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The ESG Paradox: Sustainability Scores and Carbon Costs

Ilyona Risty *
Universitas Pelita Harapan, Indonesia
Email : Ilyona.risty@uph.edu
**Penulis korespondensi : Ilyona.risty@uph.edu*

Abstract, *This study investigates the paradoxical relationship between Environmental, Social, and Governance (ESG) performance and carbon cost (CC) in the Asia–Pacific energy sector. While ESG scores are widely considered indicators of sustainable practices, their actual effectiveness in reducing carbon-related financial liabilities particularly in high-emission industries remains unclear. Using a sample of publicly listed energy companies in Asia–Pacific, the study employs panel regression analysis to assess the impact of ESG scores on projected carbon cost. ESG performance and carbon cost data were obtained from the S&P Global database. The results reveal a significant and positive association between ESG scores and carbon cost, indicating that firms with higher ESG performance tend to face greater carbon cost liabilities in the future. This suggests that, within the energy sector, high ESG ratings do not necessarily correspond to lower carbon exposure; instead, they may reflect enhanced transparency and disclosure, which makes future carbon risks more visible and quantifiable.*

Key Words: *Asia-Pacific, Carbon Cost, Energy Transition, ESG, Performance.*

1. INTRODUCTION

Amid growing global pressure on companies to prioritize sustainability, Environmental, Social, and Governance (ESG) scores have emerged as a critical benchmark for assessing non-financial performance. In the Asia–Pacific energy sector—which accounts for a substantial share of global carbon emissions—investors and regulators are increasingly demanding transparency and concrete actions to mitigate climate-related risks. Yet, a fundamental question remains: does a higher ESG score truly indicate a reduction in the "unpriced carbon cost" (UCC) that companies will bear in the future? Understanding this dynamic is essential, especially given that the energy sector in this region remains heavily dependent on fossil fuels (KPMG, 2024; Eco-Business, 2024; IEEFA, 2024). In Asia–Pacific, the energy transition has progressed slowly, with major energy and utility companies still expanding coal-based capacity despite the growing adoption of renewable energy projects. Their emissions intensity remains far above the net-zero pathway, even under mounting investor pressure and evolving energy transition policies. This creates a paradox: firms with high ESG scores may still face greater carbon cost exposure because their actual emission levels have not been effectively mitigated (Eco-Business, 2024; Energy Voice, 2024; MSCI, 2024).

While prior research has examined the relationship between ESG and climate risk (carbon risk), few studies have focused on the correlation between ESG scores and UCC as a form of unpriced carbon liability—particularly using a sample of publicly listed energy companies in the Asia–Pacific region. This study fills an important gap: determining whether "good" ESG performance could paradoxically signal greater future carbon liabilities, especially in regions

where energy transition policies and implementation remain inconsistent (PwC, 2025; ESG Post, 2024; MSCI, 2024). The phenomenon highlighted in this research is the ESG–UCC paradox—public energy companies in Asia–Pacific with higher ESG scores are also more likely to incur greater UCC in the future (positively correlated). This suggests that ESG scores may not always reflect the actual effectiveness of carbon risk mitigation; rather, they may indicate heightened awareness of such risks, which in turn can be factored into projected carbon liabilities. As such, this study not only adds to the ESG–climate risk literature but also provides critical insights for investors, regulators, and corporations in shaping more realistic and efficient energy transition strategies.

By focusing on publicly listed energy firms in Asia–Pacific, this research aims to make a significant contribution to understanding ESG as a financial risk indicator related to climate liabilities in the form of UCC. The findings offer a fresh perspective: a high ESG score does not necessarily equate to effective sustainability practices but may also reflect greater exposure to carbon pricing risks. This insight is essential for developing policies, regulations, and corporate strategies that are both holistic and effective in achieving net-zero targets and ensuring ESG initiatives translate into tangible environmental outcomes

2. THEORETICAL REVIEW

Over the past several years, carbon pricing mechanisms such as carbon taxes and emissions trading systems (ETS), have expanded across Asia–Pacific, aiming to internalize the cost of carbon emissions and incentivize decarbonization. For instance, initiatives like Singapore's carbon tax and Indonesia's emerging ETS reflect a broader shift toward embedding climate risk into corporate financials. As companies face increasing exposure to regulatory carbon costs, ESG performance particularly environmental disclosures becomes a critical channel for the market to anticipate future carbon liabilities.

The adoption of IFRS S2 (Climate-related Disclosures) across Asia–Pacific accelerates this trend by mandating standardized, decision-useful reporting of transition risks, internal carbon pricing, and scope 1–3 emissions. These disclosures enable investors to estimate potential carbon liabilities more transparently, effectively quantifying what could otherwise remain nonfinancial risk. A company with higher ESG scores often demonstrates greater clarity and comprehensiveness in such disclosures—thereby rendering its future carbon exposure more visible and measurable.

In a context where regulatory and investor scrutiny is intensifying, ESG performance may operate as a signaling mechanism. High ESG scores tend to attract more market attention and

analytic rigor, especially in carbon-intensive sectors like energy. Consequently, improved ESG transparency may paradoxically trigger higher estimates of unpriced carbon cost, as external stakeholders integrate climate-related liabilities into valuation models and debt pricing.

While much literature emphasizes ESG's role in reducing emissions, emerging empirical insights reveal mixed outcomes. For example, studies in Southeast Asia and China suggest ESG lifts financial performance and encourages environmental governance, but the impact on emissions is heterogeneous, particularly in heavy industries where energy transition lags due to structural constraints and policy gaps. Thus, in energy sectors, improved ESG may reflect better disclosure and governance rather than real emission reductions, leaving potential carbon costs unmitigated yet more accurately priced.

Combining these trends—expanding carbon pricing, standardized climate disclosures via IFRS S2, and the signaling role of ESG—creates a theoretical foundation for associating higher ESG scores with increased future carbon cost exposure. In Asia–Pacific energy firms, more detailed ESG disclosure may lead markets to price anticipated carbon liabilities more explicitly. Therefore, this study posits the following hypothesis:

H1: There is a relationship between ESG performance and carbon cost among publicly listed energy companies in Asia–Pacific.

3. RESEARCH METHOD

Research Design

This study employs a quantitative research design using a panel data regression approach to investigate the relationship between Environmental, Social, and Governance (ESG) scores and Unpriced Carbon Cost (UCC) in the energy sector across the Asia-Pacific region. The analysis is conducted using SPSS 22 software. The research is explanatory in nature, aiming to test the hypothesized association between ESG performance and future carbon cost. This approach is suitable for examining causal relationships and identifying potential paradoxes in ESG implementation within high-carbon industries.

Sample and Data Collection

The sample consists of publicly listed energy companies operating in the Asia-Pacific region, selected based on the availability of ESG performance scores 2024 and carbon cost. All data based on the company ESG scores and carbon cost are retrieved from the S&P Global database. Companies with incomplete ESG or carbon data during the observation period are excluded. The final dataset in details on table 1.

Table 1 Sample Criteria.

Criteria	Number of Companies
Public Companies in the Energy Sector in Asia Pacific	197
There is no data ESG score	56
There is no data Carbon Cost	16
Total Sampel	125

Variables Measurement

Dependent Variable: Carbon Cost (CC): CC is measured as the estimated future carbon liabilities that are not yet reflected in current financial statements. This cost estimated additional costs arising directly and indirectly in different scenario and years. Independent Variable: ESG Score: ESG performance is measured using the S&P Global ESG Score, ranging from 0 to 100, which assesses environmental, social, and governance practices based on publicly available disclosures and company-reported data. Control Variables: Return on Asset, Return On Equity, Firm size (logarithm of total assets), and leverage (total debt to total assets) that may influence carbon costs. This study uses multiple linear regression analysis with the following formula:

$$\mathbf{Y = \alpha + \beta 1X1 + \beta 2C1 + \beta 3C2 + \beta 4C3 + \beta 5C4 + \varepsilon}$$

Description:

Y = Carbon cost

α = Constant

β = Regression coefficient

X1 = ESG Score

C1 = Return on asset

C2 = Return on equity

C3 = Total asset

C4 = Leverage

ε = (Error Term)

4. ANALYSIS AND DISCUSSION

Descriptive Statistical Results

Descriptive statistics is a method for organizing and analyzing quantitative data to obtain a picture or description of the data.

The measurements used in this research description include the number of research data, minimum and maximum values, average (mean), and standard deviation of each variable. This information in table 2.

Table 2 Results of Descriptive Statistical Tests.

Variable	N	Min	Max	Mean	Stand Dev
ESG	125	10	86	35.22	16.1
ROA	125	-6.5	21.1	4.88	4.7
ROE	125	-48.5	59.28	10.30	14.5
TA	125	21568 .89	377,13 5673	19,483,04 7	49,477,72 5
DEBT	125	0.05	518.28	71.85	86.0

Source: primary data processed, 2025

The results of the descriptive statistical test show that the observations (N) in this study amounted to 125. The minimum score indicates the data's lowest value, while the table's maximum score indicates the highest value. The mean measures the average value of the data, and the standard deviation indicates the standard deviation.

Normality Test Results

The criteria used compare the level of significance obtained with the alpha level used. The data is generally distributed if sig > alpha = 0.05. A summary of the normality test results is presented in table 3

Table 3 Normality Test Results.

Standardized Residual	
N	125
Asymp. Sog. (2-tailed)	0,200

Source: primary data processed, 2025

Based on the results of data processing, it was obtained that all variables had a Kolmogorov smirnov value> 0.05, which was 0.200. So, the data obtained in this study were usually distributed.

Heteroscedasticity Test Results

Heteroscedasticity in this study was carried out using the glejser test by regressing the estimated model's absolute residual value against the independent variables. If the significance value of the variable is more significant than $\alpha = 0.05$, then the regression model used in this study does not contain heteroscedasticity. Based on table 4, heteroscedasticity Test results, the significant value of each variable is more significant than 0.05. It indicates that the regression model used in this study is free from heteroscedasticity.

Table 4 Heteroscedasticity Test Results.

Variable	t	Sig
ESG	1.373	0,173

Source: primary data processed, 2025

Based on table 4, there is no heteroscedasticity problem in this research.

Hypothesis Test Results

The hypothesis in this study uses regression analysis as shown in table 5.

Table 5 Results of Regression Analysis.

Variable	Coeff	t	Sig
Constant	6.485	23.256	.000
ESG	.017	2.677	.009
ROA	.025	.676	.501
ROE	.020	1.557	.122
TA	1.032	5.134	.000
DEBT	.001	.634	.527
Adjusted R Square		0.287	
Sig F		0.000	

Source: primary data processed, 2025

This results in table 5 refr to the following regression equation:

$$\mathbf{Y = 6.485 + 0.017X1 + 0.025C1 + 0.020C2 + 1.032C3 + 0.001C4 + C5 + \varepsilon}$$

The coefficient of determination (R^2) obtained from the regression model is 0.287, indicating that approximately 28.7% of the variation in Carbon Cost among the sampled firms can be explained by ESG score and the control variables. This suggests that the explanatory power of the model is moderate, which is consistent with empirical findings in corporate sustainability and environmental finance research, where firm-level behaviors are often influenced by a complex interplay of both observable and unobservable factors.

Discussion

ESG performance and Carbon Cost

The first hypothesis test (H1) was based on testing the effect of ESG Score on carbon cost. Because the significance probability is 0.009 and this less than 0.05, it can be concluded that the first hypothesis (H1) is accepted. Meanwhile, the β coefficient for the budget participation variable has a positive value of 0.017. This result supports H1, which shows that ESG score significantly affects carbon cost.

The results of the study show that the ESG score has a significant effect on carbon costs. Furthermore, statistically, there is a positive relationship between the ESG score and carbon costs. This indicates that within the sampled energy sector companies, strong ESG disclosure or initiatives do not necessarily translate into lower carbon related financial risks; instead, it may reflect that companies with larger operational scales and higher emissions often inherent to the energy industry are more proactive in ESG reporting while still carrying substantial carbon liabilities. Such a pattern may also imply that ESG efforts are being implemented alongside, rather than as a substitute for, carbon-intensive activities, highlighting a potential gap between sustainability commitments and tangible emission reductions.

Stakeholder theory posits that corporations exist not solely to generate returns for shareholders but also to meet the expectations and demands of multiple stakeholders, including governments, communities, investors, and non-governmental organizations (Freeman, 1984). In the context of the energy sector in Asia–Pacific, stakeholders increasingly expect firms to adopt transparent and measurable sustainability practices to address climate-related challenges. Firms with higher ESG scores are often perceived as being more responsive to these stakeholder demands. However, because the energy sector is inherently carbon-intensive, higher ESG scores may reflect enhanced disclosure rather than substantial reductions in actual emissions, leaving future carbon liabilities largely unmitigated.

Furthermore, legitimacy theory suggests that organizations seek to ensure their operations are perceived as legitimate by aligning their activities and disclosures with prevailing societal norms and values (Suchman, 1995). In carbon-intensive industries, ESG reporting can serve as a legitimacy tool to demonstrate alignment with global climate goals, thereby maintaining investor and public trust. Nevertheless, such alignment does not necessarily guarantee that the company's operational activities are significantly reducing emissions. As a result, firms may achieve legitimacy through ESG scores while still facing substantial unpriced carbon costs (UCC) due to continued reliance on fossil fuels.

Signaling theory explains how companies convey information to reduce information asymmetry between themselves and external stakeholders (Spence, 1973). A high ESG score serves as a signal to the market that the company is committed to sustainable practices. However, in the energy sector, this signal may inadvertently draw greater investor and analyst attention to the company's actual carbon exposure. As disclosure quality improves, stakeholders may become more aware of the company's long-term carbon liabilities, which can lead to higher projected UCC. Thus, ESG performance, rather than concealing risk, may amplify market perception of carbon pricing exposure.

Further analysis was conducted to identify the disclosure points of the ESG score as shown in Table 6.

Table 6 Results of Regression Analysis.

Variable	Coeff	t	Sig
Environmental	0.365	67.701	0.000
Social	0.299	45.066	0.000
Governance	0.333	53.400	0.000

Source: primary data processed, 2025

Table 6 shows the regression analysis of each component of the ESG score, and it can be seen that the most significant aspect influencing the ESG score is the Environmental aspect (36%), followed by governance (33%) and finally social (29%). This indicates that environmental aspects play a significant role in ESG scores. Furthermore, key points assessed in the environmental aspect include climate strategy, waste and pollutants, and water. This result indicates that while ESG performance is often intended to satisfy stakeholder demands (stakeholder theory) and maintain social legitimacy (legitimacy theory), it can also act as a signal that increases market awareness of future carbon liabilities (signaling theory). This integrated perspective provides a theoretical basis for the counterintuitive expectation that higher ESG scores may be associated with higher carbon costs in carbon-intensive industries such as energy.

5. CONCLUSION AND SUGGESTIONS

Conclusion

This study concludes that ESG performance, as measured by ESG scores, is positively associated with future carbon costs among publicly listed energy companies in the Asia-Pacific region. The findings challenge the common assumption that higher ESG performance inherently leads to lower carbon-related financial risks. Instead, the results suggest that energy

companies with higher ESG scores may simultaneously be larger, more emission-intensive, and therefore more exposed to carbon cost risks despite their sustainability initiatives. This highlights the complex relationship between ESG engagement and environmental liabilities in carbon-intensive sectors.

From a policy and managerial perspective, these results underscore the need for ESG frameworks to more explicitly incorporate carbon reduction metrics and tangible decarbonization strategies, rather than relying heavily on disclosure and governance indicators alone. For investors, the findings serve as a caution that strong ESG ratings in the energy sector may not directly translate into reduced exposure to carbon pricing or transition risks. Future research could benefit from expanding the model to include macroeconomic, regulatory, and technological factors, as well as exploring sectoral differences in the ESG–carbon cost relationship to better capture the nuances of sustainability performance in carbon-intensive industries.

Suggestions

This study suggests that regulators and ESG rating agencies should refine their assessment frameworks to place greater emphasis on measurable carbon reduction outcomes, rather than predominantly on disclosure quality or governance structures. In carbon-intensive sectors such as energy, integrating clear emission reduction benchmarks into ESG scoring methodologies could help ensure that higher scores reflect genuine progress toward decarbonization. Policymakers may also consider linking carbon pricing mechanisms and transition policies directly with ESG performance metrics to encourage alignment between sustainability reporting and tangible environmental impact.

For corporate managers, the findings highlight the importance of aligning ESG strategies with operational changes that directly lower carbon intensity, rather than focusing solely on improving scores through enhanced reporting or compliance activities. Energy companies, in particular, should prioritize investment in low-carbon technologies, renewable energy sources, and efficiency improvements to mitigate both environmental impact and future carbon cost exposure. Additionally, firms could strengthen stakeholder trust by providing transparent, verifiable data on emissions reductions, thereby reducing the risk of "greenwashing" perceptions and ensuring ESG initiatives deliver long-term financial and environmental value

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