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IMPACT OF DIVERSITY AND INCLUSION ON CARBON EMISSION: EVIDENCE FROM A GLOBAL SAMPLE

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ABSTRACT

We investigate whether, how, and under what conditions workforce diversity and inclusion (D&I) improve corporate carbon emission by modeling environmental innovation (EI) as a mediating mechanism and institutional ownership as a moderating force over the period from 2015 to 2023. Using data from the Global Diversity Index and Inclusion Index provided by LSEG and a sample of 21,226 firm-year observations from globally listed firms, we find that both Diversity and Inclusion are positively associated with emission-reduction performance. Mediation tests indicate that EI is strongly related to lower emissions. Moderation analyses reveal stronger D&I effects among firms with higher institutional ownership, consistent with an engaged-ownership mechanism that converts inclusive human capital into credible decarbonization initiatives. Overall, the evidence supports an integrated capabilities-and-governance account in which inclusion expands the firm's problem-solving frontier and innovation capacity, while institutional investors reinforce incentives and monitoring. The findings carry actionable implications for boards, asset owners, and regulators seeking to align D&I strategy with real-economy emission reductions.

Keywords: Diversity, Inclusion, Environmental Innovation, Carbon Emissions, Institutional Ownership, ESG, Sustainable Finance.

1. INTRODUCTION

Climate change represents one of the most acute and complex challenges facing the global community, with carbon emissions constituting the principal contributor to rising global temperatures and ecological deterioration. Within the corporate context, carbon management transcends environmental stewardship, embodying significant financial and governance concerns that directly influence firm valuation, risk exposure, and investor sentiment (Clark, 2019). In this discourse, the influence of corporate diversity and

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inclusion (D&I) has emerged as a comparatively underexamined yet potentially transformative determinant of environmental performance, particularly in relation to carbon emissions. While early literature emphasized regulatory interventions and improvements in energy efficiency (Song, Yoon, & Kang, 2020), recent scholarship increasingly highlights the strategic role of organizational governance structures and workforce heterogeneity in advancing effective environmental practices (Nuber & Velte 2021; Kyaw, Treepongkaruna, & Jiraporn, 2022).

D&I encompasses the demographic composition of the organization—across dimensions such as gender, ethnicity, and culture—and the extent to which such diversity is acknowledged, integrated, and operationalized in organizational decision-making. Diversity introduces a multiplicity of perspectives, while inclusion ensures that these varied viewpoints contribute substantively to strategic objectives. Drawing upon the resource-based view (RBV), firms possessing rare and inimitable human capital—characterized by diverse and inclusive practices—are posited to achieve sustained competitive advantage (Barney, 1991). From this theoretical perspective, D&I functions as a strategic asset that augments problem-solving capabilities, fosters innovation, and enhances organizational resilience (Richard, 2000). In the realm of environmental governance, a diverse and inclusive workforce may thus catalyze the development of robust carbon mitigation strategies, strengthen transparency in carbon disclosures, and facilitate more ambitious decarbonization initiatives.

However, empirical findings remain inconclusive. Some studies provide evidence that gender-diverse boards are associated with enhanced environmental disclosure and lower emissions intensity (Ben-Amar, Chang, & McIlkenny, 2017; García Martín and Herrero 2020, Kyaw, Treepongkaruna et al. 2022). Proponents argue that female and minority directors demonstrate heightened awareness of environmental and social risks, thereby broadening the firm's governance priorities beyond financial outcomes (Liu 2018, Haque and Jones 2020). Conversely, other scholars caution against potential drawbacks associated with diversity, including intra-group conflict, inefficiencies in decision-making, and tokenistic representation, particularly in the absence of strong inclusivity mechanisms (Talavera, Yin et al. 2018). These divergent perspectives underscore the necessity of identifying mediating and moderating pathways that elucidate the conditions under which D&I influences carbon-related outcomes.

A critical factor is institutional ownership. Institutional investors, by virtue of their financial clout and long-term investment horizon, are increasingly recognized as pivotal actors in shaping corporate sustainability agendas (Shleifer and Vishny 1986, Park, Song et al. 2019). Firms with substantial institutional ownership have been observed to exhibit stronger commitments to corporate social responsibility (CSR) and governance reform (Aggarwal, Jindal et al. 2019, Saha, Kabir et al. 2024).

Within the D&I context, institutional investors may act as catalysts, not only advocating for inclusive practices but also ensuring that such initiatives yield substantive, rather than symbolic, environmental outcomes. Hence, institutional ownership may serve as a moderating variable that intensifies the positive impact of D&I on carbon reduction.

To empirically assess these relationships, we leverage the Global Diversity Index and Inclusion Index from LSEG Workspace, which quantifies organizational diversity (e.g., board-level gender and cultural representation, women in the workforce, diversity policies) and inclusion (e.g., flexible work arrangements, accessibility services, equality metrics). Utilizing firm-level data from globally listed firms spanning 2015–2023, our analyses reveal a statistically significant positive relationship between D&I and carbon emissions reduction. Mediation analyses further confirm that environmental innovation is significantly associated with reduced emissions. Additionally, the moderating role of institutional ownership is substantiated, with D&I exhibiting stronger effects in firms with higher levels of institutional equity, consistent with a governance model characterized by active stewardship and enhanced accountability. These findings support a composite theoretical framework that combines capabilities-based and governance-based perspectives, suggesting that D&I enhances the firm's problem-solving and innovation potential, while institutional investors act as accountability mechanisms that align inclusive practices with environmental performance objectives. The study yields practical insights for corporate boards, institutional investors, and policy regulators aiming to integrate D&I into the broader architecture of sustainability strategy.

This study advances the extant literature in several dimensions. First, it represents one of the few global investigations into the intersection of D&I and carbon emissions, addressing the limitations of prior research that predominantly emphasized diversity in isolation (Gorain, Dutta, et al., 2025), neglecting the impact of Inclusion. Second, most existing studies are confined to single-country or single-industry contexts (Nuber & Velte 2021, Saadah, Setiawan, et al., 2024), thereby neglecting a holistic, cross-national perspective that incorporates the full spectrum of workforce diversity. This study by analyzing a global dataset, takes a more holistic approach towards understanding the impact of D&I on carbon emission. Third, previous research has typically focused on narrow dimensions of diversity, such as gender representation racial and cultural diversity without examining the broader implications of diverse workforce attributes (Koseoglu, Arici, Altin, & Okumus, 2024; Mehedi, Akhtaruzzaman, Boubaker, & Jasimuddin, 2024). Our study addresses this gap by analyzing the composite effects of multiple diversity dimensions on carbon emission outcomes through a global lens. Finally, we address the contextual contingencies that may condition the efficacy of D&I initiatives by examining institutional ownership as a

moderating variable. In doing so, we contribute to a more nuanced understanding of how corporate governance dynamics mediate the relationship between inclusive practices and environmental outcomes.

The remainder of this paper is structured as follows: Section 2 reviews the literature and develops hypotheses; Section 3 describes the sample, variables, and empirical model; Section 4 presents empirical results; and Section 5 concludes with key findings and policy implications.

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

2.1 Diversity and Inclusion (D&I)

Within the domains of corporate governance and sustainable finance, diversity and inclusion (D&I) are increasingly conceptualized as strategic, intangible assets that enhance organizational capacities for information processing, oversight, and complex problem-solving—ultimately influencing firm-level outcomes (Barney, 1991; Richard, 2000). The heterogeneity of boards and workforces—encompassing dimensions such as gender, cultural and ethnic background, age, tenure, and human capital—serves to strengthen both advisory and monitoring functions, mitigate groupthink, and expand the cognitive bandwidth for addressing complex issues such as climate change (Johnson, Daily, & Ellstrand, 1996).

Empirical literature consistently affirms the relevance of D&I in shaping sustainability-oriented decisions. However, studies relying on unidimensional proxies (e.g., gender representation alone) frequently yield inconsistent findings, particularly when they fail to consider inclusion practices or the contextual variables such as industry, regulation, or market dynamics. Contemporary scholarship thus advocates for a multidimensional conceptualization of D&I and a theoretical framing that elucidates the mechanisms, such as innovation through which diversity translates into organizational outcomes (Mehedi, Akhtaruzzaman, et al., 2024, Saha, Kabir, et al., 2024).

2.2 The Influence of D&I on Carbon Emissions

An expanding body of research explores the nexus between D&I, particularly gender diversity on corporate boards and environmental performance, including carbon emissions. European studies demonstrate that board gender diversity is positively associated with enhanced carbon disclosure

practices, with a more limited, though notable, connection to improved emissions performance. This line of inquiry extends beyond linear associations to explore thresholds such as critical mass and curvilinear effects, revealing that tokenistic representation may be insufficient to generate meaningful environmental impact (Nuber & Velte, 2021).

In the U.S. context, (Kyaw, Treepongkaruna, et al., 2022) finds that firms with boards achieving a critical mass of at least three female directors show statistically significant improvements in emissions reduction. Methodological rigor—through techniques such as propensity score matching, entropy balancing, and instrumental variables—bolsters the credibility of these causal claims. Evidence from the U.K., particularly in response to the 2013 regulatory mandate for carbon reporting, indicates that board diversity gains salience under tighter regulatory regimes, acting through mechanisms such as environmental innovation and capital investment (Muktadir-Al-Mukit & Bhaiyat, 2024). Cross-country analyses further support the D&I–carbon nexus, though findings often vary by firm size or sector, suggesting potential nonlinearities and contextual dependencies (Bouaddi, Basuony, et al., 2023). Therefore, we anticipate that workforce diversity and inclusion will have a positive impact on a firm's carbon emission reduction.

H1: *Diversity and Inclusion is positively associated with Carbon Emission reduction.*

2.3 The Mediating Role of Environmental Innovation

Environmental innovation (EI) which encompasses green technologies, eco-efficient products, and carbon-reducing process redesign emerges as a theoretically grounded mediator linking D&I to emissions outcomes. From the perspective of the resource-based view, cognitively diverse teams are more likely to generate diverse solution sets. Inclusive organizational climates enhance the surfacing, resourcing, and scaling of innovative ideas, enabling firms to build rare and inimitable capabilities essential for decarbonization (Barney, 1991). Empirical studies consistently highlight the role of board and workforce heterogeneity in promoting environmental innovation and resource sustainability, which in turn yields improved carbon performance (Mehedi, Akhtaruzzaman, et al., 2024). Hence, environmental innovation emerges as a promising mediating construct. Innovation is central to the corporate pursuit of decoupling economic growth from environmental degradation, achieved through the deployment of cleaner technologies, sustainable product designs, and operational reforms. The cognitive variety inherent in

diverse teams enhances the firm's capacity for creative problem-solving, thereby increasing the likelihood of novel, high-impact environmental innovations (Albitar, Borgi et al., 2023).Consequently, environmental innovation is a plausible conduit through which D&I translates into improved carbon performance.

The impact of environmental policy such as emissions trading systems and carbon taxation—further enhances the salience of EI as a transmission mechanism between D&I and environmental outcomes (Nuber & Velte, 2021). Certain studies explicitly delineate the pathways such as regulatory stringency, green investments, and innovation capacity through which D&I influences emissions, with post-regulation periods often exhibiting stronger effects (Muktadir-Al-Mukit & Bhaiyat, 2024). For example, (Demiralay, Kilincarslan, et al., 2025) investigates LGBTQ+ inclusion across 898 U.S. firms and demonstrates that stronger inclusion practices correlate with higher environmental performance and increased renewable energy adoption. The study identifies EI as a partial mediator, suggesting that inclusivity in the workplace cultivates a fertile ground for innovation-driven environmental outcomes. Accordingly, we propose the following hypothesis:

H2: *Environmental Innovation is strongly related to lower Carbon Emissions.*

2.4 The Moderating Role of Institutional Ownership

Institutional investors, given their substantial ownership stakes, long-term investment horizons, and superior monitoring capacities, play a pivotal role in shaping corporate governance and sustainability strategy. The literature frequently reports a positive association between institutional ownership and enhanced commitments to corporate social responsibility and governance reforms (Saha, Kabir, et al., 2024). In high-emission industries, institutional actors can catalyze the transformation of D&I policies from symbolic statements into concrete initiatives such as environmental innovation, internal carbon pricing, and emissions reduction targets. Thus, institutional ownership is theorized to amplify the link between D&I and carbon performance.

Studies in related governance domains suggest that gender and diversity effects are more pronounced in regulatory contexts with strong external pressures, where institutional investors

act as enforcers of stakeholder expectations (Nuber & Velte 2021, Muktadir-Al-Mukit & Bhaiyat, 2024). Despite its relevance, the moderating role of institutional ownership in the D&I–carbon emissions relationship has rarely been empirically tested, particularly in conjunction with environmental innovation as a mediator. Adjacent research examining firm performance indicates that D&I effects are indeed contingent on ownership structure, with differing impacts observed between domestic and foreign institutions (Saha, Kabir, et al., 2024). Analyzing this dynamic within an emissions context necessitates moderated mediation models that address endogeneity concerns (e.g., through instrumental variable approaches) and account for variation in stewardship types (active vs. passive, domestic vs. foreign). Accordingly, we propose the following hypothesis:

H3: *The impact of diversity and inclusion on Carbon Emission reduction becomes more pronounced as the level of institutional ownership increases in firm's ownership structure.*

3. METHODOLOGY

3.1 Data and Sample

We construct our empirical sample utilizing data from LSEG Workspace (formerly Refinitiv Eikon), a globally recognized financial and ESG database extensively employed in academic research. Our initial dataset comprises 28744 firm-year observations across 49 countries, each reporting values for the Diversity Index score and Inclusion Index score. To enhance data reliability and ensure cross-country comparability, we exclude countries with fewer than 50 firm-year observations over the sample period. Subsequently, we merge this dataset with firm-level carbon emission reduction scores, financial indicators, and additional ESG control variables. After removing firm-year observations with missing data, the final sample for the composite D&I Index analysis consists of 21,226 firm-year observations spanning 48 countries. Consistent with standard practices in the finance literature, all continuous variables are winsorized at the 1st and 99th percentiles to mitigate the influence of extreme outliers.

3.2 Dependent Variable: Emission Reduction score

The emission reduction score, obtained from Refinitiv/LSEG Workspace, captures the percentile rank of a firm's commitment and effectiveness in reducing environmental emissions across its production and operational processes. The score is benchmarked relative to the firm's industry

peers and is scaled from 0 to 100, with higher values indicating stronger performance in managing and mitigating emissions.

3.3 Independent Variables

This study uses firm-level scores from LSEG Workspace's Global Diversity Index and Inclusion Index as key independent variables. The diversity component includes indicators like gender and cultural diversity at the board level, female representation across roles, and diversity-related policies. The inclusion component covers factors such as flexible work arrangements, support for disabilities, and equality indices. All scores are based on publicly disclosed data, normalized by industry, and range from 0 to 100, with higher values indicating stronger Diversity & Inclusion performance.

3.4 Control Variables

Consistent with prior literature, we use several control variables to investigate the impact of diversity and inclusion on carbon emission reduction. These variables capture key firm characteristics that may influence carbon emission reduction outcomes, including size, financial structure, growth prospects, and risk exposure. Firm size (Size) is measured as the natural logarithm of total assets, while leverage (Lev) is defined as the ratio of total debt to total assets. Firm age (Age) is calculated as the number of years since incorporation. Cash holdings (Cash) are measured as cash and cash equivalents scaled by total assets, and property, plant, and equipment (PPENT) is expressed as a proportion of total assets. The market-based risk is captured by price volatility (Price Volatility), calculated as the standard deviation of daily stock returns over the previous year. We also use return on assets, board size and board independence among the control variables.

3.5 Mediator Variable

This study considers environmental innovation as a mediating variable in the relationship between diversity and inclusion and carbon emission reduction performance. Environmental Innovation which encompasses green technologies, eco-efficient products, and carbon-reducing process redesign emerges as a theoretically grounded mediator linking D&I to emissions outcomes. By including this variable, the analysis assesses whether the impact of D&I on carbon emission reduction performance differs depending on the extent of environmental innovation.

3.6 Moderator variable

This study considers institutional ownership as a moderating variable in the relationship between diversity and inclusion and carbon emission reduction performance. Institutional ownership is measured as the percentage of a firm's outstanding shares held by institutional investors, following prior research that links higher institutional ownership to improved corporate governance, enhanced monitoring, and stronger engagement in sustainability practices environmental innovation (García-Sánchez & García-Sánchez, 2020). Data on institutional ownership are sourced from the FactSet database. By including this variable, the analysis assesses whether the impact of D&I on carbon emission reduction performance differs depending on the extent of institutional investor involvement.

3.5 Empirical Model

To examine the influence of diversity and inclusion on carbon emission reduction, following empirical model is developed:

$$\begin{aligned} Emission\ Reduction_{,\,t+1} = {} & \alpha_0 + \beta_1 Diversity_{i,\,t} + \beta_2 Inclusion_{i,\,t} + \beta_3 Size_{i,\,t} + \beta_4 Lev_{i,\,t} + \\ & \beta_5 ROA_{i,\,t} + \beta_6 Age_{i,\,t} + \beta_7 Cash_{i,\,t} + \beta_8 PPENT_{i,\,t} + \beta_9 Price\ Volatility + \beta_{10} Board\ Size + \\ & \beta_{11} Board\ Independence + Industry + Year + Country + \boldsymbol{\varepsilon_{i,\,t}} \end{aligned}$$

where *i* and *t* denote industry and year, accordingly. The dependent variable *emission reduction* indicates the carbon emission reduction score of firm *i* at year *t+1*, as measured by LSEG workspace. The independent variables are *Diversity* score & *Inclusion* score. Control variables include the total assets (*Size*), leverage (*Lev*), Return on Assets (ROA), firm age (*Age*), cashflow (*Cash*), property, plant, and equipment net (*PPENT*), price volatility (*Price Volatility*), board size (*Board Size*) and board independence (*Board Independence*). The detailed descriptions of all variables have been provided in the Appendix. We incorporate all the control variables in all regression analyses, while also controlling for the year, industry, and country fixed effects

4. EMPIRICAL ANALYSIS

4.1 Descriptive statistics

Table 1 summarises the variables used in the empirical analyses. The dependent variable, Emission Reduction score, has 21,226 firm-year observations with a mean of 38.37 (SD = 33.36; range 0–99.85), indicating substantial cross-sectional variation in decarbonisation outcomes across the sample. The key explanatory variables also exhibit wide dispersion: Diversity score averages 23.18 (SD = 14.37; range 0–84) and Inclusion score averages 14.95 (SD = 20.85; range 0–100). Environmental Innovation—our proposed mediator—averages 23.08 (SD = 30.23; range 0–99.85). Among controls, firms are sizeable (Size mean = 16.19, SD = 2.85), moderately leveraged (mean = 0.21), and display considerable performance variability (ROA mean = 3.83, SD = 13.27). Board independence averages 60.14% and board size (logged) averages 2.19. These characteristics suggest adequate dispersion to identify relationships of interest.

Table 1: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Emission Reduction score	21226	38.37	33.36	0.00	99.85
Diversity score	21226	23.18	14.37	0.00	84.00
Inclusion score	21226	14.95	20.85	0.00	100.00
Size	21226	16.19	2.85	7.11	26.72
Leverage	21226	0.21	0.18	0.00	0.80
PPENT	21226	0.32	0.27	0.00	0.96
Age	21226	3.26	0.79	0.00	5.32
ROA	21226	3.83	13.27	-83.02	35.35
Price Volatility	21226	27.97	10.32	11.55	63.05
Cash	21226	0.17	0.18	0.00	0.94
Board Size	21226	2.19	0.32	0.00	3.40
Board Independence	21226	60.14	24.87	0.00	100.00
Environmental Innovation	21195	23.08	30.23	0.00	99.85

Note: This table presents the summary statistics of Emission Reduction, Diversity score, Inclusion score and other control variables used in this study. All variables are defined in Appendix A1 and winsorized at the 1% and 99% levels.

4.2 Correlation Analysis

Table 2 reports Pearson correlations. Emission Reduction is positively associated with both Diversity (r = 0.51) and Inclusion (r = 0.48), suggesting a prima facie link between D&I and carbon outcomes. Emission Reduction also correlates positively with firm Size (r = 0.44), and negatively with Price Volatility (r = −0.32), a proxy for risk/uncertainty. Diversity and Inclusion are themselves moderately correlated (r = 0.43), indicating related but non-redundant constructs. Importantly, the majority of correlations are well below conventional multicollinearity thresholds, alleviating immediate concerns about unstable coefficient estimates in multivariate models.

Table 2: Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) Emission Reduction score	1.00												
(2) Diversity score	0.51*	1.00											
(3) Inclusion score	0.48*	0.43*	1.00										
(4) Size	0.44*	0.08*	0.33*	1.00									
(5) Leverage	0.05*	0.06*	0.00	0.02*	1.00								
(6) PPENT	0.13*	0.01	-0.02*	0.08*	0.26*	1.00							
(7) Age	0.24*	0.14*	0.21*	0.25*	-0.10*	-0.04*	1.00						
(8) ROA	0.16*	0.10*	0.10*	0.22*	-0.04*	0.03*	0.11*	1.00					
(9) Price Volatility	-0.32*	-0.24*	-0.24*	-0.31*	-0.10*	-0.10*	-0.23*	-0.41*	1.00				

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(10) Cash	-0.21*	-0.15*	-0.10*	-0.20*	-0.31*	-0.40*	-0.11*	-0.29*	0.37*	1.00			
(11) Board Size	0.36*	0.16*	0.26*	0.39*	0.09*	0.00	0.22*	0.11*	-0.28*	-0.14*	1.00		
(12) Board Independence	0.11*	0.10*	-0.03*	-0.41*	0.19*	-0.01	-0.13*	-0.08*	0.00	-0.01	-0.14*	1.00	
(13) Environmental Innovation	0.48*	0.28*	0.31*	0.32*	0.03*	0.01	0.24*	0.10*	-0.25*	-0.15*	0.25*	-0.07*	1.00

*Notes: This table reports the pairwise correlation matrix for carbon emission reduction, Diversity score, Inclusion score and other control variables used in this study. All variables are defined in Appendix A. * Indicates statistical significance of coefficient. *** p<0.01, ** p<0.05, * p<0.1*

4.3 Baseline regression results

Table 3 presents fixed-effects regressions (firm, year, and country effects included), with t-statistics in parentheses. Diversity score is positively associated with Emission Reduction (β = 0.271, t = 22.505) and remains robust with an extended control set (β = 0.256, t = 18.286). Inclusion score shows a similar pattern (β = 0.191, t = 23.159; with controls β = 0.174, t = 18.612). These estimates indicate that a one-unit increase in Diversity (Inclusion) is linked to an increase of roughly 0.27 (0.19) points in the Emission Reduction score. Control variables behave largely as expected: Size is positively related to Emission Reduction ($\beta \approx 4.0$), while Price Volatility is negatively related ($\beta \approx -0.18$). Leverage and capital intensity (PPENT) are small and statistically insignificant. Model fit is high ($R^2 \approx 0.93$), consistent with saturated fixed effects capturing persistent heterogeneity. The baseline results provide strong evidence that more diverse and inclusive firms achieve better carbon-reduction outcomes, even after controlling for fundamentals and unobserved firm, time and country effects. Our results are consistent with (Demiralay, Kilincarslan, et al., 2025) whose findings show that LGBTQ+-inclusive workplace practices enhance environmental outcomes by fostering innovation. Consistent with our results, (Gorain, Dutta, et al., 2025) show that financial inclusion promotes carbon mitigation by facilitating investments in circular economy initiatives, supporting climate risk insurance

schemes, fostering behavioral shifts through financial literacy programs, and enabling the growth of green innovations.

Table 3: Baseline Regression results

	(1)	(2)	(3)	(4)
			Emission Reduction score	
Diversity score	0.271***	0.256***		
	(22.505)	(18.286)		
Inclusion score			0.191***	0.174***
			(23.159)	(18.612)
Size		4.045***		3.965***
		(10.556)		(10.348)
Leverage		-1.278		-1.581
		(-0.996)		(-1.234)
PPENT		-0.422		-0.813
		(-0.232)		(-0.448)
Age		9.221***		9.548***
		(6.520)		(6.753)
ROA		-0.028**		-0.026**
		(-2.280)		(-2.108)
Price Volatility		-0.190***		-0.176***
		(-4.811)		(-4.454)
Cash		3.426**		3.395**
		(2.257)		(2.237)
Board Size		0.452		0.788
		(0.611)		(1.066)
Board Independence		-0.007		-0.005
		(-0.487)		(-0.335)
Constant	29.797***	-58.272***	33.253***	-55.780***
	(105.565)	(-7.579)	(248.802)	(-7.259)

	(1)	(2)	(3)	(4)
			Emission Reduction score	
Observations	28065	20585	28065	20585
R-squared	0.930	0.930	0.930	0.930
Firm effects	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes
Country effects	Yes	Yes	Yes	Yes

*Note: This table provides our main OLS regression result as to the impact of the diversity & inclusion on carbon emission reduction. The dependent variable is emission reduction score. Superscripts ***, **, * denote statistical significance at 1%, 5%, and 10% level respectively. T-values are in parentheses *** p<.01, ** p<.05, * p<.1*

4.4 Mediation analysis: Environmental innovation as mechanism

Table 4 evaluates Environmental Innovation (Envino) as a mediator. First, Diversity predicts Envino ($\beta = 0.114$, $t = 8.233$), and Envino itself is strongly associated with Emission Reduction ($\beta = 0.181$, $t = 22.168$). When Envino enters the Emission model, the coefficient on Diversity falls from 0.271 (Table 3) to 0.236 ($t = 17.038$), indicating partial mediation. An analogous pattern holds for Inclusion: Inclusion predicts Envino ($\beta = 0.088$, $t = 9.527$), Envino predicts Emission Reduction ($\beta = 0.179$, $t = 21.964$), and the Inclusion coefficient declines from 0.191 to 0.159 ($t = 17.174$) once Envino is included—again consistent with partial mediation. The evidence supports the contention that D&I facilitate environmental innovation—via broader idea generation and inclusive resource allocation—and that these innovations translate into superior decarbonisation performance. The persistence of statistically significant direct effects suggests that additional, non-innovation channels (e.g., risk governance, stakeholder engagement) may also link D&I to carbon outcomes.

Table 4: Mediating effect: Environmental Innovation

	(1)	(2)	(3)	(4)
	Environmental Innovation	Emission Reduction score	Environmental Innovation	Emission Reduction score
Diversity score	0.114***	0.236***		
	(8.233)	(17.038)		
Environmental Innovation		0.181***		0.179***
		(22.168)		(21.964)
Inclusion score			0.088***	0.159***
			(9.527)	(17.174)
Size	2.018***	3.702***	1.971***	3.640***
	(5.318)	(9.802)	(5.199)	(9.636)
Leverage	-1.247	-1.069	-1.370	-1.331
	(-0.983)	(-0.847)	(-1.080)	(-1.055)
PPENT	-2.868	0.273	-3.078*	-0.115
	(-1.596)	(0.153)	(-1.715)	(-0.064)
Age	3.291**	8.648***	3.450**	8.929***
	(2.351)	(6.212)	(2.467)	(6.414)
ROA	-0.028**	-0.024**	-0.027**	-0.022*
	(-2.270)	(-1.978)	(-2.178)	(-1.833)
Price Volatility	-0.087**	-0.178***	-0.080**	-0.165***
	(-2.238)	(-4.589)	(-2.045)	(-4.244)
Cash	0.119	3.458**	0.093	3.466**
	(0.079)	(2.313)	(0.062)	(2.319)
Board Size	0.227	0.487	0.385	0.791
	(0.310)	(0.669)	(0.527)	(1.088)
Independent Board Members	-0.002	-0.007	-0.001	-0.005
	(-0.131)	(-0.510)	(-0.108)	(-0.388)
Constant	-19.506**	-55.274***	-18.436**	-53.022***
	(-2.562)	(-7.299)	(-2.424)	(-7.005)

	(1)	(2)	(3)	(4)
	Environmental Innovation	Emission Reduction score	Environmental Innovation	Emission Reduction score
Observations	20553	20553	20553	20553
R-squared	0.916	0.932	0.917	0.932
Firm effects	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes
Country effects	Yes	Yes	Yes	Yes

*Notes: This table reports estimates from regression results for analyzing the mediating impact of environmental innovation on the relationship between Diversity & Inclusion and carbon emission reduction. Definitions of all variables are provided in Appendix. Superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.*

4.5 Moderation analysis: Institutional ownership as amplifier on the relationship between D&I and Carbon Emission

Table 5 splits the sample into low- versus high-institutional-ownership groups. The D&I effects are markedly stronger in the high-institutional-ownership subsample: the Diversity coefficient increases from 0.201 (t = 11.116) to 0.384 (t = 14.953), while the Inclusion coefficient rises from 0.153 (t = 12.360) to 0.212 (t = 12.732). Size remains positively associated with Emission Reduction in both groups; Price Volatility remains negative. These results align with a monitoring/engagement view in which institutional investors press management to convert inclusive human-capital practices into credible, measurable environmental performance.

Table 5: Moderating effect: Institutional ownership

	(1)	(2)	(3)	(4)
	Low Inst	High Inst	Low Inst	High Inst
	Emission Reduction Score			
Diversity score	0.201***	0.384***		
	(11.116)	(14.953)		
Inclusion score			0.153***	0.212***
			(12.360)	(12.732)
Size	3.983***	4.163***	3.783***	4.071***

	(1)	(2)	(3)	(4)
	Low Inst	High Inst	Low Inst	High Inst
	Emission Reduction Score			
	(7.473)	(5.946)	(7.105)	(5.779)
Leverage	-1.765	-1.031	-1.829	-1.247
	(-1.010)	(-0.458)	(-1.048)	(-0.551)
PPENT	-1.150	-0.112	-1.637	-1.149
	(-0.464)	(-0.035)	(-0.661)	(-0.357)
Age	8.905***	6.927**	9.318***	7.123***
	(4.903)	(2.565)	(5.138)	(2.622)
ROA	-0.028	-0.033	-0.026	-0.031
	(-1.643)	(-1.529)	(-1.572)	(-1.419)
Price Volatility	-0.166***	-0.248***	-0.156***	-0.244***
	(-3.061)	(-3.428)	(-2.881)	(-3.356)
Cash	3.801*	5.310**	3.853*	4.987*
	(1.841)	(1.964)	(1.869)	(1.833)
Board Size	0.896	0.880	1.437	0.690
	(0.886)	(0.700)	(1.423)	(0.545)
Board Independence	0.019	-0.022	0.020	-0.029
	(1.053)	(-0.915)	(1.161)	(-1.195)
Constant	-54.314***	-59.144***	-51.233***	-52.228***
	(-5.238)	(-4.085)	(-4.952)	(-3.589)
Observations	11958	7141	11958	7141
R-squared	0.935	0.935	0.935	0.934
Firm effects	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes
Country effects	Yes	Yes	Yes	Yes

Notes: This table reports estimates from regression results for analyzing the moderating impact of institutional ownership on the relationship between Diversity & Inclusion and carbon emission reduction. High institutional ownership and low institutional ownership indicate the above- and below-median value of institutional ownership level. Columns 2, 4 and 6 show results for firms with high institutional ownership and columns 1, 3 and 5 show results for firms with less- than-median levels of institutional ownership. The dependent variable is carbon emission

*reduction. T-statistics are in parentheses. Definitions of all variables are provided in Appendix. Superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.*

5. CONCLUSION

This study rigorously investigated the extent, mechanisms, and contextual conditions under which diversity and inclusion (D&I) influence corporate carbon performance. Employing a comprehensive multi-country panel dataset enriched with saturated fixed effects, the analysis yields three key empirical insights. First, both diversity and inclusion exhibit robust and economically significant associations with enhanced carbon emission reduction. Second, environmental innovation (EI) emerges as a mediating mechanism: D&I positively influences EI, which in turn correlates with improved emissions outcomes. Third, the positive effect of D&I on carbon performance is markedly amplified in firms characterized by higher institutional ownership, suggesting that active institutional investors play a pivotal role in transforming inclusive human capital into verifiable decarbonization initiatives.

These findings substantiate an integrated capabilities-and-governance paradigm. Under this framework, D&I is conceptualized as a strategic enabler that expands a firm's cognitive capacity for problem-solving and innovation, while institutional investors function as governance agents who incentivize and monitor environmental performance. From a practical standpoint, corporate managers should regard D&I as a critical component of climate strategy; investors are encouraged to embed D&I-driven innovation within stewardship practices; and regulatory bodies should advance transparency frameworks that distinguish between diversity and inclusion metrics and connect environmental innovation to emissions disclosures.

APPENDIX

Variable	Definition	Author's Calculation
Dependent Variable		
Emission Reduction score	Emission Reduction score captures the percentile rank of a firm's commitment and effectiveness in reducing environmental emissions across its production and operational processes	LSEG Workspace
Independent Variable		
Diversity score	The Diversity Score is a metric that evaluates a company's performance in promoting cultural, gender, and policy-based diversity within its board, management, and overall workforce.	LSEG Workspace
Inclusion score	The Inclusion Score evaluates a company's commitment to workplace equality, flexibility, support services, and programs for employees with disabilities or special needs.	LSEG Workspace
Control Variable		
Size	The natural logarithm of the book value of a firm's asset	LSEG Workspace
PPENT	The ratio of firm's property, plant, and equipment to the book value of asset	LSEG Workspace
Price Volatility	The rolling standard deviation of stock return for the year *t* plus the previous two years	LSEG Workspace
Institutional Ownership	% of shares held by institutions	Fact set
Board Size	Number of Board members	LSEG Workspace
Board Independence	Number of independent directors/ Number of board members	LSEG Workspace

Variable	Definition	Author's Calculation
ROA	The ratio of a firm's net profit to total assets	LSEG Workspace
Cash	The ratio of a firm's cashflow to operations to the book value of its assets	LSEG Workspace
Leverage	The ratio of a firm's total debt to the book value of its assets	LSEG Workspace
Age	One plus the listing age of a firm as measured by the number of years from its IPO as reported in CRSP	LSEG Workspace

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