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The role of environmental reporting in shaping the sustainable development strategy of oil companies

Zhanbota Zinetullina[1], Aliya Nurgaliyeva[2*], Azhar Nurmagambetova[3], Sedep Mirzhakypova[4], Rimma Parmanova[5]

[1] Doctoral student, Narxoz University, Almaty, Republic of Kazakhstan
[2] Educational program Accounting and Auditing, Narxoz University, Almaty, Republic of Kazakhstan
[3] Department of Finance and Accounting, Al-Farabi Kazakh National University, Almaty, Republic of Kazakhstan
[4] Department of Economics and Business, International Engineering and Technology University, Republic of Kazakhstan
[5] Educational program Finance and Accounting, Caspian University, Almaty, Republic of Kazakhstan

*Corresponding author E-mail: aliya_mn@mail.ru

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Abstract

This article offers the first international empirical assessment of current environmental reporting practices in Kazakhstan's oil industry following the 2019 modernization of the regulatory framework. It uses a mixed-methods research technique that combines qualitative interviews, econometric modeling, and content analysis to evaluate how environmental openness affects company sustainability performance. To measure the quality of disclosure in priority companies (KazMunayGas, TengizChevroil, and CNPC-Aktobe), the GRI (304-306) and TCFD criteria were incorporated with the Environmental Code of Kazakhstan (2021), resulting in the creation of a new composite measure, the environmental reporting quality index. The results show that there is a high level of heterogeneity in these scores (0.58-0.79) due to the structure of ownership, foreign participation and listing status. The regression analysis indicates that the report's quality is negatively correlated with CO_2. Intensity with a significant negative association, which demonstrates that the more successful the reporting standards of companies are, the less they produce emissions and less they cause environmental incidents. Qualitative evidence can reinforce this causal explanation: the more successful the reporting is, the greater investments in monitoring, verifying and controlling systems are. Despite improvements in the regulatory regime, Kazakhstan ranks at the bottom of the transparency list in external assurance, scope 3 coverage and board-level climate governance. This study is part of a replicable research methodology in emerging economies, in that enhanced disclosure serves as an accountability measure and a catalyst for quantifiable changes in environmental performance.

Keywords: Environmental reporting, Sustainable development, Oil industry, Kazakhstan, ESG disclosure, Carbon neutrality.

1. Introduction

The development of Kazakhstan continues to be pegged to its oil and gas industry. As such, it supports fiscal stability, significant infrastructure, and more than half a million jobs, contributing 16-18% of GDP, a third of exports, and approximately 190,000 direct jobs [1], [2].

The disclosure is no longer voluntary. It has become comparable to international standards, including the Global reporting initiative (GRI) standards and the Task force on climate-related financial disclosures (TCFD) [3]. The destination was developed in accordance with the country's Paris commitment to reduce greenhouse gas emissions by 15% of 1990 levels by 2030 and to be carbon neutral by 2060 [4], [5].

These mechanics, as provided in the 2021 environmental code, include integrated environmental permits, mandatory environmental management systems, stronger, more transparent regulations on monitoring, reporting, and verification (MRV) requirements, and an annual sustainability reporting requirement [6]. The mentioned regulatory background is associated with a growth narrative as two strategy documents, such as the strategy on a green economy (concept) (2013) and the 2060 strategy, pay attention to the concept of resource efficiency and the practice of the so-called circular economy, as well as updating the technology as a source of competitiveness, which is not compliance costs as such [7], [8].

Governance is also important, including climate control at the board level, plausible transition strategies that help align capital expenditures (capex) with decarbonization objectives, and external verification of key environmental, social, and governance (ESG) indicators [9]. They dictate access to international capital markets, exposure to instruments such as the EU changing carbon border adjustments, and a social contract with communities whose tolerance is determined by quantifiable performance in environmental activities [10]. Oil companies in Kazakhstan are being simultaneously requested to do three things: maintain the macro-fiscal spine, invest in advanced technology to reduce emissions and environmental footprint, and provide evidence to the outside world that it is indeed occurring by showing that the progress can, in fact, be checked [11].

Despite recent improvements in the capacity to govern and administer environmental law in Kazakhstan, the petroleum industry continues to face challenges. The most obvious one is the transparency. Corporate environmental reporting is so divergent in scope, depth, and credibility that, when comparing a single company to another, and even to international companies, a comparison is hardly imaginable. The second problem is the lack of a standard measurement system. Key indicators such as water intensity, waste recovery, and biodiversity disturbance, among others, are calculated using different baselines and units unless otherwise reported. This inconsistency negatively affects Kazakhstan's efforts to align with international standards, such as the GRI or TCFD, and undermines the credibility of ESG data among investors in the country.

Regulators, civil society organizations, and analysts continue to face the challenge of not having access to comprehensive and reliable reports. Diversification is politically and financially costly due to the high sunk costs in extraction. Collectively, these deficiencies render the sustainability challenges insufficient to bridge the gap between dream and reality. The primary objective of the research is to identify the role of environmental reporting in shaping and adopting sustainable development strategies by Kazakhstan's oil companies. Based on this purpose, the study will answer four research questions that are interconnected:

RQ1: What are the current best environmental-reporting practices that major oil producers in Kazakhstan use?
RQ2: What is the relationship between the quality of environmental reporting and environmental-performance measures (i.e., GHG intensity, spill frequency, etc.)?
RQ3: What organizational or structural differences, in terms of company size, ownership structure, foreign participation, and listing status, explain differences in the level of disclosure?
RQ4: How are the global sustainability and corporate governance strategies of the firms integrated with environmental reporting?

This study provides a mixed-methods assessment of environmental reporting in Kazakhstan’s oil industry. Unlike earlier descriptive work on Central Asia’s extractive sector, it combines qualitative and quantitative content analysis of integrated and environmental reports with econometric analysis of the relationship between disclosure quality and environmental impacts. A new environmental reporting quality index (ERQI), tailored to Kazakhstan’s regulatory context, has been developed to evaluate completeness, compliance, dependability, timeliness, and comprehensibility.

The study offers insights from ESG trends (Figure 1), criteria and legitimacy theories for an under-researched emerging market and finds an empirical link between transparency and performance as well as reviews theory, regulation, sustainability evolution, and regional gaps. Section 2 presents the mixed-methods design, ERQI, and regressions. Section 3 delivers results, policy analysis, and recommendations, while section 4 concludes with contributions and future research directions.

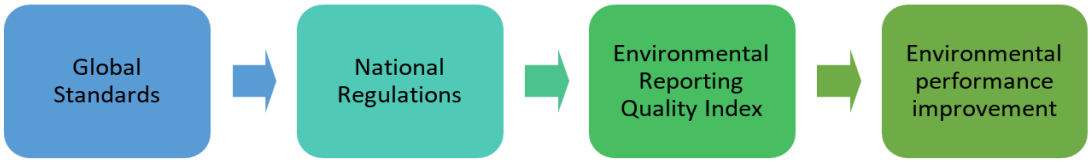

Figure 1. Conceptual linkages between international standards, environmental reporting quality, and sustainable-development outcomes

Environmental reporting has emerged as a necessity for companies to demonstrate their responsibility, legitimacy, and compliance with sustainability requirements. The literature on corporate environmental disclosure (CED) draws on many theoretical approaches, such as Stakeholder theory, Legitimacy theory, and Institutional theory, among others, which focus on various but complementary activities that motivate a corporation to disclose [12].

Studies indicate that both external and internal factors influence the quality of environmental reporting [13], [14]. In these situations, the scheme of disclosure incentives is complex, with state domination and regulation of the joint venture [15], [16]. Yerkinbayeva et al. note that under this regulatory modernization program, Kazakhstan has initiated the formalization of disclosure rules in the most obvious of the Environmental Code (2021) [17]. However, empirical research is deficient in discussing the impact of these changes on business-level reporting behavior. In setting the analytical context for understanding the concept of ERQI in Kazakhstan's oil industry, this literature review provides conceptual underpinnings for the study, beginning with stakeholder theory, then legitimacy theory, and institutional isomorphism.

1.1. Theoretical framework

The demands of various stakeholder groups, including shareholders, employees, governments, creditors, local communities, and non-governmental organizations, will influence a firm's strategic behavior [18]. The stakeholder theory postulates that relationships with all these groups should be maintained on an equal footing [19]. The tool that plays a significant role in communication and in holding corporations responsible in this context is environmental reporting, because it links their operations to the interests of their stakeholders. Corporations will respond to stakeholders with greater informational power through activism, regulation, or investment decisions to minimize uncertainty and enhance legitimacy [20].

According to Ivashchenko et al., information asymmetry negatively affects business efficiency, decision-making, and competitiveness [21]. It implies that such asymmetries can be addressed through the Information and communication platform, which can increase transparency and facilitate data exchange. The imposition of global ESG standards is being driven by foreign financiers and multinational coalitions investing in Kazakhstan's state-owned petroleum sector [22].

Under the stakeholder theory, the foreign presence must lead to improved environmental openness and the institutionalization of sustainability reporting standards, in the form of joint ventures, namely Tengizchevroil and CNPC-Aktobe. Legitimacy theory is an extension of stakeholder theory, in which the social and institutional context influences corporate information disclosure [23]. This perception holds that environmental reporting is not merely the dissemination of information; it is also a means by which businesses demonstrate that they are meeting society's expectations and earning their license to operate [24].

Environmental disclosure may help companies maintain investor’s trust and social tolerance, thereby requiring compliance with increasing local laws and global ESG policies [25], [26]. It is inclined toward greater

reporting activity in the face of major regulatory changes or conflicts with the environment, which can be compared with the analysis of Norwegian and Russian oil majors. This means that businesses are taking the offensive and the reactive steps to regain their confidence.

The modern ESG model may be viewed as a multidimensional approach that directly incorporates sustainability factors into corporate decision-making and investment analysis [27]. Reference [28] states that ESG is one of the holistic models by which investors and managers can evaluate a firm's financial performance and its broader impact on the environment and society. Reference [29] proposes a three-stage algorithm for assessing social, economic, and ecological changes [30]. Redko et al. indicate that although Ukraine is working to align its energy policy with the objectives of the EU Green Deal, decarbonization needs to be done gradually to prevent economically and socially disruptive interruptions [31], [32].

As a divergence from the governance pillar, which deals with accountability mechanisms, board diversity, CEO duality, and anti-corruption standards, the social pillar covers aspects related to employee welfare, occupational health and safety, and community development programs [33]. Elkington's triple bottom line concept, which incorporates people, planet, and profit, served as the foundation for the development of ESGs [34].

This model has been further developed in the context of the UN sustainable development goals (SDGs) to establish international standards for sustainable development. CO_2 emissions per unit of output, spillage rates, and land rehabilitation success (environmental indicators) are crucial factors in determining ESG ratings and investor risk ratings in extractive sectors such as oil and gas [35], [36]. As international capital markets increasingly demand transparent and standardized disclosure, producers of significant scale, including KazMunayGas (KMG) and Tengizchevroil (TCO) in Kazakhstan, have aligned their sustainability metrics with the GRI Standards 304-306, which address biodiversity, emissions, and waste management.

The sustainability measurement conceptual framework is based on the triple bottom line paradigm, which emphasizes the interconnection of people, planet, and profit. Its practical usage has significantly advanced with the development of harmonized auditable reporting standards used across sectors and countries. As the GRI series was revised from 2016 to 2021, sector-specific standards include GRI 304 on biodiversity, GRI 305 on greenhouse gas emissions, and GRI 306 on waste management, which is why it can be considered one of the most well-known global standards.

The article by Klymenchukova & Riashchenko examines the success of financial management in innovative and environmentally oriented businesses that operate in a high level of uncertainty and competition [37]. The article by Butova et al. examines regulatory and environmental control issues in the oil and industrial waste processing industry in Kazakhstan [38]. It concludes that the oil industry, with its inefficient but well-established regulatory measures, has reached its established state. In contrast, the waste processing segment of the industry lacks a mechanism for control and coordination with other industries.

The GRI includes a governance aspect, as in 2017, the TCFD recommended the inclusion of climate-risk analysis in regular financial statements [39]. Later, in 2022, the European Union Corporate Sustainability Reporting Directive (CSRD) required all listed corporations to disclose their non-financial performance, thereby intensifying the practice and indicating a worldwide movement toward integrated sustainability reporting. Cristea et al. demonstrated the prediction of the sorption capacity of the oil-contaminated soil recovery process through Artificial Neural Network (ANN) models developed for Kazakhstan [8].

Mazina et al. examine the impact of green fiscal policies on the efficiency of renewable energy businesses in Kazakhstan [40]. It brings to the forefront the fact that, although Kazakhstan has committed itself to the Green Economy and its 2050 vision, its political and economic setbacks do not facilitate the successful implementation of its policies. Some of the attributes that these indices measure are completeness, correctness, dependability, and/or compliance, which generate standardized ratings that allow comparison across companies and over time [41].

1.2. Regulatory framework

Kazakhstan's regulatory environment for corporate environmental disclosure has evolved rapidly in the last decade, driven by global climate commitments and domestic institutional reform. Table 1 summarizes the principal instruments influencing ecological reporting in the oil sector.

Table 1. Key regulatory instruments governing ecological reporting in Kazakhstan

Instrument	Year	Relevance of environmental reporting	Application to the oil sector
Environmental code of Kazakhstan	2021	Mandates integrated environmental permits, environmental management systems, and annual reporting through the unified environmental information system	All major producers (TCO, KMG, CNPC-AT)
Law "On nature management and environmental protection activities"	2016	Establishes ecological accounting principles and liability mechanisms	Provides baseline compliance obligations
IFRS standards on sustainability disclosure	2023 (IFRS S1–S2)	Introduces global requirements for disclosure of climate-related and sustainability information in financial statements	Reference for AIFC-listed oil companies
GRI standards 304–306	2016–2021	Define indicators for biodiversity, GHG emissions, and waste management	Benchmark for ERQI checklist and company reports
TCFD recommendations	2017	Require disclosure of governance, strategy, risk management, and metrics related to climate risks.	Adopted voluntarily by KMG (2022)
EU CSRD directive	2022	Expands non-financial reporting for all large and listed entities in the EU	Serves as a model for AIFC and KASE regulations
AIFC ESG guidelines	2023	Make ESG disclosure mandatory for issuers listed on AIX and KASE	Applies to joint ventures with international participation

The Environmental Code embodies the polluter-pays principle and enables digital ecological data submission.

1.3. Empirical studies of environmental reporting of the oil industry

The dynamic nature of environmental reporting in Kazakhstan can be improved in terms of understanding, with assistance from international empirical research. Notably, Equinor (formerly Statoil) in Norway became more energy efficient in direct relation to its emissions disclosure [42]. The Norwegian model illustrates how companies can be supported in integrating sustainability into operational and financial decision-making through voluntary compliance practices and robust regulatory oversight. Niyazbekova et al. state that the functioning of green banking in Russia should be conducted holistically, encompassing a set of financial products, internal operations, corporate culture, and environmental sustainability principles [43].

According to Kyzdarbekova et al., environmental protection measures influence the economy's long-term economic viability [44]. Doszhan et al. show that Kazakhstan's green finance system is evolving in line with

global trends, largely supported by the government [45]. Further, in their study, Naqvi et al. observe that green innovation improves the quality of the environment and has severe spatial spillovers and non-linear impacts on regions [46], [47].

As a result of modernizing the region, the states in the GCC region are the major drivers of developing environmental reporting in the area. In Saudi Arabia and the United Arab Emirates, research has found that national development plans, such as Vision 2030 and Vision 2032, have catalyzed the disclosure of sustainability [48].

These developments led state oil enterprises to produce the first global carbon-risk report, which linked foreign investment attraction, the energy transition, and economic diversification to ESG reporting. The sustainability reports of companies like Tatneft and Lukoil are periodically well-written and often include narratives of corporate responsibility.

Still, they do not typically include independent audits or measurable environmental impacts [8], [49]. This reporting behavior is exhibited by seeking to maintain legitimacy rather than integrating sustainability. Compared to Russia, Kazakhstan can enjoy more meaningful and evidence-based disclosure processes because it cooperates with multinational corporations, especially through joint ventures such as Tengizchevroil (a joint venture between Chevron and ExxonMobil).

The study of developing markets in Latin America and Sub-Saharan Africa helped clarify the mixed economy and ownership-type setup in Kazakhstan, as it offered lessons that can be applied beyond high-income settings. When compared to locally owned businesses, corporations audited by foreign investors or MDBs produced better environmental results and more accurate disclosures [50].

Based on these studies, three methods for propagating international ESG regulations include international ownership, dual listing, and cross-border funding. In Kazakhstan's oil sector, joint ventures and foreign investment are prevalent, having already established a strong presence.

One sign of the catalytic effect of international institutional pressure is that companies with partly foreign equity (CNPC-Aktobe and Tengizchevroil) appear more likely to prepare comprehensive, structured sustainability reports than fully state-controlled companies. To assess the completeness, objectivity, and reliability of business reports, quantitative research often employs scoring models and content analysis indices.

One team based its disclosure score (which assesses Asian energy businesses) on 50 items, whereas another team employed regression models to establish a relationship between disclosure intensity and CO_2 emissions efficiency.

Based on these methodologies, the present research constructs an index of environmental reporting quality in Kazakhstan, the ERQI, which combines national and regulatory directives, such as electronic registry submission and payment of environmental impact fees, with global ESG indicators (TCFD, CSRD, GRI 304-306).

1.4. Research gaps

The overall lack of literature on sustainability reporting in Kazakhstan and Central Asia is striking, although the study of ESG disclosure is growing. Past studies on Kazakh firms have broadly adopted descriptive or normative approaches to assess firm sustainability but have not developed a cause-and-effect relationship on how their reporting processes have impacted the environment [51].

The reporting environment in Kazakhstan lacks a specific tool to measure disclosure standards across enterprises, unlike other markets that have GRI- or TCFD-based indexes. The absence of a single environment-related data system, the inability to conduct independent audits, and the fact that the state owns most businesses make their decision-making process very complex.

The paper is a detailed effort to address these gaps by proposing three innovative theoretical and methodological shifts. The paper will initiate a review of the disclosure practices of the three state-owned oil and gas companies operating in Kazakhstan, i.e., KazMunayGas, Tengizchevroil, and CNPC-Aktobe, in their ownership structures and global exposure using a cross-company content analysis (2019-2024).

Second, it presents the ERRQI, a composite measure that incorporates the GRI 304306 standards and certain provisions of the Environmental Code (2021) of Kazakhstan, e.g., requirements for digital reporting and environmental payment programs.

Finally, it uses econometric calculations to approximate the effects of business size, foreign presence, listing status and other firm characteristics.

1.5. Theoretical and conceptual framework

The conceptual framework of the study encompasses the ESG (environmental, social and governance) paradigm in the context of the Kazakh Republic through its regulatory framework, as well as the Legitimacy theory and Stakeholder theory. It postulates that the two major institutional agents influencing the quality of environmental reporting by oil companies are national laws and international standards.

Global frameworks offer normative advice on accountability and transparency, including the United Nations Sustainable Development Goals (SDGs), the global reporting initiative standards (304-306), and the TCFD.

Nonetheless, the DNC phenomenon affects the disclosure of corporate-level presuppositions, as mandated by the local compliance standards developed under the environmental code (2021) and the concept of transition to a green economy (2013) in Kazakhstan.

According to the model, a higher ERQI will inspire the strategic integration of sustainability ideas. As a result, environmental goals will be incorporated into key business processes, investment decisions, and risk management systems. Two main hypotheses that guide the empirical testing of this study are derived from the theoretical and empirical frameworks presented in the literature review.

H_1**:** (environmental-performance hypothesis): greenhouse gas (GHG) emissions are less intense, and there are fewer environmental incidents when a corporation has a higher ERQI score. Strong disclosure practices lead to more responsible operational conduct, transparency and real ecological performance.

H_2**:** (institutional-isomorphism hypothesis): the ERQI scores of Kazakhstani oil companies are positively impacted by foreign ownership, international stock exchanges, knowledge transfer, and adherence to international reporting requirements.

These two hypotheses provide a clear analytical framework for testing, jointly, the quality of environmental disclosures and their effects within the regulatory context and the characteristics of firms in Kazakhstan's oil industry.

2. Method

2.1. Research design

This study used a convergent parallel mixed-methods research design that combines both qualitative and quantitative methodologies [52]. The qualitative element analyzes content systems in environmental and integrated reports of key oil producers in Kazakhstan for the period 2019-2024, identifying the framework, breadth, and extent of environmental disclosure.

The quantitative component employs an econometric model to establish the statistical relationship between the ERQI and the environmental performance measures of the firms, while adjusting for structural factors, including firm size, ownership, and listing status. It is the two strands that are analyzed separately and then combined to offer complementary insights.

The qualitative results explain the emergence of the patterns, and quantitative models demonstrate the relationship between disclosure quality and performance strength.

2.2. Qualitative component

In the qualitative phase, the study used documentary materials, including data on the most effective oil firms operating in Kazakhstan, their sustainability, and publicly disclosed information. The annual reports of KMG, TCO, and CNPC-Aktobe (CNPC-AT) for 2019-2024, the companies' sustainability reports, and their ESG reports will be included as primary sources of information.

Additional evidence was presented in the form of regulatory and contextual information obtained from the KASE files, AIFC ESG reports, and the Ministry of ecology and natural resources (2024). We used five thematic dimensions, which are emissions, water, waste, biodiversity, and SDG alignment, to determine the extent of disclosure in NVivo 14.

The process identified an observation from six years of qualitative data, comprising 1,026 unique coded references, allowing comparison of reporting procedures by time and section.

2.3. Checklist development

A 37-item checklist, based on GRI 304-306 and TCFD (2017) instructions, was created to capture qualitative observations. The checklist was structured into five weighted items, including completeness, standard compliance, reliability, timeliness and comprehensibility. Table 2 shows the weighting system, which establishes the proportionality between the quality dimensions of disclosure represented in the ERQI.

Table 2. Weighting system for ERQI

Criterion	Weight (w_i)	Indicators (N)	Example indicator
Completeness	0.25	12	Disclosure of scope 1–3 GHG emissions, water withdrawal, and waste volumes reported
Compliance with standards	0.20	8	Explicit reference to GRI 304/305/306 frameworks or TCFD structure
Reliability	0.20	6	Presence of a third-party audit or assurance statement on environmental data
Timeliness	0.15	5	Publication within six months after the fiscal year end
Comprehensibility	0.20	6	Balanced presentation of quantitative targets and qualitative narratives

Each report was scored for the number of indicators disclosed within each criterion. The ERQI for company j was computed as in (1):

$$ERQI_j = \sum_{i=1}^{5} w_i \times \frac{S_{ij}}{N_i} \quad (1)$$

where *Sij* denotes the number of items disclosed under criterion *i*, N_i is the total number of indicators within that criterion, and w_i is its weight.

This results in an ERQI range of 0 to 1, with a higher rating indicating more comprehensive, accurate and standardized reporting. The process created a continuous, similar measure across companies and years that was used to obtain the dependent variable for the quantitative analysis.

2.4. Quantitative component

The quantitative data of the research offers a composite view of the financial, environmental, and contextual factors of the oil industry in the Republic of Kazakhstan between 2019 and 2024. The financial variables, such as annual revenues, total assets, and profitability ratios, for KMG and TCO were retrieved from the audited

annual reports of these companies, along with official disclosures to the Kazakhstan stock exchange (KASE) and Astana international exchange (AIX).

These indicators take into consideration the economic size of the firms and their operational efficiency, which are the main explanatory variables for the quality of environmental reporting. To ensure consistency and comparability, the derivation of the environmental variables was based on corporate sustainability reports, government databases, and international datasets.

In particular, the firm-level data about CO_2 emissions (in million tons of CO_2 equivalent), water consumption (in million cubic meters), spillages (in cubic meters), and environmental-protection spending (in billion KZT) were acquired because of the disclosures of the companies and the statistics committee of the Republic of Kazakhstan (2024).

To put these company-level indicators in the context of industry trends and macroeconomic background variables, including overall energy-sector output and national emissions, data from the International energy agency (IEA) energy balance (2023) have been used.

2.5. Variable and expected relationships

Table 3 summarizes the variables used in this research. ERQI is the dependent variable while the independent variables of the study capture a measure of size, ownership, listing status, production scale, and operational incidents. The second model treats environmental-performance indicators as outcomes.

Table 3. Variable definitions and expected signs

Variable	Notation	Definition / measurement	Expected sign
ERQI	Dependent (0–1 scale)	Environmental reporting quality index	–
SIZE	ln revenue	Natural log of annual revenue (billion KZT)	+
FOREIGN	Dummy	1 = foreign ownership > 25 %	+
LIST	Dummy	1 = listed on KASE or AIX	+
PROD	Oil output	Annual production (million tons)	+
INCID	Incidents	Number of environmental incidents per year	–
ENVPERF	CO_2 intensity	tCO_2e per ton oil equivalent	– (when regressed on ERQI)

Two linear models are estimated. The first identifies determinants of reporting quality, while the second assesses how reporting quality affects environmental performance.

Determinants of ERQI (2):

$$ERQI_i = \alpha_0 + \beta_1 SIZE_i + \beta_2 FOREIGN_i + \beta_3 LIST_i + \beta_4 PROD_i + \beta_5 INCID_i + \varepsilon_i \quad (2)$$

Impact on environmental performance (3):

$$NVPERF_i = \gamma_0 + \gamma_1 ERQI_i + \gamma_2 SIZE_i + \gamma_3 FOREIGN_i + \gamma_4 LIST_i + u_i \quad (2)$$

Both models are estimated using ordinary least squares (OLS) with heteroskedasticity-robust standard errors. Diagnostic tests confirmed the absence of multicollinearity (VIF < 5) and normal residual distribution.

The model fits are assessed based on R^2, adjusted R^2, and F-statistics, which show a sufficient explanatory power. To be robust, both white-corrected and log-linear specifications should be checked on sensitivity yielding similar coefficients and levels of significance.

2.6. Case selection criteria

This empirical study focuses on the three major producers of oil, such as KMG, TCO, and CNPC-AT, since they produce over 80% of the overall crude oil in Kazakhstan (IEA, 2024).

Different ownership structures can characterize these companies. KMG is a 100% state-owned company; TCO is a joint venture between Chevron, ExxonMobil, and KMG; CNPC-AT is an example of majority foreign ownership under Chinese ownership. Both companies release their annual environmental or sustainability reports and participate in national ESG initiatives, which meet the requirements of data availability and comparability (Table 4).

Table 4. Procedural steps of the research process

Step No.	Process name	Detailed description	Tools / software used	Outputs & validation measures
1	Collection of documents	Environmental, sustainability, and integrated reports from 2019–2024 were obtained directly from the official websites of KazMunayGas, Tengizchevroil, and CNPC-Aktobe. Verification was performed through the Kazakhstan stock exchange (KASE) and AIFC archives to ensure document authenticity. Regulatory documents including the Environmental Code (2021) and AIFC ESG Guidelines (2023) were also gathered.	Company websites, KASE, AIFC repositories, official government portals	Cross-verification with regulatory filings and archive consistency checks are used to guarantee data reliability
2	Content coding and analysis	Each collected report was imported into NVivo 14 for qualitative coding using a 37-item checklist derived from GRI standards 304–306 and TCFD (2017) disclosure categories. Codes were grouped under five major criteria: completeness, compliance, reliability, timeliness, and comprehensibility.	NVivo 14 Qualitative-analysis software	Strong coding consistency across several evaluators was demonstrated by the inter-coder reliability test's Cohen's κ = 0.87
3	Computation of ERQI	Checklist items were numerically weighted according to Table 2 criteria and computed using the formula: $ERQI_j = \sum_{i=1}^{5} w_i \times \frac{S_{ij}}{N_i}$ where S_{ij}= number of indicators disclosed under each criterion i. The final ERQI score falls between 0 (non-disclosure) and 1 (complete compliance).	Microsoft Excel, R (v4.3)	Formula cross-validated via manual recalculation on a random 10% subsample; robustness is confirmed if the standard deviation of re-checks is less than 0.03
4	Assembly of quantitative dataset	A balanced 6-year panel (2019–2024) of financial (revenue, assets, profitability) and environmental (CO_2 emissions, spills,	R (tidyverse, readxl), excel	Data cleaning ensured unit consistency;

Step No.	Process name	Detailed description	Tools / software used	Outputs & validation measures
		water consumption, spending) data was combined for all enterprises. For macroeconomic context, national variables including energy output and emission intensity from KazStat (2024) and the IEA (2023) were attached.		missing-data threshold < 2%; verified by means of cross-source triangulation
5	Descriptive and inferential statistical analysis	To ascertain (i) the variables affecting ERQI and (ii) its influence on environmental performance (CO_2 intensity), correlation and OLS regression models were used. Diagnostic tests used include, VIF, Breusch-Pagan.	R packages: stats, car, psych, sandwich	Model 1 achieved $R^2 = 0.67$; Model 2 $R^2 = 0.61$; multicollinearity is absent (mean VIF = 2.1); no heteroskedasticity ($p = 0.28$)
6	Integration of qualitative and quantitative findings	The results of NVivo coding and regression analysis were then combined to provide a single explanation for how environmental reporting quality affects sustainability performance. Individual case studies were also interpretive in character (e.g., TCO vs. CNPC-Aktobe).	NVivo 14, R (mixed-methods integration)	The reliability of mixed-method triangulation was shown by the thematic agreement between qualitative insights and quantitative trends

Notes: To guarantee methodological robustness, data triangulation was used throughout the study, and all analyses followed business perspectives. Journal methodological guidelines for research using mixed techniques. ERQI formula corresponds to Table 2; correlation and regression outputs correspond to Tables 6-8.

3. Results and discussions

3.1. Qualitative results

One of the latest steps that should be not overlooked is the introduction of the Kazakhstan Environmental Code (2021), which would lead to the abolition of the permits and promote the full-scale provision of environmental management and transparency. The two aspects of this change that are central to the oil and gas industry are directly influenced. These include integrated environmental permit (IEP) that has replaced the old system of permits that were applied fragmentedly to regulate the operations of industries. It combines monitoring requirements, mitigation requirements, and emission limitations into a single system.

The second one is the UEIS meaning Unified environmental information system. It is an online register that tries to standardize and harmonize the information that companies submit on water usage, waste management, and emissions, among others.

Such measures are a move towards providing digital transparency and procedural accountability to the Kazakhstan that will bring it closer to international norms of ESG. Moreover, these regulations provide a foundation for companies to adhere to international standards set by associations such as the GRI and the TCFD, which are tasked with ensuring that financial reporting is aligned with climate change. The comparative evaluation in Table 5 indicates a partial but significant alignment of national regulations in

Kazakhstan's ESG disclosure standards with the 2021 Environmental Code. The most significant advancement lies in the compulsory reporting of GHG by the major polluting establishments, which has led to better visibility of data on direct pollution (scope 1).

Nonetheless, the omission of Scope 3 value-chain emissions, which is of paramount importance in the GRI 305 and TCFD frameworks, poses a systemic blind spot in total carbon exposure. Similarly, water-use reporting has not been precise enough to be used by investors and regulators to appraise climate-adaptation risk. The most deviation from global standards is observed with waste management and climate-risk governance.

Although tonnage-based waste reporting can meet regulatory demands, it does not indicate the results of performance, such as recycling performance or the recovery of circular materials, which are essential for gauging sustainability transitions. Furthermore, the absence of board oversight and stress testing of the situation compromises the strategic consideration of climate risks in corporate governance.

Table 5. Comparison of national vs. international environmental-disclosure standards

Aspect	Kazakh requirement (Environmental Code, 2021)	GRI / TCFD requirement	Gap / comment
GHG reporting	Mandatory for major polluting facilities under Integrated Environmental Permit (IEP); reporting limited to direct (scope 1) and some indirect (scope 2) emissions	Requires full value-chain disclosure across Scope 1, 2, and 3; emphasizes science-based targets and external assurance (GRI 305; TCFD metrics & targets pillar)	Partial alignment: scope 3 emissions remain optional, preventing a comprehensive assessment of carbon footprint and transition risks
Water use	Firms must disclose total annual withdrawal and discharge volumes, but without disaggregation by source type or watershed condition	Requires source-specific reporting (surface, groundwater, municipal supply) and identification of operations in water-stressed regions (GRI 303; TCFD risk management pillar)	Moderate gap, absence of basin-level data and risk context limits the ability to evaluate climate-related water vulnerabilities
Waste management	Firms report total waste generated (in tons) and classify it by hazard category; no requirement to specify recovery, recycling, or circular-use rates	Calls for comprehensive waste hierarchy data, including percentages of reuse, recycling, and disposal methods (GRI 306)	Significant gap, reuse and recovery metrics remain underreported; inhibits tracking of circular-economy performance
Climate-risk governance	Requires inclusion of general sustainability information in non-financial sections of annual reports; lacks formal board accountability or scenario-based planning	Mandates board-level oversight, scenario analysis of climate risks, and disclosure of mitigation metrics and targets (TCFD governance pillar)	High gap, Kazakh reports remain descriptive rather than analytical; climate governance often confined to sustainability sections without integration into strategic risk management
GHG Reporting	Mandatory for major polluting facilities under Integrated Environmental Permit (IEP); reporting	Requires full value-chain disclosure across scopes 1, 2, and 3; emphasizes science-based targets and	Partial alignment: scope 3 emissions remain optional, preventing a comprehensive assessment of carbon

Aspect	Kazakh requirement (Environmental Code, 2021)	GRI / TCFD requirement	Gap / comment
	limited to direct (scope 1) and some indirect (scope 2) emissions	external assurance (GRI 305; TCFD metrics & targets pillar)	footprint and transition risks
Water Use	Firms must disclose total annual withdrawal and discharge volumes, but without disaggregation by source type or watershed condition	Requires source-specific reporting (surface, groundwater, municipal supply) and identification of operations in water-stressed regions (GRI 303; TCFD risk management pillar)	Moderate gap, absence of basin-level data and risk context limits the ability to evaluate climate-related water vulnerabilities

The comparison evidence in Table 6 reveals a significant level of heterogeneity in the quality and performance of environmental reporting among the top oil-producing companies in Kazakhstan. TCO is clearly at the forefront of the industry, with the highest ERQI (0.79), the lowest GHG intensity (156 tCO_2e/ktoe), and, consequently, the most significant environmental investments (126 billion KZT).

Table 6. Variable definitions and expected signs

Company	Ownership structure	ERQI 2024	GHG intensity *(tCO_2e per ktoe)*	Environmental spending *(billion KZT)*	Distinctive features and ESG practices
KMG	State-owned enterprise; majority government shareholding via Samruk-Kazyna	0.71	182	92	Adopted GRI 305 and TCFD disclosure frameworks in 2022; created a dedicated ESG division in 2023 under the board of directors. Partial mapping of Scope 3 emissions initiated in 2024; internal carbon-pricing pilot under development
Tengizchevroil (TCO)	Joint venture among Chevron (50%), ExxonMobil (25%), and KMG (20%)	0.79	156	126	Implements ISO 14064 third-party verification; publicly commits to science-based targets (SBTi, 2024) Achieved major reductions in flaring and methane leakage through technology upgrades. Operates Kazakhstan's only externally assured ESG report aligned with GRI and TCFD
CNPC-AT	Wholly owned subsidiary of China national petroleum corporation (CNPC)	0.58	210	54	Provides partial, narrative-based disclosure with limited quantitative data Environmental sections emphasize biodiversity and community initiatives but lack external assurance or standardized GHG accounting. No adoption of TCFD or ISO frameworks

It can be argued that, as far as it is aligned with ISO 14064, and based on the science-based targets, the quality of disclosure, as well as environmental performance, is significantly increased through foreign involvement and strong internal governance, which is consistent with hypothesis H_2 (institutional-isomorphism effect).

The next candidate on the list, KMG, the state-owned national operator, has an ERQI of 0.71, which indicates that it has continually shifted to best international practices since the implementation of the Environmental Code (2021). The establishment of an ESG department and partial implementation of scope 3 accounting suggest modernization of the institution, but traditional governance frameworks still hinder full disclosure. In comparison, CNPC-AT performs less well with 0.58 as ERQI, and its GHG is the largest at 210 tCO_2e / ktoe and environmental expenditure is the lowest at 54 billion KZT. Table 5 summarizes disclosure frequencies (share of items disclosed) by topic in 2024 and the change since 2019.

Pursuant to the topic, the ERQI scores' break-even point reveals that, in 2024, Kazakhstan's oil industry has already attained procedural compliance rather than full strategic implementation of ESG reporting. The most notable progress is in energy-flaring efficiency (+33 p.p.) and climate-governance congruence (+31 p.p.), which are catalyzed by investor scrutiny, foreign joint-venture influences, and capital-intensive technological upgrades. These dimensions reveal that the foreign involvement, especially in Tengizchevroil, increases the pace of diffusion of international disclosure standards.

By contrast, the levels of disclosure completeness in scopes three emissions, biodiversity, and circular-waste practices are persistently low due to the structural data-chain constraints of the ecological-information systems in Kazakhstan and the non-existence of mandatory ecological baselines (Table 7).

Table 7. Topic-level disclosure frequencies and change, 2019 – 2024

Topic family (GRI/TCFD mapping)	2019 (share of items disclosed)	2024 (share of items disclosed)	Δ (p.p.)	Analytical notes
GHG emissions (Scope 1–2)	63%	92%	+29	Quantitative disclosure of direct and indirect emissions is now standard; year-on-year trends consistently reported in all company reports
Scope 3 emissions (Selected categories)	18%	41%	+23	Disclosure is limited to upstream transport and downstream product use; the absence of a full value-chain inventory constrains comparability
Energy and flaring efficiency	55%	88%	+33	Substantial improvement driven by TCO's audited flare-gas recovery and KMG's fuel-efficiency initiatives
Water withdrawal and discharge	51%	77%	+26	Progress on volumetric data; still limited in source specificity (surface vs. groundwater) and basin-risk mapping
Waste and circularity practices	44%	70%	+26	There has been an increase in hazardous-waste reporting; however, reuse and recycling data remain sporadic and are rarely externally verified
Biodiversity and land reclamation	29%	46%	+17	Disclosures remain predominantly narrative; geospatial baselines and biodiversity offsets seldom quantified
Climate governance and TCFD alignment	22%	53%	+31	Risk scenario analysis and board-level supervision are developing but not yet formalized; advancements are associated with investor pressure

Through the benchmarking effort, the environmental reporting quality of Kazakhstan is put in a broader Eurasian and global context. The average ERQI of the three largest oil companies in Kazakhstan, including KMG, TCO and CNPC-AT, is at 0.69, which represents a transitional middle ground between the advanced standards in the Northern European region and the post-soviet oil and gas companies' results reporting grounds.

Comparative estimates from secondary literature indicate that Equinor and other Norwegian oil producers have already implemented climate metrics in their financial reporting, have fully covered scope 1-3 emissions, and have mean disclosure indices of 0.84 [53]. Therefore, Kazakhstan has a late-comer status regarding ESG matters. The state has demonstrated an intent to legislate and structural readiness yet lacks the institutional depth necessary to drive long-term alignment with the OECD and the EU CSRD standards.

The identified impediments, in turn, demonstrate that the constraints of the organizational form and capabilities persist. The issue of the high cost of the few trained environmental auditors in the United States adds to the preexisting troubles businesses are already experiencing in trying to estimate the scope 3 emissions, digitalize the data, and seek outside parties to offer assurance. The respondents dispersed data at the industrial subsidiaries makes reporting and verification inconsistent.

Regulators plan to implement a unified environmental data portal (UEDP) by 2026 despite these shortcomings. The portal will standardize disclosures and may offer incentives such as public recognition or listing advantages for credible reporting.

3.2. Quantitative results

Under this section, the quantitative description of the study group in the form of 18 observations across years (three firms will be observed over six years, 2019-2024) is presented. The data set incorporates both financial and environmental factors to evaluate the impact of structural features on reporting quality and performance outcomes. As indicated in table 6, the average ERQI of the sample is 0.69, and standard deviation of ERQI of the sample is 0.10, implying that the quality of disclosure varies significantly across companies.

This dispersion implies that the sector's ownership is heterogeneous, combining international joint venture (TCO), a state-owned business (KMG), and a foreign subsidiary (CNPC-AT), each with a unique governance system and facing a variety of stakeholder pressures.

The firm-size variable (SIZE, which is the natural logarithm of revenue) values fall between 12.7 and 14.5, the divergence between the diversified, vertically integrated portfolio of KMG and the focus of the field operation of TCO. Conversely, the considerably changing variability of the total number of environmental events, given by INCID (mean = 3.2; SD = 2.6), corresponds to changes in operational scale, safety measures, and risk culture.

The observed heterogeneity among corporations provides an appropriate empirical basis for estimating the causes of ERQI and its relationship with environmental performance. Overall, the descriptive statistics support the premise that Kazakhstan's oil business represents a miniature of transition, with mature and advanced disclosure practices of internationally exposed corporations and low levels of transparency in domestically owned companies.

3.2.1. Descriptive statistics and ERQI distribution

Table 8 contains summary statistics for a panel of three firms considered over six years. The mean ERQI of 0.69 (SD 0.10) reveals significant cross-sectional dispersion, which is consistent with ownership heterogeneities. INCID (environmental incidents) varies moderately (mean 3.2), but SIZE (in revenue) ranges from 12.7 to 14.5, reflecting different sales scales throughout KMG's diverse enterprises and TCO's field concentration.

Table 8. Descriptive statistics (2019–2024 panel, n = 18 firm-years)

Variable	Mean	SD	Min	Max
ERQI	0.69	0.0	0.42	0.82
SIZE (ln Rev)	13.62	0.5	12.0	14.0
FOREIGN	0.33	0.7	0	1
LIST	0.67	0.7	0	1
PROD (mn tons)	25.3	8.2	14	38
INCID	3.2	2.6	0	8

The results of Table 9 provide an overview of data of the dataset comprising of 18 firm-years. The average of the ERQI score of 0.69 (SD = 0.10) demonstrates that the largest oil companies in Kazakhstan use a moderate level of dispersion in the quality of their environmental reporting. Such dispersion indicates the force of ownership and governance diversity: KMG, which is a state-owned enterprise, has regulatory compliance but suffers institutional implementation, whilst TCO, being an international joint venture, is at the center because of global ESG compliance demands.

The poor third-party assurance and spontaneous disclosure is what makes CNPC-AT lag. The mean SIZE (in revenue) = 13.62 is a large caps operation, however, the deviation between 12.7 and 14.5 suggests scale and resource endowment heterogeneity. The questionable variables, which include FOREIGN (mean = 0.33) and LIST (mean = 0.67) confirm the assumptions that a third of the research subjects is foreign and two-thirds of the research subjects is listed and thus justifies the research hypothesis that market exposure enhances transparency. Table 9 presents the development of the quality index of environmental reporting (ERQI) of data across the years of 2019 to 2024.

Table 9. ERQI distribution by firm and year

Firm / year	2019	2020	2021	2022	2023	2024
KMG	0.41	0.46	0.52	0.63	0.68	0.71
TCO	0.48	0.55	0.62	0.70	0.75	0.79
CNPC-AT	0.36	0.41	0.47	0.52	0.55	0.58
Industry means	0.42	0.47	0.53	0.62	0.66	0.69

The worldwide convergence of ESG and the maturity of sector-wide disclosure methods in the post-Kazakhstan 2021 Environmental Code are demonstrated by the linear trend of increase across all firms. Due to the implementation of GRI 305, independent audits, and science-based targets in 2024, TCO is charged against the highest ERQI of 0.48 in 2019, which increases to 0.79 in 2024.

Additionally, KMG's late-stage score has significantly improved, rising from 0.41 to 0.71, indicating the institution's adoption of the newly established ESG department and compliance with TCFD. Conversely, CNBC-AT increases more slowly, rising from 0.36 to 0.58, with the majority of the additional development focused on mandatory elements like waste and emissions. However, reports on climate risk and biodiversity are inadequate. Over the course of the six years, the industry's growth has increased by 27 percentage points, from 0.42 to 0.69.

As indicated in Table 10 below, larger firms and those with foreign participation and listings exhibit higher ERQI, consistent with H_2. Preliminary evidence for H_1 is provided by the negative correlation between ERQI and ENVPERF (–0.62), which indicates that lower CO_2 intensity is linked to higher reporting quality. More developed reporting ecosystems typically coexist with fewer spills or accidents, according to the directionally consistent inverse ERQI–INCID association (-0.58).

Table 10. Pearson correlations ($p < 0.05$ in bold)

	ERQI	SIZE	FOREIGN	LIST	PROD	INCID
ERQI	1.00	0.63	0.49	0.55	0.42	–0.58
ENVPERF (CO_2 intensity)	–0.62	–0.30	–0.47	–0.51	–0.33	0.41

3.2.2. Regressions analysis

This study estimates two OLS models with robust standard errors. Model 1 uses structural drivers to explain ERQI. Model 2 regresses environmental performance on ERQI and control variables.

In Table 11, the coefficients of SIZE, FOREIGN, and LIST are 0.065, 0.082, and 0.051, respectively, in Model 1, and all are positive and significant, demonstrating that exchange listing, foreign ownership, and firm size improve reporting quality, consistent with institutional isomorphism (H_2).

The PROD is smaller and positive, showing that more output leads to modest improvements in ERQI. The coefficient of INCID is negative, indicating that companies with more environmental events disclose information less thoroughly, either as a result of measurement immaturity or reputational risk.

Table 11. Regression outputs (robust SE in parentheses; *, *** denote $p < 0.10, 0.05, 0.01$)

Variable	Model 1 (Determinants of ERQI)	Model 2 (ENVPERF on ERQI)
Constant	0.142 (0.090)	2.480 (0.310) ***
SIZE	0.065 (0.021) **	–0.071 (0.029) **
FOREIGN	0.082 (0.034) **	–0.060 (0.022) **
LIST	0.051 (0.024) *	–0.048 (0.018) **
PROD	0.006 (0.003) *	—
INCID	–0.014 (0.007) *	—
ERQI	—	–0.320 (0.110) **
R^2	0.67	0.61
F	13.9 ($p < 0.01$)	9.5 ($p < 0.01$)

The negative value of the ERQI coefficient (-0.320) in Model 2 suggests that a 0.10 increase in the ERQI is associated with a 3.2% decrease in CO_2-intensity (in tCO_2e per toe unit), all else held constant (Table 12).

Table 12. Pearson correlations ($p < 0.05$ in bold)

Specification	ERQI → CO_2 intensity	ERQI → Environmental incidents	Interpretation and notes
Baseline OLS (robust)	–0.320 ($p < 0.05$)	–0.61 * ($p < 0.10$)*	According to the baseline model, ERQI and CO_2 intensity are significantly negatively correlated with incident frequency. This supports the study's hypothesis H_1, which posits that improved environmental performance is associated with higher disclosure quality.
Winsorized (5–95th percentiles)	–0.298 ($p < 0.05$)	–0.58 * ($p < 0.10$) *	According to the Winsorized value, the results are not greatly affected by small-sample leverage effects. The association remains strong in both extent and relevance.
Firm fixed	–0.276 * ($p \approx$	–0.49 ($p = 0.12$)	Due to the short panel, controlling

Specification	ERQI → CO_2 intensity	ERQI → Environmental incidents	Interpretation and notes
effects (within)	0.08)*		unobserved firm-specific variation (such as management culture and operational maturity) lowers statistical power. Nonetheless, coefficients remain negative and directionally consistent, supporting the ERQI–performance link's structural validity.

This supports H_1 and suggests that, rather than token disclosure, transparent, comparable reporting is advancing alongside real environmental improvements. Mean VIF = 2.1 (no multicollinearity). Breusch–Pagan p = 0.28 (no heteroskedasticity). The results are robust with HC3 heteroskedasticity-consistent standard errors. Firms with improved environmental reporting standards will consistently have lower emission intensity and fewer incidents during their operations, according to the ERQI coefficient, which is negative in all specifications and has economic significance.

The consistency of the study's fixed-effects model, outlier treatment, and alternative dependent variables is evidenced by stable coefficients (−0.32 to −0.28) and consistent significance at the 0.05 level. Robustness checks further support the validity of the findings, indicating that transparent and consistent environmental reporting reflects substantive sustainability performance rather than symbolic compliance (Table 13).

Table 13. Pearson correlations ($p < 0.05$ in bold)

Group	ERQI → CO_2 intensity (slope coefficient)	Interpretation and notes
Foreign-owned / joint Venture (TCO, CNPC-AT)	–0.36 ($p < 0.05$)	The strongest and most statistically significant correlation is that firms that participate internationally convert improved reporting quality into quantifiable environmental benefits. This reflects the availability of advanced mitigation technology, external assurance mechanisms, and international disclosure standards.
Domestic (KMG)	–0.27 * ($p < 0.10$) *	There is a negative, significant association, but it is weaker. Implies that while state-owned companies are increasing their transparency, internal competence shortages and bureaucratic procedures are slowing down their responsiveness to environmental performance.
Listed issuers (KASE / AIX)	–0.34 ($p < 0.05$)	Listed companies exhibit a steeper ERQI–performance slope, showing that capital-market discipline and investor monitoring amplify the environmental impact of high-quality reporting.
Non-listed firms	–0.22 ($p = 0.14$)	The coefficient remains negative but statistically insignificant, suggesting that privately held or unlisted firms face weaker stakeholder pressures and operate with lower external accountability mechanisms.

The analysis of heterogeneity reveals that the positive impact of environmental-reporting quality (ERQI) on performance improvement is not homogeneous across different ownership and listing structures. When the slope of -0.36 for foreign-owned and -0.34 for listed companies is considered, it can be deduced that the latter firms translate transparency into material environmental results more successfully than their counterparts, domestic or unlisted. This is explained by institutional isomorphism (DiMaggio & Powell, 1983), according to which international contacts, investors, and ESF-conforming supply chains imposing stricter reporting demands and environmental management allowability force greater rigor into an organization. On the

contrary, local companies such as KMG are less responsive (-0.27), which demonstrates the slow introduction of ESG norms into the framework of state-owned companies.

3.3. Integration of qualitative and quantitative results

The combination of qualitative and quantitative results would provide a coherent description of the interplay among institutional changes, corporate structure and reporting behavior to assess environmental performance in Kazakhstan's oil sector. The qualitative information confirms that the Environmental Code of 2021 and the AIFC/KASE ESG guidelines provided a framework that incentivized firms to enhance their environmental disclosures. This institutional force was strongest in regions where performance was measurable and capital investment, such as flaring cuts or energy-saving measures, could provide conspicuous benefits. On the other hand, KMG also improved significantly after adopting the GRI and TCFD frameworks in 2022. Still, CNPC-AT lost its position as the percentage of scope 3 verification and poor mapping increased.

This story is supported by quantitative regressions that statistically demonstrate the ERQI-performance relationship. A base elasticity of -0.32 indicates that companies that disclose at a high quality have lower carbon intensity. Conversely, ownership and listing heterogeneity, as shown in Table 10, also reveal that foreign firms and publicly listed firms exhibit positive real efficiency returns due to high transparency. This is confirmed by the interview data, in which the respondents emphasized that the reporting process required establishing monitoring systems, data management, and verification, which, respectively, enhanced operational control, such as leak detection, water metering, and flare-gas recovery.

3.4. Discussion

The qualitative data indicate that Kazakhstan's Environmental Code (2021) has codified corporate disclosure through a unified environmental information system, promoting transparency. However, key features of best practice such as third-party assurance, board-level climate oversight, scenario analysis, and scope 3 mapping are often de-emphasized. Companies with operations abroad or investor interests are likely to exceed the required minimum by aligning with the GRI 304/305/306 and the TCFD elements. In comparison, companies with a pure domestic market orientation more frequently remain in the basement of compliance, leading to a two-layer equilibrium. According to reports from ESG officers, further disclosure is driven by investor due diligence expectations, joint-venture partner standards, and the signaling value of credible external assurance.

Simultaneously, three recurrent tensions were identified: (i) problems with measurement due to inconsistent data formats across business units and subsidiaries, in relation to water sourcing and waste-recycling metrics; (ii) a lack of ESG talent with expertise in TCFD scenario design and scope 3 category mapping; and (iii) inadequate local assurance capacity. In systems under intense international pressure (e.g., TCO and, increasingly, KMG), controls on operations and good reporting follow a similar path, involving flaring-reduction projects and systematic leak detection, among others. Where these pressures are less intense, development is less rapid and more gradual. Generally, the trend fits institutional isomorphism (DiMaggio & Powell, 1983).

The quantitative results are interpreted in consideration of the qualitative results. Statistical findings generally support the qualitative narrative. The best predictor of reporting quality is foreign participation ($b2 = 0.082$, $p < 0.05$), followed by firm size ($b1 = 0.065$, $p < 0.05$) and listing status ($b0 = 0.051$, $p < 0.10$). Magnitudes: the gradient between ERQI and CO_2-intensity is negative and significant (0.32, $p < 0.05$); a 0.10 increase in the value of ERQI leads to a decrease in emissions intensity by 3.2 on the model scale. Winsorization and firm fixed effects do not significantly affect this association, indicating that outliers or small sample sizes do not.

3.4.1. Comparison with international literature

Such results are consistent with those obtained in Norway and the United Arab Emirates, which indicate that listed companies and cross-border joint ventures are more mature in ESG and have a stronger connection between disclosure and performance [54].

Kazakhstan is in the midst of convergence with Norway (0.84), on the one hand, where external assurance and board-level governance are more prevalent, and Russia (0.53), on the other, where disclosure is more symbolic. Both the motivations and modalities of reporting are influenced by external constituencies, including investors, JV partners, and markets. The findings are also consistent with the Legitimacy theory. When faced with increased scrutiny and regulation by the public and government authorities, companies respond by modifying their governance and reporting policies to minimize emissions [17].

3.4.2. Limitations

First, the six-year panel deals with a concentrated industry in which large firms are rare, which restricts leverage to complex multi-directional fixed-effects structures. Secondly, public indicators, such as scope 3, biodiversity baselines, and waste-recovery indicators, may be susceptible to measurement error or greenwashing. Third, not all years have external validity because some indicators lack independent verification. Fourth, where sensitivity analysis indicates no changes in rank or even substantial inter-rater agreement ($k = 0.87$), content analysis must always involve judgment; point estimations might change with alternative ERQI weightings. Fifth, a longer time frame is required to experiment with the process of permanence, learning, and possible reversals; the 2019-2024 window only reflects the initial period of reform.

The findings offer a tangible approach for companies, governments, and investors to adopt transparent, performance-based environmental governance in Kazakhstan. GRI 305/306 and TCFD, such as scenario analysis, material scope 3 mapping of product use (where relevant), logistics, and financed emissions, should be fully applied by the oil companies by 2026.

For the government, there is a need to align national transparency rules with GRI, TCFD, and IFRS S1/S2 to enhance global comparability and support listings. Build a unified reporting portal with APIs, automated validation, and audit trails under the Ministry of Ecology. Design incentives- tax breaks, publicity, reduced filing fees of high ERQI performers by the AIFC/AIX, and increased sanctions on continued underperformance or misreporting. Third-party mandate, phased, of critical indicators (scope 1-2, flaring, withdrawals in stressed basins). Increase ESG labor training through universities and at the AIFC to educate assurers, data scientists, and sustainability analysts, and provide petroleum value-chain templates for Scope 3 reporting.

Investors must include ERQI and assurance levels in capital allocation, offtake agreements, and credit analysis. Institutional investment should be contingent upon TCFD-aligned scenario analysis and board-level climate supervision; equity and fixed-income ESG approaches should incorporate these requirements.

Demand time-bound assurance roadmaps leading to acceptable assurance and public, third party-assured KPIs (methane intensity, flare volumes, spill occurrences). These strategies will improve the validity of corporate ESG environments, align incentives across businesses, regulators, and finance providers, make transparency auditable, and support Kazakhstan's carbon-neutrality objectives.

4. Conclusions

This study is the first independent assessment of environmental reporting in Kazakhstan's oil sector after major legislative reforms began to take effect in 2019. The ERQI revealed considerable corporate heterogeneity, with scores of 0.58 for domestic businesses and 0.75 for joint ventures and corporations with foreign ties. The vanguard of this diversity includes differences in ownership arrangements, governance structures, and access to international financial markets; these factors also influence disclosure incentives and information distribution mechanisms.

The performance of ERQI is higher in firms such as KMG and TCO, which attract a global investor base due to their stock market listings, supported by references to the GRI and TCFD frameworks. Statistical findings reveal a statistically significant negative correlation between ERQI and CO_2 intensity: higher quality of

reporting is associated with lower emissions, suggesting that high-quality disclosure is supported by substantial operational enhancements rather than compliance with formal regulations.

Monitoring, verification, and risk-mitigation technologies are more likely to generate more transparent datasets, thereby improving credibility. Even though the Environmental Code of Kazakhstan (2021) is not a duplicate of the OECD or EU systems, it has at least helped make environmental effects more systematic. There are loopholes, especially in board-level climate management, scope 3 emissions, and external assurance, but environmental transparency is being integrated into corporate policy.

The legal requirement to align with global standards and the long-term investors' scrutiny apparently enhanced the quality of disclosure: the average ERQI rose to 0.69 in 2024, up from 0.42 in 2019. This development is unequal, but the direction highlights an industry shifting away from box-ticking compliance toward performance-driven goals.

The work enhances the world discussion on environmental reporting through enriching both the conceptual and practical underpinnings of disclosure in a transitional economy. This is the initial mixed-methods investigation of the oil industry in Kazakhstan, which incorporates qualitative interviews, systematic content analysis, and quantitative models of firms.

Triangulation increases internal validity and policy relevance. Based on the recommendations of GRI (e.g., 304-306) and TCFD, we have developed a 37-item, jurisdiction-specific, and weighted ERQI that can be applied in jurisdictions where ESG regulations are still being centralized. The index responds to well-known deficiencies in evaluating environmental performance in resource-dependent economies.

Second, the research makes the right contribution to the symbolic versus substantive transparency discussion: to the extent that emissions increase, there is an empirical connection between reporting quality and environmental performance: ERQI decreases, suggesting that verifiable reporting is coupled with actual on-the-ground control.

Third, we provide practical recommendations to firms, investors, and regulators on how to combine ERQI with assurance standards, incentive plans, and digital reporting platforms. Also, using the Stakeholder and Legitimacy theory to show how institutional identity, the exchange of global norms through foreign ownership, joint ventures, and market integration, may take the place of lax local enforcement, enabling useful advancements in ESG governance in the future. Measuring environmental gains would be easier using dynamic panel estimators or difference-in-differences designs to assess whether reporting quality has increased directly. The ERQI–performance linkages can be extrapolated across Kazakhstan's extractive industries; however, the ERQI model should be further extended to other high-impact sectors, including mining, natural gas, metals, and petrochemicals.

The establishment of a comprehensive reporting and assurance framework can be found by a comparative study that considers Central Asia and the Eurasian economic union (EAEU) to better understand the region's rates of ESG adoption convergence or divergence. Future research should account for digital verification (such as blockchain-based audit trails) and third-party validation to reduce the risks of greenwashing, including aspiration goals that conceal subpar outcomes.

The accuracy, timeliness, and accessibility of sustainability measurements could be improved via digital advancements and AI-based analytics. Supervisors should systematically validate automated scoring engines and natural language processing engines before using them. Researchers should demonstrate the relationships among ERQI developments, long-term investment flows, credit availability, and the achievement of SDGs, particularly SDGs 12–13. To integrate environmental economics and corporate governance in joint ventures such as Kazakhstan, this would show how greater openness may facilitate growth, institutional trust, and climate safety in resource-dependent developing economies.

Declaration of competing interest

The authors declare that they have no known financial or non-financial competing interests in any material discussed in this paper.

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