, M. A. (2022). Circular causation. In Knowledge and the university (pp. 53-70). Springer. https://doi.org/10.1007/978-

981-16-6986-6_3

Clarkson, P. M., Li, Y., Richardson, G. D., & Vasvari, F. P. (2011). Does it really pay to be green? Determinants and consequences of proactive environmental strategies. Journal of Accounting and Public Policy, 30(2), 122-144. https://doi.org/10.1016/j.jaccpubpol.2010.09.013

Eccles, R. G., Ioannou, I., & Serafeim, G. (2014). The impact of corporate sustainability on organizational processes and performance. Management Science, 60(11), 2835-2857. https://doi.org/10.1287/mnsc.2014.1984

Flyvbjerg, B. (2021). Top ten behavioral biases in project management: An overview. Project Management Journal, 52(6), 531-546. https://doi.org/10.1177/87569728211049046

Flyvbjerg, B., Bruzelius, N., & Rothengatter, W. (2003). Megaprojects and risk: An anatomy of ambition. Cambridge University Press. https://www.cambridge.org/core/books/megaprojects-and-risk/DB94C70CABF8A4FF38FC487AFDD90341

Friede, G., Busch, T., & Bassen, A. (2015). ESG and financial performance: Aggregated evidence from more than 2000 empirical studies. Journal of Sustainable Finance & Investment, 5(4), 210-233. https://doi.org/10.1080/20430795.2015.1118917

George, A. L., & Bennett, A. (2005). Case studies and theory development in the social sciences. MIT Press. https://mitpress.mit.edu/9780262572224/

Hirth, L. (2015). Market value of solar power: Is photovoltaics cost-competitive? IET Renewable Power Generation, 9(1), 37-45. https://doi.org/10.1049/iet-rpg.2014.0101

IEA. (2024). Renewables 2024: Analysis and forecast to 2030. International Energy Agency. https://www.iea.org/reports/renewables-2024

IRENA. (2023). Renewable power generation costs in 2022. International Renewable Energy Agency. https://www.irena.org/Publications/2023/Aug/Renewable-Power-Generation-Costs-in-2022

Kahneman, D. (2011). Thinking, fast and slow. Farrar, Straus and Giroux. https://us.macmillan.com/books/9780374533557/thinkingfastandslow

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. Economics and Policy, forthcoming. https://www.espublisher.com

Liu, J., Wang, Y., & Zhang, X. (2024). Forecasting errors and economic implications for renewable energy trading. Energy Economics, 130,107295.https://doi.org/10.1016/j.eneco.2023.107295

MacKenzie, D. (2006). An engine, not a camera: How financial models shape markets. MIT Press. https://mitpress.mit.edu/9780262134606/

Miller, P., & Power, M. (2013). Accounting, organizing, and economizing: Connecting accounting research and organization theory. Academy of Management Annals, 7(1), 557-605. https://doi.org/10.5465/19416520.2013.783668

Modell, S. (2009). In defence of triangulation: A critical realist approach to mixed methods research in management accounting. Management Accounting Research, 20(3), 208-221. https://doi.org/10.1016/j.mar.2009.04.001

Modell, S. (2015). Making institutional accounting research critical: Dead end or new beginning? Accounting, Auditing & Accountability Journal, 28(5), 773-808. https://doi.org/10.1108/AAAJ-09-2013-1457

Modell, S. (2017). Critical realist accounting research: In search of its emancipatory potential. Critical Perspectives on Accounting, 42, 20-35. https://doi.org/10.1016/j.cpa.2016.03.001

Sayer, A. (2000). Realism and social science. Sage. https://doi.org/10.4135/9781446218730

Taleb, N. N. (2007). The black swan: The impact of the highly improbable. Random House. https://www.

penguinrandomhouse.com/books/176226/the-black-swan-by-nassim-nicholas-taleb/

Yin, R. K. (2018). Case study research and applications: Design and methods (6th ed.). Sage. https://us.sagepub.com/en-us/nam/case-study-research-and-applications/book250150