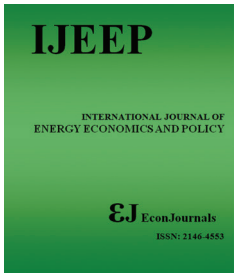

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Beyond Governance: How Foreign Ownership and Commitment Transform Indonesia's Carbon Reduction Efforts

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ABSTRACT

Indonesia is still a major contributor to global carbon and the largest contributor in Southeast Asia. However, research on carbon emissions in the Indonesian corporate context remains limited. This study aims to investigate how climate governance might help lower carbon emissions by mediating the action of climate change commitment and the moderating effect of foreign ownership in carbon-intensive sectors in Indonesia. This study investigated 183 firm-year observations of energy, industry, and transportation companies listed on the Indonesian Stock Exchange (2015-2023). Climate governance had a strong direct adverse impact on carbon emissions. Importantly, this relationship is significantly mediated by climate change commitment and moderated by foreign ownership. These findings suggest that policymakers should implement drivers that enhance climate governance among companies while simultaneously enforcing stronger climate commitments for effective carbon reduction strategies. This study is among the first to investigate the link between climate governance and carbon emissions from the prism of both mediation and moderation paths in an emerging economic environment, thus stressing how organizational commitment and ownership structure increase the effectiveness of climate governance.

Keywords: Carbon Emission, Climate Governance, Climate Change Commitment, Emerging Economy, Foreign Ownership, Indonesia
JEL Classifications: M41, Q56, Q52

1. INTRODUCTION

Climate change is one of the most critical challenges of the 21st century, and reduction of carbon emissions has emerged as an urgent global priority (An et al., 2021; Orazalin et al., 2024). Carbon-intensive industries, particularly energy, transportation, and the industrial sector, are responsible for approximately 70% of the global greenhouse gas emissions (Nurdiawati and Urban, 2021; Ouyang et al., 2020; Paltsev et al., 2021; Talaei et al., 2020; Wang et al., 2021). Indonesia, the sixth largest carbon emitter worldwide (Shafina, 2023; Wicaksono, 2023; Zuhriyah, 2024) and the largest in Southeast Asia, faces significant challenges in meeting its Paris Agreement commitment to reducing emissions by 32% through domestic efforts by 2030 (Bureau of Communication and Public Information, 2024).

This study investigates the link between climate governance and carbon emissions by combining stakeholder theory (Freeman, 1984) and sustainability theory (Elkington, 1997; WCED, 1987). While earlier studies have examined this direct relationship (Bedi and Singh, 2024; Bui et al., 2020; Kılıç and Kuzey, 2019), recent research has shown that climate governance does not consistently improve carbon performance directly, and usually requires mediating variables (Liêu et al., 2024; Ong et al., 2021; Xia et al., 2022). Particularly in developing nations such as Indonesia, research on particular mechanisms that support this relationship is still scant (Liêu et al., 2024; Ong et al., 2021; Xia et al., 2022).

Three important gaps in the literature were identified in this study. First, there is a scarcity of research examining the effectiveness of climate governance mechanisms in improving carbon performance in

Indonesia, despite its major emitter status, although research on carbon emission disclosure in Indonesia has grown substantially in recent years (Hapsari and Prasetyo, 2020; Hermawan et al., 2018; Meiryani et al., 2023; Pratiwi et al., 2021; Purwanti et al., 2022; Puspitaningtyas and Ratnawati, 2024; Ratmono et al., 2020; Salsabilla et al., 2024; Solikhah et al., 2020; Wahyuningrum et al., 2022). Second, little is known about how commitment to climate change moderates the relationship between governance and emissions. Third, few studies have examined how ownership structures, especially foreign ownership, moderate environmental performance.

Using a mediation model, we investigated how commitment to climate change introduces foreign ownership as a moderating factor and acts as an intermediary between governance and emissions. This method presents a contingency viewpoint based on past studies proving the impact of climate governance on organizational climate change commitment, (Albitar et al., 2023) and the impact of such commitment on carbon emissions (Dahlmann et al., 2019). It also extends the research by verifying the favorable environmental impact of foreign ownership (Farooq, 2021; Ghachem et al., 2022; Hadj and Ghodbane, 2021; Kim et al., 2021; Mi, 2024; Song et al., 2021).

Focusing on businesses in Indonesia's industrial, transportation, and energy sectors listed on the Indonesia Stock Exchange (IDX), this study addresses three main questions.

1. Does climate governance affect carbon emissions?
2. What is the role of climate change commitment in the relationship?
3. What is the role of foreign ownership in the relationship?

With foreign ownership strengthening this link, our study showed that climate governance has a major direct influence on carbon emissions and indirect effects via climate change commitment. This study adds to the body of knowledge by offering the first empirical data on governance-emissions mechanisms in Indonesia's carbon-intensive industries, showing how organizational commitment transforms governance into performance and exposes how ownership structure improves governance efficiency in carbon reduction.

This paper is structured as follows: Section 2 presents the Indonesian context and background; Section 3 provides a theoretical literature review; Section 4 surveys the empirical literature and develops our hypotheses; Section 5 describes the research design; Section 6 presents and discusses the empirical findings; and Section 7 concludes with a summary of the study's contributions, limitations, and implications for future research.

2. BACKGROUND

With 733.2 million tons of CO_2 projected for 2023, Indonesia ranks sixth globally, and is the largest carbon emitter in Southeast Asia (Shafina, 2023; Zuhriyah, 2024). The nation has committed to ambitious emissions reductions: 32% through domestic efforts by 2030, 41% with international support, and net-zero emissions before 2025 (Bureau of Communication and Public Information, 2024; Dutu, 2016). The Indonesian context presents unique climate governance challenges, primarily because of the economy's 85% dependence on fossil fuel (Dutu, 2016). The energy, transportation, and industrial sectors are Indonesia's main emission sources, collectively contributing over 70% of national carbon emissions (Nadya, 2023), yet these energy-intensive industries face unique decarbonization challenges requiring breakthrough (Åhman et al., 2017).

Although Indonesia has demonstrated dedication through international agreements and internal policies, implementation flaws remain. Appropriate governance structures and multi-stakeholder involvement determine the effectiveness of climate commitment, and Amelia Novita (2021) evidence points to a positive correlation between governance quality and carbon emission reduction (Radityo and Bandi, 2024).

With 53.3% of Indonesia's total investment (IDR 186.3 T), foreign direct investment (FDI), especially in the transportation, industrial, and energy sectors, greatly influences climate governance scene of the nation (Kusmayadi, 2023). Studies have shown that FDI can help promote advanced technology transfer and cleaner energy adoption (Sarkodie and Strezov, 2019; Shabir et al., 2022). However, the moderating dynamics between FDI, climate governance, and emissions reduction in Indonesia are still mostly unknown.

Our study examines these intricate interactions in Indonesia's high-emission industries from 2015 to 2023, spanning the implementation of important policy changes such as the Paris Agreement ratification in 2016, carbon tax introduction in 2021, and NDC enhancement in 2022. Inspired by sustainability and stakeholder theories, this study fills theoretical voids in mediating and moderating effects by offering evidence-based governance recommendations that balance economic development with climate change (Elkington, 1997; Freeman, 1984).

3. THEORETICAL LITERATURE REVIEW

This subsection presents the theoretical framework for investigating the interrelations among climate governance, climate change commitment, carbon emissions, and the moderating effect of foreign ownership.

3.1. Sustainability Theory

Sustainability theory from the Brundtland Report (Brundtland, 1987) defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs," later expanded to the triple bottom line integrating economic, social, and environmental considerations (Elkington, 1997; Purvis et al., 2019).

This theory offers a normative framework for carbon emission-reducing policies related to corporate environmental responsibility. With carbon emission management as the main indicator of governance effectiveness, climate governance applies sustainability ideas through policies and innovations to lower environmental impact (Bui et al., 2020; Tang and Demeritt, 2018).

The theory also explains organizational climate change commitment, a company's explicit dedication to addressing

climate issues (Dahlmann et al., 2019). This commitment reflects organizational responsibility toward sustainability and predicts the implementation of carbon reduction initiatives, with stronger commitments translating into measurable emissions reductions (Littlewood et al., 2018).

Particularly in high-emission sectors, where economic growth pressures compete with environmental concerns, sustainability theory is especially pertinent in emerging economies such as Indonesia, as these countries balance fast industrial development with environmental protection (Setiawan et al., 2021).

3.2. Stakeholder Theory

Stakeholder theory clarifies the relational dynamics that influence business environmental behavior, thus complementing the sustainability perspective. Businesses must consider the interests of many stakeholders, including governments, communities, investors, consumers, and staff in their decision-making processes (Freeman,1984). This hypothesis clarifies how voters motivate businesses to implement strict climate governance policies (Yunus et al., 2020).

Through regulatory mandates, market preferences, investment screening, and advocacy, stakeholders shape companies toward transparent climate governance models (Bui et al., 2020; Kılıç and Kuzey, 2019). This pressure is most evident in carbon-heavy sectors, in which the demand for openness among stakeholders is high.

This theory also clarifies the moderating role of foreign ownership, as foreign investors bring about international environmental standards and expectations, thus strengthening the climate governance systems of domestic businesses (Döring et al., 2020; Kim et al., 2021). International stakeholders sometimes drive the adoption of more exacting climate policies and improve carbon performance.

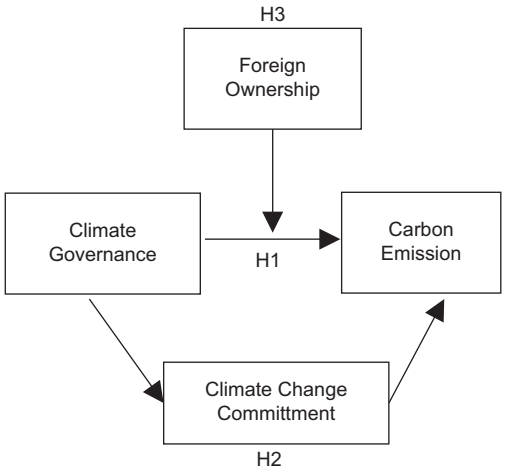
3.3. Integration of Theoretical Perspectives

Together, these ideas offer a strong structure to understand the connections in this study. While stakeholder theory addresses external pressures that influence implementation success, sustainability theory clarifies why carbon reduction requires climate governance and commitment. While stakeholder theory addresses "how" and "who," sustainability theory answers "why" and "what," so addressing many aspects of corporate environmental behavior.

This integrated framework is especially pertinent in Indonesia, because it directs our analysis of how foreign ownership (moderator) and climate change commitment (mediator) affect carbon emissions. While stakeholder theory explains why foreign ownership moderates this relationship through different environmental expectations, sustainability theory suggests that effective governance should lower emissions, mediated by companies' internalization of climate concerns.

Based on the integrated theoretical framework, Figure 1 shows our conceptual model, in which the independent variable is climate governance, the dependent variable is carbon emissions,

Figure 1: Framework of the study



the mediating variable is climate change commitment, and the moderating variable is foreign ownership. In the following sections, this research model directs our empirical inquiry and hypothesis development.

4. EMPIRICAL LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Extending the theoretical framework developed above, this section generates testable hypotheses by reviewing the empirical data on the interactions between our main variables.

4.1. Climate Governance and Carbon Emission

The mixed results of empirical research on the link between carbon emissions and climate governance point to the necessity for contingency strategies. Effective climate governance strategies, including environmental committees, carbon strategies, and environmental management systems, (Bedi and Singh, 2024; Bui et al., 2020) have appeared to improve carbon performance. These governance systems offer institutional frameworks through which sustainability ideas can be applied.

From a sustainability standpoint, these governance systems build organizational capacity to monitor, report, and lower carbon emissions by means of responsible environmental resource management and hence help to enable (Toukabri and Mohamed Youssef, 2023). Stakeholder theory also helps explain how media, investors, and government policies force businesses to implement successful carbon management plans (Yunus et al., 2020). Good climate governance design increases responsibility and openness, thereby improving carbon performance and reducing emissions (Bui et al., 2020; Velte, 2024). Based on these theoretical arguments and empirical data, we propose the following hypothesis:

H_1: Climate governance is negatively associated with carbon emissions.

4.2. Mediating Climate Change Commitment

Climate change commitment—a company's clear dedication to tackling climate issues via formal policies, targets, and actions—serves as a vital link between climate governance structures

and emissions reductions (Albitar et al., 2023; Dahlmann et al., 2019). Studies of governance systems devoid of organizational dedication have revealed an inadequate capacity for environmental performance. For example, Eleftheriadis and Anagnostopoulou (2017) businesses with strong climate governance but poor commitment attained less emission reduction than those with both strong attributes. Likewise Xhindole and Tarquinio (2024), 42% of the variance in the relationship between board-level climate governance and carbon performance across European companies was explained by climate change commitment.

From the standpoint of sustainability theory, climate change commitment reflects the environmental concerns included in strategic objectives (Minhas et al., 2024), transforming governance from symbolic to substantive action. An important mediating function of organizational commitment was shown by, Dahlmann et al. (2019) who found that firms with strong commitment were 2.8 times more likely to reach emission targets than those with low commitment were.

The stakeholder theory explains how external pressures activate commitment, as businesses react to different expectations with real commitments rather than surface-level policies (Ong et al., 2021). Evidence from Indonesian businesses indicates that companies with strong climate change commitments have reduced carbon intensity, despite having the same governance structures (Minhas et al., 2024). Drawing on this theoretical and empirical basis, we propose the following hypotheses:

H_2: Climate change commitment mediates the relationship between climate governance and carbon emissions.

4.3. Foreign Ownership as a Moderator

Through knowledge transfer, accountability pressure, and adoption of international standards, foreign ownership can drastically moderate the relationship between climate governance and carbon emissions (Döring et al., 2020; Kim et al., 2021). (Zhang et al., 2020)) found that foreign investment under environmental regulations significantly reduces carbon emissions in developed regions Even when government quality is considered, companies with significant foreign ownership show lower carbon emissions than their domestic counterparts do (Farooq, 2021; Omri and Hadj, 2020).

From the stakeholder perspective, foreign investors have higher environmental standards. Kim et al. (2021) discovered in 440 publicly traded Asian companies that a 10% increase in foreign ownership is linked to a 12% increase in climate governance effectiveness. Foreign investors providing global environmental standards and reputation management top priorities drive this effect (Ghachem et al., 2022). International stakeholders have become increasingly important in environmental decision-making in Indonesia, where foreign investment in high-emission industries has risen by 32% between 2015 and 2023 (Kusmayadi, 2023).

By bringing cutting-edge environmental practices and technologies, ustainability theory contends that foreign ownership helps balance economic and environmental imperatives (Sarkodie and Strezov, 2019; Shui et al., 2024). According to Mardini and Elleuch Lahyani (2021) foreign-owned companies, the climate governance structure shows emissions reductions that are 23% higher. In developing nations, such as Indonesia, where foreign investors offer private governance with environmental standards to balance institutional voids, this moderating effect is more notable (Shui et al., 2024). Drawing on these empirical data and theoretical arguments, we propose the following hypotheses:

H_3: Foreign ownership moderates the relationship between climate governance and carbon emissions.

5. RESEARCH DESIGN

5.1. Data and Sample Selection

From 2015 to 2023, this study examines companies listed on the Indonesia Stock Exchange (IDX) in the industrial, transportation, and energy sectors - Indonesia's top carbon emitter. Following Indonesia's acceptance of the Paris Agreement, this era marks notable policy changes including early carbon tax implementation, increased sustainability reporting standards, and renewable energy targets of 23% by 2025.

The timeframe also has methodological benefits, such as standardized emissions data availability, better environmental disclosure policies, and a sufficient longitudinal scope to capture governance effects on carbon performance.

Table 1 summarizes the sample selection process. From the 1,728 potential firm-year observations in the target sectors, we excluded observations with unavailable sustainability reports (n = 1,118) and undisclosed carbon emissions (n = 421). Six observations lacked foreign ownership data, yielding a final sample of 183 firm-year observations from 70 companies across the energy (38), transportation (10), and industrial (22) sectors.

5.2. Variable Measurement

This section explains the operationalization of our variable. Table 2 presents the references, data sources, and operational definitions used for all variables.

5.2.1. Dependent variable

The natural logarithm of the total annual CO_2 equivalent emissions (t) was used to measure the carbon emissions. Following the literature, we used logarithmic transformation to handle skewed distributions and enable percentage change interpretation (Azar et al., 2021; Bolton and Kacperczyk, 2021; Hasan et al., 2024;

Table 1: Company sample selection process for idx listed 2015-2023

Selection criteria	Firm-year observations
Initial population: Companies listed on IDX (2015-2023) in the energy, industrial, and transportation sectors	1.728
Less: Exclusion	
Companies without sustainability and annual report.	(1.118)
Companies without carbon emission data.	(421)
Companies with incomplete foreign ownership data	(6)
Final sample	183

Table 2: Operationalization of research variables

Variable	Measurements	Data source	References
Dependent Variable: Carbon Emissions	Natural logarithm of total annual CO_2 equivalent emissions (tons) including scope 1 (direct), scope 2 and scope 3 (indirect emissions)	Sustainability report	(Azar et al., 2021; Bolton and Kacperczyk, 2021; Hasan et al., 2024; Hossain et al., 2023)
Independent Variable: Climate Governance	Composite score (0-5), summing five binary indicators: (1) Environmental committee; (2) Carbon strategy; (3) Environmental management system; (4) Sustainability report; (5) Climate incentive. Each assigned 1 if present, 0 otherwise.	Sustainability report	(Bedi and Singh, 2024; Bui et al., 2020)
Mediating Variable: Climate Change Commitment	Composite score (0-4) summing four binary indicators: (i) SDG 13 on climate action support, (ii) recognition of climate change as a risk or opportunity, (iii) Scope 3 CO_2 emissions disclosure, and (iv) an emission reduction target. Each assigned 1 if present, 0 otherwise.	Sustainability report	(Albitar et al., 2023)
Moderating Variable: Foreign Investment	Percentage of shares owned by foreign investors relative to total outstanding shares.	Annual report	(Thai et al., 2023)

Hossain et al., 2023). Our assessment included Scope 1 (direct emissions), Scope 2 (indirect emissions from acquired energy), and Scope 3 (other indirect value chain emissions). The data were obtained from corporate websites, annual reports, and sustainability studies.

5.2.2. Independent variable

Based on (Bui et al., 2020) climate governance, was operationalized as a composite metric and extended with further indicators from Bedi and Singh (2024). We compiled five binary signals that capture the infrastructure of climate governance inside a company:

1. Environmental committee: Equals 1 if the company has a board-level environmental committee; otherwise, 0.
2. Climate incentives: Equals 1 if the business offers incentives for climate change management; otherwise 0.
3. Sustainability reporting: If company releases a specific sustainability report, sustainability reporting equals 1; otherwise, it equals 0.
4. Carbon strategy: Equals 1 if the board has a specific climate change strategy; otherwise, equals 0.
5. Environmental management system (EMS): 0 otherwise; equals 1 if the business has instituted an EMS.

Content analysis of corporate reports and websites helped evaluate these indicators. The composite score was computed as the sum of these indicators, and ranged from 0 (no climate governance) to 5 (comprehensible climate governance).

5.2.3. Mediating variable

Climate change commitment was measured as a composite score by (Albitar et al., 2023) aggregating four binary incikators.

1. Support for SDG 13: Equals 1 if the company explicitly references SDG 13 in sustainability reporting and 0 otherwise.
2. Climate risk recognition: Equals 1 if the company acknowledges climate change as a commercial risk/ opportunity in strategic planning and 0 otherwise.
3. Scope 3 reporting: Equals 1 if the company reports Scope 3 emissions (indicating comprehensive voluntary carbon accountability) and 0 otherwise.
4. Emission reduction targets: Equals 1 if the company has established specific emission reduction targets with timelines and 0 otherwise.

The composite score ranges from 0 to 4, with higher scores indicating stronger organizational climate commitment.

5.2.4. Moderating variable

Foreign ownership was measured as the percentage of shares held by foreign investors relative to the total outstanding shares (Thai et al., 2023). This continuous variable captures the influence of international investments on corporate decision making. Data were collected from annual reports and verified against IDX disclosures.

5.3. Research Model and Analytical Approach

5.3.1. Model specification

To examine the direct, mediating, and moderating relationships, we developed regression models based on prior climate governance and carbon emissions (Bedi and Singh, 2024; Bui et al., 2020).

First, we tested the direct relationship between climate governance and carbon emissions:

$$CE = \alpha + \beta_1 CG + \varepsilon \quad (1)$$

Second (Baron and Kenny, 1986), we examined mediation by examining CG's effect of CG on CCC and then CCC's effect on CE, while controlling for CG.

$$CCC = \alpha + \beta_1 CG + \varepsilon$$

$$CE = \alpha + \beta_1 CCC + \varepsilon \quad (2)$$

Finally, We conclude by looking at the moderating impact of foreign ownership.

$$CE = \alpha + \beta_1 CG + \beta_2 FO + \beta_3 (CG \times FO) + \varepsilon \quad (3)$$

Where CE is carbon emissions (log of CO_2 equivalent), CG is the climate governance score (which ranges from 0 to 5), CCC is the climate change commitment score (0-4), and FO is the percentage of foreign ownership.

5.3.2. Estimation procedure

Data from IDX-listed companies (2015-2023) were analyzed using SPSS 26.0. We employed multiple linear regression for direct effects (Equation 1) and ordinal regression for the

CG-CCC relationship (because CCC is ordinal), and the mediation significance was tested using the Sobel test (Sobel, 1982).

For moderation (Equation 3), we used hierarchical regression (Aiken and West, 1991), first entering the main effects (CG, FO), and then the interaction term (CG × FO). The variables were mean-centered to minimize multicollinearity.

Diagnostic tests confirmed the model validity, including normality (Kolmogorov-Smirnov), multicollinearity (VIF), and heteroscedasticity (Glejser) tests. All models satisfied the classical assumptions, indicating unbiased estimations.

6. EMPIRICAL RESULTS AND DISCUSSION

6.1. Empirical Results

6.1.1. Descriptive statistics

We collected a final sample of data from 70 IDX-listed companies in three sectors: Energy (38 companies, 54.3%), industry (22 companies, 31.4%), and transportation (10 companies, 14.3%). Table 3 presents descriptive statistics of the variables used in this study.

As presented in Table 3, the carbon emissions varied significantly across the samples, averaging 6,973,331 tons (SD = 20,996,266 tons), with a minimum of 0.33 tons. A high standard deviation relative to the mean indicates significant variation in company operations, necessitating logarithmic transformation in our regression analyses.

Companies implemented an average of 2.20 climate governance mechanisms (SD = 0.82, range: 1-4) out of the five possible elements. Climate change commitment averaged 1.89 (SD = 1.22, range: 0-4), indicating that companies typically adopt approximately two of the four commitment traits. Foreign ownership averaged 28.17% (SD = 27.34%), ranging from 0.001% to 97.70%, providing sufficient variability to test the moderating hypothesis.

Climate governance, climate change commitment, and foreign ownership variables showed relatively normal distributions, with means exceeding the standard deviations. However, carbon emissions displayed a positively skewed distribution, typical of environmental performance variables, with standard deviations exceeding the mean.

6.1.2. Results of classical assumption tests

Our models satisfied all regression assumptions: the Kolmogorov-Smirnov test confirmed normality ($P = 0.200 > 0.05$), multicollinearity tests showed tolerance values >0.10, VIF <10, and the Glejser test revealed no heteroscedasticity ($P > 0.05$).

6.1.3. Results of mediation analysis

Table 4 presents our mediation analysis, following (Baron and Kenny, 1986) the approach supplemented by the Sobel test to assess the significance of the indirect effect.

As shown in Table 4, climate governance showed a significant negative relationship with carbon emissions ($\beta = -3.277$, $P < 0.001$), supporting Hypothesis 1. Climate governance was positively related to climate change commitment ($\beta = 0.283$, $P < 0.001$), which in turn was negatively associated with carbon emissions ($\beta = -0.645$, $P = 0.007$). The Sobel test confirmed the significance of this indirect effect ($z = -2.199$, $P = 0.028$), supporting Hypothesis 2's prediction that climate change commitment mediates the governance-emissions relationship.

6.1.4. Results of moderation analysis

Table 5 presents the results of the moderated regression analysis, which tested the moderating effect of foreign ownership on the relationship between climate governance and carbon emissions.

As shown in Table 5, both climate governance ($\beta = -2.329$, $P < 0.001$) and foreign ownership ($\beta = -5.111$, $P < 0.001$) have significant negative effects on carbon emissions. The significant interaction term ($\beta = -1.626$, $P < 0.001$) supports Hypothesis 3, indicating that foreign ownership strengthens the negative relationship between climate governance and carbon emissions.

6.2. Discussion of Findings

6.2.1. Evolution of climate governance in indonesian companies (2015-2023)

Our analysis reveals a significant but uneven development of climate governance across IDX-listed companies during 2015-2023.

Table 3: Descriptive statistics of variables (*n*=183)

Variables	Definition	Minimum	Maximum	Mean	Standard deviation
CE	Carbon Emissions (tons CO_2e)	0.33	11,382,089	6,973,331	20,996,266
CG	Climate Governance Score (0-5)	1	4	2.20	0.82
CCC	Climate Change Commitment Score (0-4)	0	4	1.89	1.22
FO	Foreign Ownership (%)	0.00001	0.977	0.28	0.27

Table 4: Results of mediation analysis

Steps	Path and Relationship	Unstandardized Coefficients		Standardized Coefficients	t	Signifance
		B	Std.Error	Beta		
Step 1	CG→CE (c path)	−3.277	0.094	−0.931	−34.182	0.000
Step 2	CG→CCC (a path)	0.283	0.077	0.264	3.675	0.000
Step 3	CCC→CE (b path)	−0.645	0.235	−0.200	−2.747	0.007
Step 4	CG→CE (c' path)	−3.272	0.097	−0.943	−33.610	0.000

Table 5: Statistical test results (moderation)

Model	Unstandardized coefficients		Standardized coefficients	t	Siginifances
	B	Std. Error	Beta		
(Constants)	21.220	0.734		28.905	0.000
CG	−2.329	0.212	−0.672	−10.983	0.000
FO	−5.111	1.421	−0.144	−3.595	0.000
CG×FO	−1.626	0.404	−0.296	−4.021	0.000

Source: Output SPSS, 2025

Figure 2 shows four key dimensions evolved differently:

1. Driven by stricter rules following the Paris Agreement, EU sustainable finance requirements, and global supply chain sustainability standards, Environmental Management Systems (EMS) showed the strongest increase (from 5% in 2018 to 45% by 2023).
2. The adoption of the Carbon Strategy remained under 5% in 2015-2017 before reaching an inflection point in 2018; it then progressively rose to 22% by 2023, in line with the development of ESG criteria in business strategy and investment decisions.
3. Beginning in 2017 and reaching only 12% by 2023, Environmental Committees have displayed the most recent adoption. However, companies with these committees usually show better environmental management and more thorough sustainability disclosures.
4. Despite the 2021 carbon tax legislation signalling that economic incentives for climate action remain underdeveloped, Climate Incentives remain almost nonexistent throughout the timeframe, with only one corporation implementing such mechanisms by 2023—a key gap.

6.2.2. Evolution of corporate climate change commitment

Figure 3 exposes different patterns in four aspects of climate commitment:

1. SDG 13 adoption grew steadily from almost zero in 2018 to 45% by 2023; an inflection point in 2019-2020 reflects a growing alignment with global sustainability frameworks.
2. Climate Risk/Opportunity: A significant change in corporate knowledge is indicated by recognition showing the steepest increase and accelerating greatly after 2020 to reach 50% adoption by 2023.
3. Lagging behind other commitment indices, the emissions reduction target setting followed a modest but positive trend, rising gradually after 2018 to reach 20% adoption by 2023.
4. Third Scope Emissions Reflecting the technical complexity and optional character of scope 3 reporting, disclosure showed the slowest adoption, starting only after 2021 and rising to roughly 15% by 2023.

These trends imply a chronological sequence in which awareness of climate risks and opportunities, and more general sustainability commitment, precede useful actions and thorough disclosure. The post-2020 acceleration across all measures fits the rising global climate awareness following the COVID-19 pandemic and investors' growing attention on ESG.

Figure 2: Trends in climate governance indicators in indonesian companies (2015-2023)

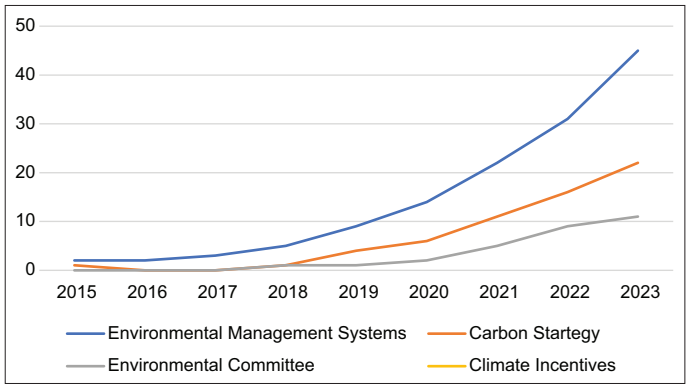
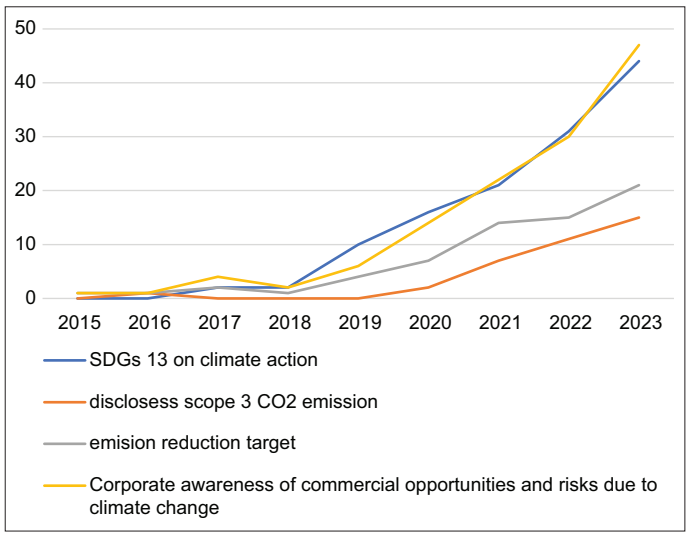


Figure 3: Trends in indonesian corporate climate change commitment indicators (2015-2023)



6.2.3. Climate governance and carbon emission

The regression results revealed a noteworthy negative relationship between climate governance and carbon emissions ($\beta = -3.227$, $P < 0.001$). Companies with climate governance systems—that is, those with carbon strategies, environmental management systems, carbon incentives, and integration of carbon oversight into board structures and processes—showed noticeably lower carbon emission levels than those with less effective governance structures. This result is in line with those of previous studies (Bedi and Singh, 2024; Bui et al., 2020).

Three mechanisms explain this relationship: (1) climate governance guarantees responsibility and oversight of emission management, (2) it directs resource allocation toward emission reduction initiatives through established channels, and (3) it improves compliance with increasingly strict regulations following OJK Regulation No. 51/POJK.03/2017 (Kılıç and Kuzey, 2019; Toukabri and Mohamed Youssef, 2023).

These results expand stakeholder theory by highlighting the particular processes by which integrated management systems (Ong et al., 2021; Yunus et al., 2020) translate environmental pressures into better performance under board control. By showing

how formal government systems include environmental factors in decision-making, especially in sectors accounting for more than 70% of Indonesia's emissions, they also support the sustainability theory. This aligns with evidence from similar energy-intensive industries where low-carbon technology promotion proves most effective for emissions reduction (An et al., 2018; Bains et al., 2017). Stronger regulatory frameworks and raised investor climate risk awareness help clearly show the effectiveness of this integration in consistent carbon performance improvements from to 2018-2023 (Toukabri and Mohamed Youssef, 2023).

6.2.4. The mediating role of climate change commitment

We show notable mediation in the governance-emissions relationship by climate change commitment. The Sobel test verified this indirect impact ($z = -2.199$, $P = 0.027$); both the routes from climate governance to commitment ($\beta = 0.283$, $P = 0.001$) and commitment to carbon emissions ($\beta = -0.645$, $P = 0.007$) were significant.

These findings reveal that, while governance structures directly reduce emissions, they also foster organizational commitment, which produces additional environmental benefits. Effective climate governance transforms into actionable commitment, resulting in significant carbon reduction, and highlighting the need for genuine corporate climate commitment beyond administrative compliance.

This mediation effect corresponds with the emphasis of sustainability theory on using organizational commitment to include environmental factors in the main economic operations. Targeting a 29% emission reduction by 2030 (Sarjiya et al., 2023; Wahyono et al., 2024). It also offers an understanding of Indonesia's implementation mechanism for its Nationally Determined Contributions Program.

From a stakeholder perspective, governance mechanisms indirectly influence emissions by reshaping organizational priorities, which then affect operational decisions. This supports stakeholder theory's proposition that various stakeholders drive the integration of environmental objectives into corporate decision making (Junianto et al., 2023; Made et al., 2024; Setiawan et al., 2021).

6.2.5. The moderating effect of foreign ownership

The moderation analysis shows that foreign ownership significantly moderates the relationship between climate governance and carbon emissions in Indonesian companies ($\beta = -1.626$, $P < 0.001$) from to 2015-2023. Consistent with the sustainability theory, this effect demonstrates how foreign investment establishes a balance between economic and environmental interests. Foreign investors typically introduce cleaner technologies and improved management practices to reduce their emissions (Sarkodie and Strezov, 2019; Udemba et al., 2019).

A negative moderation coefficient indicates that firms with greater foreign ownership demonstrate stronger links between governance mechanisms and emission outcomes. From the stakeholder perspective, our results suggest that international investors in jurisdictions with stringent environmental regulations exert substantial pressure on Indonesian companies to implement sustainability policies. Foreign ownership is associated with enhanced transparency and accountability in carbon disclosures (Putra and Lindrianasari, 2024; Udemba et al., 2019), thus strengthening the connection between governance structures and environmental performance.

7. CONCLUSION

This study examined the correlation between climate governance and carbon emissions, focusing on the mediating influence of climate change commitment and the moderating effect of foreign ownership. Using 183 firm-year observations from Indonesia's energy, transportation, and industrial sectors between 2015 and 2023, we conducted a mediation and moderation study to evaluate our conceptual framework.

Our study yielded three principal insights. Initially, climate governance directly influenced carbon emissions, corroborating the hypotheses of the prompt effects of governance instruments. Second, commitment to climate change substantially mediates this link, suggesting that governance frameworks must be assimilated through organizational dedication to facilitate emission reductions. Third, foreign ownership influences the government-emissions link, indicating that international investment can improve governance efficacy under suitable circumstances.

Longitudinal analysis has identified significant trends in Indonesian companies since 2020: a heightened adoption of environmental management systems, carbon strategies, and committees as well as an augmented commitment to climate initiatives through support for SDG 13, emission reduction objectives, and acknowledgement of climate-related business prospects. Nonetheless, climate incentives are predominantly underdeveloped, which indicates a substantial deficiency in Indonesia's sustainable governance framework.

This study conceptually enhances the comprehension of the impact of governance on carbon emissions through mediating and moderating routes while also expanding sustainability and stakeholder theories to emerging economies. Our findings indicate that the efficacy of governance is dependent upon its conversion into authentic organizational commitment and is influenced by ownership characteristics.

Our research suggests that policymakers should enhance governance frameworks and promote business climate commitment through incentives, capacity building, and awareness initiatives. The establishment of governance mechanisms is inadequate for business leaders. Integrating governance into organizational principles and behaviors is crucial to ensure compliance does not become a superficial endeavor.

These constraints encompass sector-specific emphasis, dependence on secondary data that may overlook implementation quality, and a quantitative methodology that fails to adequately account for contextual variables. Future studies should broaden sectoral

coverage, integrate primary data, utilize mixed methodologies, compare other nations, and extend temporal perspectives to capture the long-term sustainability effects.

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