The Impact of ESG Performance on Corporate Value in Energy Companies

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Abstract. This study employs a two-way fixed effects model to systematically investigate the impact mechanisms and heterogeneity characteristics of ESG performance on corporate value among Chinese A-share energy-sector listed firms (2009–2022). The results demonstrate that energy enterprises' ESG performance exerts a significant positive influence on corporate value. Mechanism analysis reveals that ESG-driven value enhancement is mediated through green technology innovation, which improves energy efficiency and market competitiveness. Heterogeneity tests indicate stronger ESG valuation effects in non-SOEs and renewable energy firms. These findings elucidate the value creation logic of ESG practices in energy industries, providing empirical evidence to inform policy formulation for green energy transitions and the establishment of a China-specific ESG evaluation framework.

Keywords: Energy companies, ESG performance, Corporate value, Green technology innovation

1 Introduction

Global climate change has transitioned from scientific projections to urgent reality, prompting over 150 nations to commit to carbon neutrality targets aimed at restructuring economic growth through systemic emission reductions. As the primary driver of global carbon emissions, the energy sector faces unparalleled decarbonization pressures [1]. The Statistical Review of World Energy 2023 reveals energy-related CO2 emissions reached 39.3 billion metric tons in 2022, accounting for 87% of global emissions- a historic high. Crucially, fossil fuels continue to dominate global energy consumption despite rising renewable penetration, with traditional energy firms lagging behind the *Paris Agreement*'s decarbonization timelines. This context positions environmental, social, and governance (ESG) frameworks as critical tools for reconciling profit motives with societal responsibilities, particularly in the environmentally sensitive and policy-intensive energy sector [2].

China, the world's largest energy consumer and carbon emitter, plays a pivotal role in global climate governance. The State Council's 2021 Guidelines for Carbon Peaking and Neutrality mandates building a "clean, low-carbon, secure, and efficient energy system," integrating ESG metrics into corporate evaluations via carbon markets and

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green finance mechanisms. However, structural contradictions persist: traditional energy firms remain path-dependent on carbon-intensive technologies [3], while new energy enterprises grapple with high R&D costs and low market penetration despite technological potential [4]. These dual challenges render China's energy ESG landscape both uniquely complex and strategically critical. GCL Technology Holdings Co., Ltd. has established a transparent ESG disclosure system by aligning its reporting with international standards. This practice enhanced investor confidence and secured green financial support, with clean energy business revenue exceeding 60% in 2024. The company was recognized as "2024 ESG Best Environmental Responsibility (E) Practice Enterprise" for its exemplary environmental governance.

2 Literature Review

Over the past decade, ESG has become an increasingly important part of conducting business globally. Extensive research demonstrates a significant positive correlation between ESG performance and corporate value [5]. Wang and Yang [6] found that companies with strong ESG performance receive better market evaluations and are able to show positive aspects to the public, improve corporate reputation, and thus enhance corporate value. Han's [7] study revealed that ESG ratings facilitate access to commercial credit, elevating corporate value. Scholars examine the relationship between enterprise ESG performance and corporate value through different mechanisms of action. Zhang et al [8] highlighted that the improvement of corporate ESG performance can reduce the cost of debt financing, lower corporate financial risk, and then enhance corporate value. Yao and Jiang [9] proposed that actively practicing ESG development concepts significantly improves corporate innovation output, and a higher degree of ESG practice strengthens the ability to obtain corporate social capital, improves managers' short-sighted behavior, and eases financing constraints, thus promoting corporate innovation and thus enhancing corporate value.

Comparative studies reveal stark contrasts between Chinese and global energy ESG practices. For example, European oil majors (e.g., Shell, TotalEnergies) face stricter investor-led ESG scrutiny, mandating explicit Scope 3 emission targets. U.S. shale gas firms prioritize operational ESG metrics over holistic governance reforms, reflecting divergent stakeholder priorities. China's unique "green finance ecosystem," characterized by state-backed green loans and carbon trading pilots, creates distinct path-ways for ESG value realization compared to market-driven mechanisms in the West.

Building on this gap, this study advances a sector-specific analysis by investigating how ESG performance affects corporate value in energy enterprises through green innovation mechanisms. Additionally, it examines the moderating effects of ownership structure and technological endowments on the ESG-value nexus, providing novel theoretical and empirical contributions to contextualized ESG research.

3 Theoretical Analysis and Hypotheses

3.1 Direct Impact of ESG Performance on Corporate Value

Stakeholder theory posits that corporate development requires not only profit generation but also responsiveness to environmental, employee, and community stakeholders for optimal resource utilization [10]. For energy enterprises, ESG integration creates dual value pathways. First, institutionalizing ESG governance mandates multi-stakeholder oversight, compels environmental and social accountability, and reduces operational costs by mitigating environmental litigation risks and production disruptions [11]. Second, superior ESG performance signals operational stability to stakeholders, enhancing corporate reputation to secure lower financing costs, broader market access, and talent acquisition advantages--all contributing to market valuation growth [12]. Additionally, robust ESG profiles demonstrate governance efficacy, attracting skilled human capital to drive productivity and innovation, thereby generating sustainable value [13]. Therefore, this study proposes the following research hypotheses:

H1: Strong ESG performance enhances the corporate value of energy enterprises.

3.2 Mediating Role of Green Technological Innovation

Green technology innovation necessitates substantial R&D and human capital investments—a requirement amplified in energy firms developing clean production and circular technologies. Robust ESG performance ensures sustained resource allocation to green innovation through dual mechanisms. First, strong ESG credentials mitigate information asymmetries by signaling operational efficacy and environmental stewardship, attracting high-caliber management teams and enhancing audit rigor for transparent sustainability reporting [14]. This fosters stakeholder trust, facilitating access to financing and policy incentives. Second, green innovation's dual environmental-economic returns--pollution reduction, energy efficiency gains, and cost optimization [15]--enable market expansion and profitability growth while aligning with ecological imperatives [16], thereby elevating corporate value. Therefore, this study proposes the following research hypotheses:

H2: Green technological innovation mediates the relationship between ESG performance and corporate value in energy enterprises.

4 Research Design

4.1 Sample Selection and Data Sources

This study employs publicly available data from listed companies in the energy sector as the research sample. According to the 2012 industry classification standards established by the China Securities Regulatory Commission (CSRC), this study selected data from 69 listed companies in the energy sector spanning 2009 to 2022. The sample encompasses five critical sub-industries: Electricity, Heat Production and Supply; Gas Production and Supply; Coal Mining and Washing; Water Production and Supply; and

Petroleum and Natural Gas Extraction. All financial and operational data were systematically obtained from three authoritative databases: the Wind Financial Terminal, the CSMAR Database, and the EPS Global Statistical Database.

4.2 Model Specification

Baseline Regression. To investigate the impact of energy enterprises' ESG performance on corporate value while controlling for the effects of individual and temporal heterogeneity on estimation results, this study constructs a two-way fixed effects model:

$$\text{tobinQ}_{it} = \alpha_0 + \alpha_1 \text{ESG1}_{it} + \alpha_2 \text{Controls} + \lambda_t + \delta_i + \varepsilon_{it} \quad (1)$$

ESG1 denotes corporate ESG performance, tobinQ represents firm value, δ_i and λ_t denote individual and time fixed effects, respectively, and ε_{it} is the stochastic error term.

Mediation Analysis. Building on the aforementioned theoretical analysis and leveraging insights from prior research [17], this study employs the widely used stepwise regression approach to construct the following mediation mechanism model:

$$\text{lngp}_{it} = \beta_0 + \beta_1 \text{ESG1}_{it} + \beta_2 \text{Controls} + \lambda_t + \delta_i + \varepsilon_{it} \quad (2)$$

Here, lngp_{it} denotes the mediating variable of green technology innovation, and β_1 captures the effect of ESG performance on green technology innovation. A statistically significant β_1 coefficient indicates that ESG performance exerts a significant impact on green technology innovation.

After incorporating the mediator variable, the impact of ESG performance on corporate value is re-estimated as follows:

$$\text{tobinQ}_{it} = \varphi_0 + \varphi_1 \text{ESG1}_{it} + \varphi_2 \text{lngp}_{it} + \varphi_3 \text{Controls} + \lambda_t + \delta_i + \varepsilon_{it} \quad (3)$$

In this equation, φ_1 and φ_2 are the coefficients to be estimated. If both and φ_1 are φ_2 statistically significant and the coefficient of φ_1 diminishes, it demonstrates that green technological innovation serves as a critical transmission pathway through which ESG performance affects the corporate value of energy enterprises.

4.3 Variable Definitions

Dependent Variable. This study employs Tobin's Q (tobinQ) as the metric to measure corporate value [18].

Independent Variable. This study utilizes the Huazheng ESG rating data to assess the ESG performance of energy enterprises. Additionally, drawing on the methodology of Gao et al. [19], the nine-tier rating scale ("AAA" to "C") is converted into numerical scores ranging from 9 to 1. Annual average ESG ratings are subsequently calculated to quantify corporate ESG performance on a yearly basis.

Mediator. Total Factor Productivity (TFP), R&D expenditure, and patents are the three most commonly used indicators in existing studies to measure technological innovation. However, in imperfectly competitive markets, TFP struggles to precisely gauge firms' innovation levels, while micro-level firm studies often face challenges in obtaining reliable R&D expenditure data. Compared to TFP and R&D expenditure, patents offer timelier accessibility and richer granularity. Leveraging detailed data on patent applicants, technological categories, and claims enables in-depth and nuanced analysis of corporate innovation behaviors [20]. Therefore, this study adopts the logarithm of the number of green invention patents and utility model patent applications (plus one to avoid zero values) to quantify green technological innovation levels.

Controls. To mitigate endogeneity issues arising from omitted variables, this study selects the following control variables: asset size, debt-to-asset ratio, cash-to-total assets ratio, corporate growth, and ownership concentration. The specific definitions of these variables are detailed in Table 1.

Table 1. Variable definition.

Variable type	Variable name	Variable symbol	Variable definition
Dependent Variable	corporate value	tobinQ	Tobin's Q = (Equity Market Value + Net debt market value)/Total Assets at period end
Independent Variable	ESG performance	ESG1	Huazheng's comprehensive score of ESG performance
		ESG2	Bloomberg's comprehensive score of ESG performance
Controls	Asset Size	size	The logarithm of the corporate's total assets
	Debt-to-Asset Ratio	lnlev	The logarithm of the corporate's debt-to-asset ratio
	Cash-to-Total Assets Ratio	cashflow	The corporate's cash flow ratio
	Corporate Growth	growth	The corporate's operating income growth rate
	Ownership Concentration	top5	The number of shares held by the corporate's top five shareholders
Mediator	green technological innovation	lngp	The logarithm of the number of green invention patents and utility model patent applications plus 1

5 Empirical Results

5.1 Descriptive Statistics

This study conducts descriptive statistical analysis on the collected data, as summarized in Table 2. The results reveal that Tobin's Q--the proxy for corporate value--ranges from a minimum of 0.779 to a maximum of 11.409, with a mean value of 1.366. This indicates significant disparities in corporate value and uneven development levels among the sampled firms. For ESG performance, the scores span from 1 to 7, with a mean of 4.419, suggesting room for improvement in ESG practices across energy enterprises and notable variations between individual samples.

Table 2. Results of descriptive statistics.

Variables	Obs	Mean	Std. dev	Min	Max
tobinQ	966	1.366	0.665	0.779	11.409
ESG1	966	4.419	1.128	1	7
ESG2	966	29.085	10.669	2.163	87.426
size	966	23.921	1.590	19.702	28.636
lnlev	966	-0.663	0.419	-4.784	0.414
growth	966	1.548	17.614	-0.725	324.096
cashflow	966	0.082	0.073	-0.156	0.858
top5	966	63.231	17.389	12.256	98.469
lngp	966	1.138	1.414	0	6.538

5.2 Baseline Regression

The results of the baseline regression are presented in Column (1) of Table 3. As shown, the regression coefficient of corporate ESG performance on the corporate value of energy enterprises is 0.057, which is statistically significant at the 1% level. This demonstrates that strong ESG performance exerts a significant positive impact on corporate value, thereby validating Hypothesis 1 (H1).

Table 3. Regression results.

VARIABLES	(1) tobinQ	(2) tobinQ	(3) tobinQ
ESG1	0.057***		
	(0.019)		
ESG2		0.010**	
		(0.004)	
L.ESG1			0.051***
			(0.018)
size	-0.402***	-0.411***	-0.485***
	(0.045)	(0.045)	(0.049)
lnlev	-0.269***	-0.299***	-0.163**
	(0.072)	(0.072)	(0.073)
growth	0.009***	0.009***	0.002
	(0.001)	(0.001)	(0.002)

cashflow	1.472***	1.429***	1.210***
	(0.283)	(0.284)	(0.282)
top5	-0.005**	-0.005**	-0.006***
	(0.002)	(0.002)	(0.002)
Constant	10.768***	10.901***	12.901***
	(1.087)	(1.088)	(1.178)
Observations	966	966	897
R-squared	0.586	0.585	0.572

Note: Standard errors in parentheses;*** p<0.01, ** p<0.05, * p<0.1

5.3 Robust test

This study employs two approaches to test the robustness of the baseline regression results:

Substitution of Independent Variables. The Bloomberg ESG performance data is utilized to replace the original ESG metrics. As shown in Column (2) of Table 3, the positive relationship between ESG performance and corporate value in energy enterprises remains statistically significant, confirming the robustness of the findings.

Addressing Endogeneity. To mitigate endogeneity arising from model specification and potential bias caused by lagged effects of corporate value, this study follows the methodology of Ren et al. [21] by incorporating a one-period lag of the explanatory variable (ESG performance) into the model. The results in Column (3) of Table 3 demonstrate that the lagged ESG performance continues to exhibit a statistically significant positive coefficient at the 1% level. This confirms the persistent impact of ESG performance on corporate value and further validates the robustness of the conclusions.

5.4 Mediation Analysis

The mediation effect test results are presented in Table 4. Specifically, the coefficient of ESG performance on green technological innovation is 0.65, which is statistically significant at the 5% level, indicating that ESG performance significantly promotes corporate green innovation. After incorporating the mediator variable (green technological innovation), the coefficient of ESG performance on the corporate value of energy enterprises decreases from 0.057 to 0.053, suggesting that green technological innovation partially mediates the impact. This confirms that green technological innovation serves as a critical channel through which ESG performance influences corporate value, thereby validating Hypothesis 2 (H2).

Table 4. Mechanism test results.

	(1)	(2)
VARIABLES	lngp	tobinQ
ESG1	0.065**	0.053***
	(0.032)	(0.019)

lngp		0.054***
		(0.019)
Controls	YES	YES
Constant	-6.747***	11.135***
	(1.902)	(1.091)
year FE	YES	YES
id FE	YES	YES
Observations	966	966
R-squared	0.720	0.590

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

5.5 Heterogeneity Analysis

SOEs vs. *non-SOEs.* Under China's institutional environment, state-owned enterprises (SOEs) and non-SOEs exhibit significant differences in organizational governance, social responsibility, policy pressure, and executive incentives. SOEs maintain strong political ties with the government, necessitating exemplary ESG implementation aligned with national mandates, which inherently embeds policy-driven and compulsory characteristics. In contrast, non-SOEs prioritize economic efficiency but voluntarily engage in social responsibility practices to demonstrate sustainable management capabilities, thereby generating greater societal resonance. Consequently, non-SOEs are more likely to enhance corporate value through improved social responsibility performance. This study posits that the value effect of ESG performance is more pronounced in non-SOEs. As shown in columns (1) and (2) of Table 5, the ESG coefficient for non-SOEs exceeds that of SOEs, confirming that the value-enhancing effect of ESG performance is stronger in non-SOEs, consistent with the theoretical inference.

Table 5. Heterogeneity analysis results.

	(1)	(2)	(3)	(4)
	SOEs	Non-SOEs	Renewable	Traditional
VARIABLES	tobinQ	tobinQ	tobinQ	tobinQ
ESG1	0.049**	0.126**	0.143**	0.051**
	(0.020)	(0.070)	(0.063)	(0.021)
Controls	YES	YES	YES	YES
Constant	13.433***	5.680	2.718	11.728***
	(1.237)	(3.535)	(3.788)	(1.140)
year FE	YES	YES	YES	YES
id FE	YES	YES	YES	YES
Observations	849	117	70	896
R-squared	0.562	0.748	0.787	0.588

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Renewable Energy vs. Traditional Energy. Due to divergent resource-technology endowments between traditional and renewable energy sectors, traditional energy firms rely heavily on natural resource advantages whereas renewable energy enterprises are technology-driven, leading to distinct priorities in their transformation and sustainable

development trajectories. Traditional energy firms, typically in the maturity stage of the industry lifecycle, maintain stable business models and profitability while accumulating extensive experience in addressing environmental and social challenges. Moreover, investors have already priced in ESG risks for traditional energy firms through market valuations, resulting in limited incremental impact of ESG performance on their corporate value. Conversely, renewable energy firms face elevated ESG expectations from stakeholders; failure to meet these standards triggers more pronounced valuation adjustments. This study hypothesizes stronger ESG value effects in new energy firms. As shown in columns (3) and (4) of Table 5, ESG regression coefficients remain significantly positive for both subsectors, with the coefficient for renewable energy firms substantially exceeding that of traditional counterparts, confirming heightened ESG value relevance in technology-intensive energy enterprises—consistent with theoretical expectations.

6 Conclusions and Recommendations

This study empirically examines the impact of ESG performance on corporate value in energy enterprises using panel data from Chinese A-share listed companies (2009–2022) and elucidates underlying mechanisms. Key findings are as follows:

(1) ESG performance positively enhances corporate value in energy firms. First, integrating ESG into governance frameworks compels environmental and social responsibility compliance, mitigating environmental penalties and operational risks to ensure sustainability. Second, superior ESG performance signals governance efficiency, fostering stakeholder trust to reduce financing costs, expand markets, and attract talent, thereby driving value through operational efficiency and innovation.

(2) Green technology innovation mediates the ESG-value relationship. Robust ESG performance strengthens green innovation capabilities by securing talent pipelines, stabilizing business environments, and mobilizing financial/policy support, which reinforces resource allocation to green R&D. Such innovation reduces pollution while improving energy efficiency and market share, ultimately elevating corporate value.

(3) The ESG-value nexus is more pronounced in non-SOEs and technology-intensive renewable energy firms. Non-SOEs leverage voluntary ESG initiatives to demonstrate sustainable management prowess, generating social recognition and value premiums through a "reputation-resource-value" virtuous cycle. In contrast, SOEs prioritize policy compliance due to political embeddedness and regulatory mandates. Meanwhile, renewable energy firms face heightened ESG expectations tied to green technology and governance transparency, where unmet standards incur severe valuation penalties. Conversely, traditional energy firms in mature stages exhibit stable business models with market-priced ESG risks, diluting marginal value effects of ESG performance despite accumulated environmental governance experience.

Based on the above findings, this study proposes the following recommendations:

(1) At the government level, regulatory authorities should mandate standardized ESG disclosures for energy enterprises by establishing a unified evaluation framework with explicit incentives and penalties. Periodic audits should enforce accountability.

Concurrently, governments should establish Dual Carbon Innovation Hubs in industrial clusters (e.g., Beijing-Tianjin-Hebei, Yangtze River Delta), integrating academic, corporate, and financial resources to provide SMEs with subsidized pilot-scale testing services.

(2) At the industry level, sector leaders should form Net-Zero Technology Alliances to address shared technical challenges under standardized IP-sharing protocols. A decentralized ESG data platform should be developed to aggregate mandatory industry-wide emissions, green certificate trading, and community grievance data, enabling cross-enterprise verification and anomaly alerts. Industrial parks should pilot Energy Synergy Net-works, utilizing digital systems to optimize cross-firm waste heat and material ex-changes, achieving reduction in supply chain carbon intensity.

(3) At the corporate level, on the one hand, energy companies should reduce environmental pollution, save energy and reduce emissions, promote employee welfare diversification, establish transparent decision-making mechanisms, incorporate ESG indicators into executive compensation contracts, set verifiable annual targets, and bind the conditions for the exercise of equity incentives; on the other hand, energy companies should increase their investment in and support for green technological innovation, and they can establish partnerships with scientific research institutes, colleges and universities, and other enterprises to share resources and knowledge to accelerate the development and application of green technologies.

However, the energy sector selected for the study fails to distinguish the heterogeneity of its ESG-driving mechanisms, although it covers a number of subsectors, and the high environmental sensitivity and policy dependence of energy firms make the study's conclusions likely to be inapplicable to industries with low environmental impacts.

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