Aligning Pay with the Planet: A Study of Executive Compensation, Sustainability Incentives, and Greenhouse Gas Outcomes

Emmanuel A. Morrison[1], Douglas A. Adu[1], Yongsheng Guo[1], Danson Kimani[2]

[1]Teesside International Business School
Teesside University
Tees Valley, UK
TS1 3BX

[2]University of York,
York, UK
and University of Essex,
Colchester, UK,
YO10 5DD

[1] Corresponding Author, Emmanuel A. Morrison, Department of Finance, Performance and Marketing, Teesside International Business School, Teesside University, Tees Valley, UK, TS1 3BX.
Email: e.morrison@tees.ac.uk

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Abstract

This study focuses on the role of corporate governance structures (CGS) in improving greenhouse gas performance (GHGP). We utilise an international dataset comprising of 41,370 firm-year observations from over 50 countries over a 20-year period (2002-2022). The findings unveil that executive compensation (EC) is associated with increased process-based greenhouse reduction procedures (GHGRP) but has no similar effect on total GHG emissions reduction. Our results provide novel evidence on the improvement in GHGP when sustainability-based incentive such as the sustainable compensation adoption indicator (SCAI) is integrated with GHGRP. In additional analyses, we find GHGRP on its own does not improve GHGP. Our results endorse the perspective of symbolic legitimation, suggesting that firms tend to employ GHGRP to cultivate favourable perceptions among stakeholders and safeguard their legitimacy. A theoretical contribution is made toward understanding how firms might operate more efficiently through corporate sustainability strategies. The paper delineates the potential for firms to play a more active role in the transition towards a low-carbon economy and help combat climate change.

Keywords

Executive compensation; Corporate governance strategy; CSR; Greenhouse gas

1. Introduction

Global climate change remains a key source of alarm for firms, governments, as well as other stakeholders as a result of increasing greenhouse gas (GHG) emissions (Albitar et al., 2023; Kolk, 2016). This phenomenon has resulted in increased pressure by governments and shareholders that multinational corporations (firms) should demonstrate accountability and responsibility to stakeholders by engaging in, as well as reporting on corporate practices concerning climate change mitigation and minimising GHG emissions (Backman, 2017; Pisani et al., 2017). In this regard, firms can play a more active role in the transition towards a low-carbon economy. As a result, global efforts have been made by firms and governments to combat climate change and global warming by implementing a variety of guidelines, initiatives and practices (Gaganis et al., 2021). For instance, the Net-Zero Coalition involves over 70 countries and over 3000 firms dedicated to attaining net-zero emissions by 2050 in several ways, including renewable energy innovation, and mobilising finance for climate change (UN, 2023). In addition, at the recent COP28 held in Dubai, global leaders pledged to accelerate efforts towards net zero emissions and transition away from fossil fuels in energy systems through utilisation of zero and low carbon fuels.

We focus our research on the role of firms in improving GHG performance (GHGP) and the transition to a low-carbon economy because these large companies make substantial contribution to the global GHG emissions (Haque & Ntim, 2020). The privileged position held by the large firms means that they have the capacity to improve not only their own GHGP, but could potentially influence the operation of their suppliers, partners and distributors (Adu et al., 2022a). This makes GHG reduction procedures (GHGRP) of firms of paramount interest when exploring how to transition to low carbon economy. firms have a symbiotic association with their suppliers, distributors, partners and subsidiaries. In particular, firms depend on their suppliers for raw materials and other resources, and distributors to get their products to the consumers, and similarly, suppliers, distributors subsidiaries rely on the firms for financial support and direction to become long-term partners (Alexander et al., 2023). In this context, firms can potentially act as climate change initiatives champions or promotors in the corporate environment. Nonetheless, for firms to achieve this goal, they need to have a paradigm shift from the traditional business model to a low GHG emission setting.

Although climate change research has been expanding steadily, there is little focus on process oriented GHG outcomes (GHGRP), which are designed to enhance minimising total GHG (GHGP) (Orazalin et al., 2023). Prior studies have predominantly concentrated on evaluating the impact of GHGP on financial performance (FP), yielding varying results (e.g., Adu et al., 2022a; Delmas et al., 2015; Homroy, 2023; Lewandowski, 2017). For instance, Lewandowski (2017) reports a curvilinear relationship between GHG performance and financial performance (FP), suggesting that companies with higher levels of emission reduction have a positive relationship between carbon performance and FP, and vice versa.

We examine the impact of executive compensation (EC) on both symbolic GHGRP and substantive GHGP. Moreover, we investigate whether corporate governance structures (CGS) mechanisms including a sustainability compensation adoption indicator (SCAI) moderate these relationships, as consequence, improve the link between EC and GHGP. Our unique dataset consists of 1970 firms in 67 discrete industries in 50 countries, covering the period 2002 to 2022. Previous studies have emphasised the significance of CGS in developing climate change initiatives that add value to shareholders (Aguilera et al., 2021; Hussain, 2018). Effective CGS measures for example, can promote accountability for sustainable business operations (SBOs) through fostering involvement with corporate social responsibility (CSR) practices, thereby providing a robust diligent response to the potential negative social and environmental impact of firms (Orazalin and Baydauletov, 2020).

We contribute to the literature in several ways. First, this study extends previous literature on GHG emissions (Orazalin et al., 2023), by exploring whether EC and SCAI can serve as credible channels for firms to reduce GHG emissions. Our results noticeably uncover the motivation of executives to invest in self-reported GHG emission activities as we observe that individually, both EC and SCAI have positive impact on GHGRP. In contrast, the evidence reveals that EC and SCAI have no effect on GHGP.

Second, notwithstanding emerging interest in climate change studies (Abbass et al., 2022), relatively a few studies have explored the link between GHGP and GHGRP. As a result, this study is one of the first to investigate the impact of GHGRP on GHGP, while taking into account the moderating function of SCAI in this relationship. Specifically, our findings demonstrate that, firms that have both SCAI and BSCI in the corporation engage in less GHGRP activities. This evidence suggests that the tendency for firms to rely on superior GHGRP activities instead of improving GHGP (i.e., improved oversight role of the board on GHG emission activities). More importantly, we reveal that the interaction variable between GHGRP and SCAI has a significant but delayed positive influence on GHGP. The results from these analyses clearly show that the moderating impact of these variables should be explored when investigating the interaction between firms' CGS and GHGP. Overall, the findings corroborate the symbolic legitimation and stakeholder theories, as firms that engage in more GHGRP continue to produce significant amounts of pollution unless there is pressure from stakeholders.

Further, this study also engages in several in-sampling comparative measures, climate reforms and policies. In addressing the gap left by previous studies' insufficient data for Scope 3 emissions, this study incorporates Scope 3 emissions to explore the link between variables on the total GHGP of firms. The results reveal that when a portion of EC is linked to sustainability, executives tend to engage in certain initiatives that could include engaging with suppliers to decrease emissions thus highlighting the advantages of supply chain decarbonisation at the community level. The relationships are also tested for the Paris, Kyoto, pre-reform eras. The findings reveal that with each progressing climate agreement, firms have adopted robust SCAI to help in improving GHGP, thus emphasising the necessity of worldwide initiatives in enhancing awareness amid stakeholders and institutions about the detrimental effects of poor GHGP.

Further, the findings suggest that countries with carbon tax policies engage in CGS such as SCAI that improves GHGP (i.e., low GHG emissions).

The remaining sections of this paper are organised as follows: the second section presents the theoretical background and hypotheses development of the study. The research methodology is then presented in the third section. The fourth section presents the results leading to the discussion and conclusion in last section.

2. Theoretical background and hypotheses development

Previous studies (Nigam et al., 2018; Phung et al., 2022), have delved into various facets of EC, SCAI, GHGRP and GHGP. These studies have employed a range of theoretical approaches, particularly drawing from economic, regulatory, and socio-theoretical backgrounds. This current study adopts a comprehensive, multi-theoretical framework that specifically leverages both legitimacy and stakeholder theories to analyse and understand the interrelationships among EC, SCAI, GHGRP and GHGP.

Legitimacy Theory, with its intricate connections to both traditional economic theories (like agency and resource dependence) and social theories (such as stakeholder and legitimacy), serves as a multifaceted framework for understanding corporate behaviours (Haque and Ntim, 2020; Suchman, 1995). This theory can be dissected into two primary perspectives: economic efficiency and social legitimacy. From the economic efficiency viewpoint, companies engage in SBOs that are cost-effective and actively reduce GHGRP, thereby yielding tangible environmental benefits (Mazouz and Zhao, 2019). In contrast, the social legitimacy perspective posits that firms symbolically align with institutional expectations to gain and maintain organisational legitimacy (Suchman, 1995). High legitimacy levels afford firms better access to economic resources, talent recruitment and retention, stakeholder relationship enhancement, and superior market competition (Oliver, 1991; Pfeffer & Salancik, 1978).

In seeking societal acceptability, firms often resort to symbolic legitimation strategies. These strategies primarily involve impression management tactics where firms create superficial impressions to address stakeholders' sustainability concerns rather than effectuating significant environmental or social improvements (Ashforth and Gibbs, 1990). Enhanced sustainability disclosures, for instance, are utilized to bolster corporate legitimacy and reputation, though they may not correlate with actual GHGP performance (Adu et al., 2022b; Haque and Ntim, 2020). Conversely, firms aiming for economic efficiency engage in substantive practices to make informed decisions that bolster their economic efficiency (Dahlmann et al., 2019; Haque and Ntim, 2020). In the context of this study, this involves taking cost-effective measures to mitigate climate change through the implementation of GHGRP, potentially leading to actual improvements in GHGP. However, the implementation of extensive GHGRP can be resource-intensive and time-consuming. Consequently, firms may favour symbolic GHGRP and promote CGS such as SCAI to cultivate positive perceptions (greenwashing) among stakeholders (Berrone and Gomez-Mejia, 2009). Nevertheless, previous studies (Adu et al., 2022; Haque and Ntim, 2020) have reported that such measures often fall short in enhancing actual GHGP (Aguilera et al., 2007).

Firms with effective CGS may develop strong relationships with stakeholders by implementing environmentally friendly practices and promoting environmental initiatives (Michelon and Parbonetti, 2012). The stakeholder theory postulates that a firm's engagement in environmental initiatives enhances the relationships with all its stakeholders (Freeman, 1984). Previous studies indicate that high commitment to sustainability can be beneficial to stakeholders such as employees and consumers. For employees, high commitment to sustainability can minimise staff turnover, thus affirming the idea that employees prefer firms with greater commitment to sustainability and vice versa (Backhaus et al., 2002; Berrone and Gomez-Mejia, 2009). Similarly, consumers respond favourably to firm's high commitment to sustainability by actively seeking out for environmentally friendly products/services and willingness to pay higher prices for these (Berrone & Gomez-Mejia, 2009; Du et al., 2007). As a result, the stakeholder theory encourages the adoption of CGS mechanisms such as SCAI, and the application of sustainability-related practices (GHGRP) in order to enhance corporate image and strengthen relationship with stakeholders.

The multi-theoretical framework of legitimacy and stakeholder theories indicate that firms can respond to varying stakeholder requirements and environmental regulations by implementing GHGRP and or engaging in CGS measures such as establishing SCAI. The adoption of these measures may: (i) substantively reduce emissions through increased efficiency and lower operating costs (Bui et al., 2021; Dahlmann et al., 2019) and/or (ii) symbolically enhance the firm's image and maintain legitimacy (Burke et al., 2019; Haque and Ntim, 2020; Walls et al., 2012). Finally, drawing on the literature discussion presented above, **Fig. 1** depicts the graphical representation of the research framework for the present study.

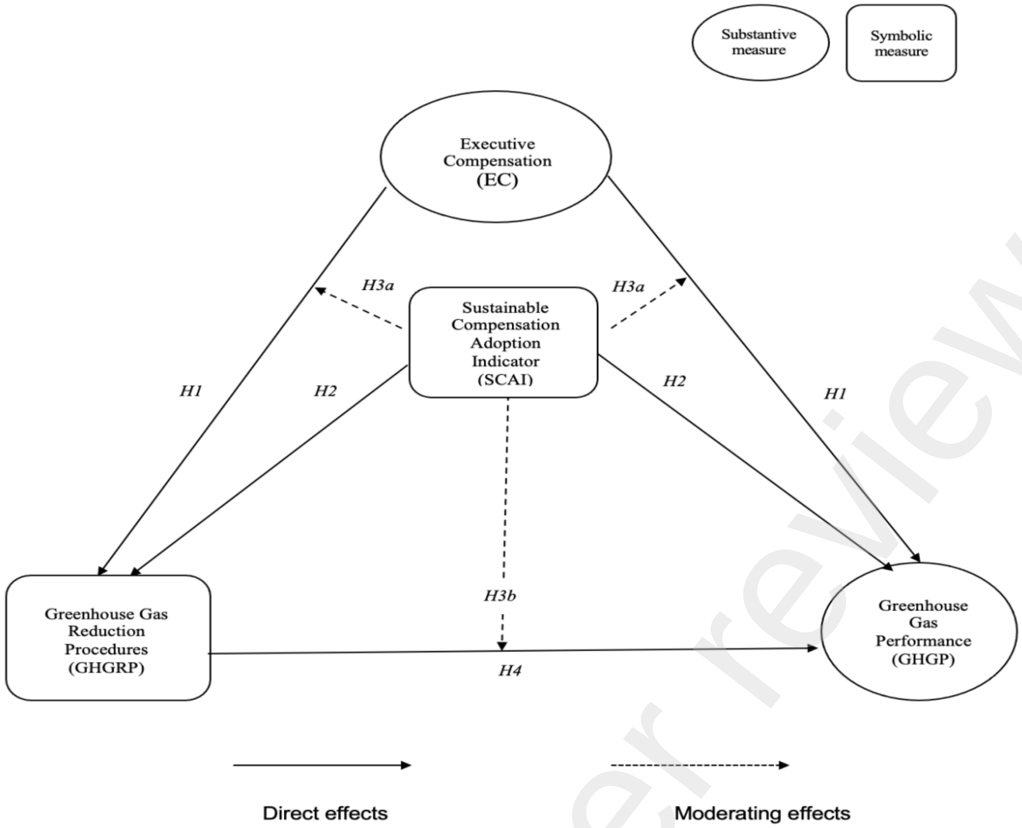

Fig. 1. Research Model

2.1. The effect executive compensation on greenhouse gas performance and greenhouse gas reduction procedures

Executives play a major part in firms actively engaging in SBOs and GHGRP (Garca-Sánchez and Martnez-Ferrero, 2019; Shahab et al., 2020). The efficiency perspective of the legitimacy recommends that firms should construct EC in such a way that it can motivate them to engage in SBOs, particularly GHGRP (Campbell et al., 2007). Investment in GHGRP might potentially lead to economic benefits (efficiency) for firms in areas such as energy conservation (Mahoney and Thorn, 2006) and water conservation. Evidence from prior studies (eg., Tauringana and Chithambo, 2015) suggests that incentive based CGS systems can be utilised to improve corporate carbon performance in a variety of ways.

Prior empirical studies have mainly established a positive relationship between EC and carbon performance (Haque, 2017; Haque and Ntim 2020; Maas, 2018). Haque and Ntim (2020) found that EC is positively associated with GHG performance of firms in 13 industrialised European countries. The forgoing evidence suggests that EC is a major determinant of a firm's carbon-related strategies and actions, notwithstanding the verity that the formation of EC and its effect on GHG performance are more likely to be influenced by shareholders' and executives' economic interests.

Therefore, the legitimation/symbolic approach argues that high EC is likely to encourage climate-related practices that will enhance corporate legitimacy, mitigate climate risks, and increase the wealth of powerful economic players. As previously demonstrated, GHGRP improve corporate legitimacy and economic benefits for shareholders and executives. Consistent with the legitimation/symbolic and empirical studies (eg., Adu et al., 2022b; Haque and Ntim, 2020), the study then anticipates that EC will have a stronger positive effect on process-oriented GHGO than actual GHGO. Accordingly, the first hypothesis is:

H1: The level of EC is positively correlated with GHGO, and this association is more pronounced for GHGRP than GHGP.

2.2. The effect of sustainable compensation adoption indicator on greenhouse gas performance and greenhouse gas reduction procedures

SCAI, as a mechanism aligning executive compensation with sustainability goals, is expected to drive actions that result in lower GHG emissions and more robust GHGRP, in response to these stakeholder expectations. This proposition is grounded in stakeholder theory, which posits that firms are motivated to meet the expectations of stakeholders who increasingly prioritize environmental sustainability (Freeman, 1984). Similarly, the legitimacy theory suggests that firms adopt SCAI as a means to gain societal legitimacy by demonstrating their commitment to environmental stewardship (Suchman, 1995). Also, the symbolic legitimation view asserts that SCAI that is not tied to actual GHG emission reduction targets may increase the performance of process-oriented carbon but might not lead to better actual carbon performance. By adopting a sustainable compensation mechanism, firms signal their dedication to reducing their environmental impact, thereby enhancing their legitimacy in the eyes of the public and stakeholders. Previous literature (Cohen et al., 2023; Haque and Ntim, 2020) indicate that integrating sustainability metrics into executive compensation agreements correlates with enhanced sustainability outcomes. SCAI can motivate executives to commit more substantially to SBOs, thereby boosting the company's legitimacy and potentially leading to better GHGO. Empirically, Cordeiro and Sarkis (2008) report that SCAI might often be deployed as a mere symbolic gesture aimed at bolstering corporate image, rather than as an effective tool for achieving efficiency and tangible performance enhancements. This viewpoint suggests that while SCAI tied to sustainability goals may improve process-oriented sustainability measures, they do not always result in tangible improvements in key performance indicators like GHG emissions. Accordingly, we hypothesise the following:

H2: SCAI is positively correlated with GHGO, and this association is more pronounced for GHGRP than GHGP.

2.3. The moderating effect of sustainable compensation adoption indicator

Critics of SCAI argue that EC on its own is ineffective in aligning company executives' interests with those of shareholders, thus necessitating the development of SCAI (e.g., Adu et al., 2022b). The adoption of SCAI has the potential to influence firms executives to participate in GHGRP and carbon reduction activities, thus enhancing firms legitimacy (Haque and Ntim 2020). Prior empirical studies have established that SCAI have a moderating impact on the EC-GHGP nexus (Cohen et al., 2023; Haque and Ntim, 2020). For example, Cohen et al. (2023) suggest that the inclusion of ESG indicators is correlated with improvements in key ESG outcomes in US firms. Therefore, board compensation committees could be in a better position to appraise a firm's carbon risks in order to develop a more efficient EC scheme by incorporating SCAI, thus improving GHGO (Bose et al., 2023). Nonetheless, other scholars (eg., Haque and Ntim, 2020) argue that corporate boards could utilise EC contracts as a symbolic (legitimacy) image management tool to appeal to stakeholders rather than a substantive (efficiency) strategy. Therefore, the combination of prior research and the symbolic legitimation support the view that any symbolic SCAI that is not linked to actual GHGP reduction targets may improve only process based GHGO but may not always improve actual GHGO. According to the legitimacy theory, the adoption of SCAI signifies a firm's alignment with contemporary social and environmental sustainability norms, thereby enhancing its perceived legitimacy, particularly in GHGRP (Suchman, 1995). The integration of SCAI into GHGRP can lead to more robust sustainability strategies, thereby positively influencing GHGP. Additionally, by implementing SBOs, organizations can transition from merely symbolic practices to realizing genuine CCE achievements (Berrone and Gomez-Mejia, 2009). Recent research has shed light on the effects of sustainability-based incentives on different dimensions of corporate performance (Adu et al., 2022; Derchi, 2021; Ritz, 2022; Radu and Smaili, 2022). Specifically, Derchi et al. (2021) discovered that linking the pay of executive officers to Corporate Social Responsibility (CSR) targets led to beneficial outcomes in the third year, underscoring a delayed yet significant effect on CSR performance. However, the combined impact of these SCAI and GHGRP on enhancing overall GHGP has not been thoroughly explored. The interplay between SCAI and GHGRP implies that aligning incentives with strategic environmental goals can foster more effective execution of these initiatives. This congruence ensures that the incentives are not merely symbolic but actively contribute to achieving concrete sustainability objectives, such as enhancing GHGP. Therefore, we propose the following hypotheses:

H3a*:* In firms with SCAI, the link between EC and GHGRP is stronger than the link between EC and GHGP.

H3b: In firms with SCAI, the link between GHGRP and GHGP is stronger.

2.3 The effect of greenhouse gas reduction procedures on greenhouse gas performance

As established from the legitimation perspective, firms might partake in SBOs to attain strategic objectives such as bolstering legitimacy, securing stakeholder support, and providing access to vital resources (Suchman, 1995). Therefore, firms might pursue legitimacy for their business activities in this regard by establishing symbolic and/or substantive GHGRP. Engaging in substantive measures that involve GHGRP that aim to execute GHG mitigation initiatives that could lead to substantial changes in GHG utilisation and hence lower actual carbon emissions is the best indication of a company's dedication to reducing carbon emissions. However, firms seem to formulate and implement symbolic carbon initiatives such as the GHGRP with the aim of acquiring legitimacy and support from certain stakeholders rather than achieving substantial reductions in GHGP (Siddique et al., 2021). However, firms may also avoid engaging in substantive GHGRP such as supply chain decarbonisation, modifications in manufacturing techniques and retrofitting buildings considering they are expensive, laborious, time-consuming, not immediately noticeable by the market (Berrone et al., 2017). For instance, McKinsey (2021) highlights that supply chain decarbonisation can be very complex as it is highly dependent on the collaborative effort between suppliers, consumers and other stakeholders.

Previous empirical studies have found no relation between carbon reduction initiatives and reduction in actual carbon emissions (Damert and Baumgartner, 2017; Haque and Ntim, 2020). For instance, Haque and Ntim (2020) contend that companies could symbolically engage in GHGRP to increase legitimacy while making no substantial attempts to reduce actual GHG emissions. This stance is congruent with arguments on greenwashing, that firms under pressure from stakeholders may use symbolic GHGRP to preserve legitimacy and regulate stakeholders' perceptions of environmental concerns (Bansal and Kistruck, 2006). Nonetheless, recognising that firms pursuing legitimacy could use symbolic and/or substantive carbon emission reduction measures, the following non-directional hypothesis is proposed in this study:

***H4**:* GHGRP has an impact on GHGP.

3. Research methodology

This study utilizes a comprehensive methodology encompassing both univariate and multivariate data analyses. This section delineates the systematic application of these analytical techniques, encompassing the definition of variables, the process of sample selection, the construction of research models, and the execution of panel regression analysis. Additionally, we conduct further analysis and various robustness checks to ensure the reliability and validity of our findings.

3.1 Description of variables

3.1.1 Dependent variables

As illustrated in the conceptual framework (Figure 1), in addition to the EC, SCAI and BSCI variables, this study utilises a symbolic measure of GHG (eg., GHGRP) and a measure for GHG emissions (eg., GHGP). Based on previous studies (e.g., Haque and Ntim, 2020; Orazalin et al., 2023), the GHGRP index is developed to measure the GHGRP.[1] GHGRP is an index adjusted for sector specifics and weighted based on 41 unique GHG reduction initiatives at the firm level, where higher GHGRP values indicate increased advocacy for climate-related issues. The list of

[1] Greenhouse gas reduction procedures (GHGRP) refer to executive-driven efforts encompassing actions, planning, frameworks, transparency measures, and strategic policies aimed at mitigating the profound repercussions of climate change.

41 provisions for the index is attached in Supporting Information. Alternatively, consistent with similar studies (Moussa et al., 2020; Orazalin et al., 2023), this study utilises the natural logarithm of the GHGP, encompassing both Scope 1 and Scope 2 emissions in tonnes as the substantive measure for carbon performance.[2]

3.1.2 Independent variables

For EC, consistent with similar studies (Adu et al., 2022b; Haque and Ntim, 2020), this study employs the natural logarithm of total fixed and variable compensation in USD, paid to all senior executives, as disclosed by the firms as a substantive measure of EC and the SCAI as a symbolic measure. Additionally, the SCAI is measured by a binary variable is used, set to 1 if the firm incorporates sustainability-based incentives, and 0 in the absence of such incentives.

3.1.3 Control variables

A variety of control variables are used in this investigation to consider the possible influence of distinct country- and firm-specific characteristics on the GHGO. Following related studies (eg., Orazalin et al., 2023) this study utilises a range of CG characteristics including board independence, board size, and the duality of CEO-Chairman roles. Furthermore, consistent with previous studies (Adu et al., 2022b; Siddique et al., 2021), the study employs various control variables at the firm level, including factors like company size, leverage, profitability, and capital intensity. Ultimately, the study employs country-level governance and macroeconomic indicators such as inflation and GDP growth rates, as in previous studies (Marin and Vona, 2021; Orazalin et al., 2023). All variables are fully detailed in Table 1.

[2] Scope 1 encompasses emissions directly originating from sources owned or managed by the company, while Scope 2 consists of indirect emissions stemming from the use of purchased electricity, cooling, heat, steam, and similar sources. Higher positive greenhouse gas performance (GHGP) values signify elevated levels of greenhouse gas emissions, indicating weaker GHG performance and vice versa.

Table 1

Descriptions of variables

Variable	Symbols	Measurement	Source
Dependent variables			
Greenhouse gas reduction procedures	GHGRP	The index represents a sector-adjusted weighted average, derived from 40 specific firm-level elements pertinent to climate change initiatives and practices. Its scale extends from 0 (indicating an absence of climate GHGRP) to 40 (signifying fully implemented GHGRP).	Refinitiv Workspace
Greenhouse gas performance	GHGP	The natural logarithm of total GHG emissions, encompassing both Scope 1 (direct emissions from sources that are owned or controlled by the company) and Scope 2 consists of indirect emissions stemming from the use of purchased electricity, cooling, heat, steam, and similar sources in tonnes. Higher positive total Greenhouse Gas values signify elevated levels of greenhouse gas emissions, indicating weaker greenhouse gas performance and vice versa.	Refinitiv Workspace
Independent variables			
Executive compensation	EC	The natural logarithm of the aggregate fixed and variable compensation disbursed to all senior executives, reported in USD. The fixed component encompasses the base salary and additional non-monetary benefits, including housing, healthcare, and transportation. The variable component encompasses bonuses and other long-term incentive schemes, such as equity ownership and extended share options.	Refinitiv Workspace

Sustainable Compensation Adoption Indicator	SCAI	A binary variable is used, set to 1 if the firm incorporates sustainability-based incentives, and 0 in the absence of such incentives.	Refinitiv Workspace
Corporate governance control variables			
Number of board meetings	NMEET	The natural logarithm of the number of board meetings during the year.	Refinitiv Workspace
Board size	BSIZE	The natural logarithm of the total number of board directors at the end of the fiscal year.	Refinitiv Workspace
Board independence	BIND	The proportion of board members who are independent.	Refinitiv Workspace
Board gender diversity	BGEND	The proportion of female board members	Refinitiv Workspace
CEO Chairman duality	CEOCD	A binary variable is applied, where it is assigned a value of 1 when the CEO and the board chair are distinct individuals, and 0 in cases where they are the same person.	Refinitiv Workspace
Firm-level control variables			
Firm size	FSIZE	The natural logarithm of total assets.	Refinitiv Workspace
Profitability	PROF	The ratio of net income to total asset value.	Refinitiv Workspace
Leverage	LEVE	The ratio of total debt divided to the aggregate value of total assets.	Refinitiv Workspace
Slack	SLACK	The ratio of cash and cash equivalents divided to the aggregate value of total assets.	Refinitiv Workspace
Capital intensity	CAPIN	The ratio of property, plant and equipment to the aggregate value of total assets.	Refinitiv Workspace
Country-level control variables			
GDP growth	GDP	The total production value, encompassing the gross value added by local producers, inclusive of product taxes, while deducting subsidies not included in the product values.	World Bank

Inflation rates	INF	The yearly percentage change in the prices of goods and services, which can either remain constant or fluctuate within the year.	World Bank
WGI	WGI	A composite index constructed to represent country governance quality. Computed based on CG factors including regulatory quality, rule of law, government effectiveness and political stability. This metric ranges between 0 (poor governance quality) and 1 (highest possible level of governance excellence).	Worldwide Governance Indicators

3.2 Sample

The initial sample for this study was comprised of firms from around the globe, spanning from 2002 to 2022. The selection of the sample was contingent on the availability of relevant data from the Refinitiv Workspace database, covering 63 industrialized countries. This was later refined to exclude financial firms due to their unique regulatory, accounting, and governance characteristics (Luo and Tang, 2021; Orazalin et al., 2023). The focus shifted to non-financial firms with consistent data over at least five consecutive years. Essential data, including GHGP, GHRP, SCAI, EC, CG and firm-specific metrics, were sourced from the Refinitiv Workspace database. Country governance indicators were gathered using the Worldwide Governance Indicators by Kaufmann et al. (2011), and macroeconomic factors like GDP growth rates and inflation were obtained from The World Bank database (World Bank, 2020). The final sample comprises 1,970 firms across 67 distinct industries, totalling 41,370 company-year observations. Table 2 details the sample selection process and sample distribution by countries.

Table 2

Sample selection process and sample distribution by countries

Panel A. Sample selection

Steps	Process	Sample by Countries	Sample by Firms
1	Obtain a list of non-financial firms with data in the Refinitiv Eikon database	63	43120
2	Access a list of firms that with data on GHGE for at least 5 years	53	2903
3	Narrow down the list of firms that with data on GGMP for at least 5 years	53	2367
4	Narrow down the list of firms that with data on executive compensation for at least 5 years	51	2268
5	Narrow down the list of firms that with data on SCAI for at least 5 years	51	1970

Panel B. Sample distribution by country

Country	Firms	Observations	Percentage (%)	Cumulative (%)
Australia	101	2121	5.13	5.13
Austria	6	126	0.30	5.43
Belgium	18	378	0.91	6.35
Brazil	48	1008	2.44	8.78
Canada	111	2331	5.63	14.42
Chile	18	378	0.91	15.33
China	38	798	1.93	17.26
Colombia	5	105	0.25	17.51
Czech Republic	2	42	0.10	17.61
Denmark	19	399	0.96	18.58
Finland	24	504	1.22	19.8
France	79	1659	4.01	23.81
Germany	73	1533	3.71	27.51
Greece	6	126	0.30	27.82
Hong Kong	139	2919	7.06	34.87
Hungary	2	42	0.10	34.97
India	48	1008	2.44	37.41

Indonesia	16	336	0.81	38.22
Ireland	8	168	0.41	38.63
Israel	5	105	0.25	38.88
Italy	34	714	1.73	40.61
Japan	293	6153	14.87	55.48
Kazakhstan	1	21	0.05	55.53
Kenya	1	21	0.05	55.58
Republic of South Korea	61	1281	3.10	58.68
Kuwait	3	63	0.15	58.83
Luxembourg	1	21	0.05	58.88
Malaysia	34	714	1.73	60.61
Mexico	34	714	1.73	62.34
Morocco	1	21	0.05	62.39
Netherlands	24	504	1.22	63.6
New Zealand	18	378	0.91	64.52
Norway	57	1197	2.89	67.41
Philippines	10	210	0.51	67.92
Poland	26	546	1.32	69.24
Portugal	10	210	0.51	69.75
Russia	19	399	0.96	70.71
Saudi Arabia	3	63	0.15	70.86
Singapore	21	441	1.07	71.93
South Africa	71	1491	3.60	75.53
Spain	32	672	1.62	77.16
Sri Lanka	1	21	0.05	77.21
Sweden	47	987	2.39	79.59
Switzerland	37	777	1.88	81.47
Taiwan	89	1869	4.52	85.99
Thailand	22	462	1.12	87.11
Turkey	13	273	0.66	87.77
United Arab Emirates	2	42	0.10	87.87
United Kingdom	211	4431	10.71	98.58
United States of America	28	588	1.42	100

Total	1970	41370	100	

3.3 Empirical methodology

This study employs panel data regression analysis as the optimal method due to its suitability in capturing the dynamic relationship between independent and dependent variables over time, as well as its adeptness in handling data structured in a longitudinal panel-time (firm-year) format. This analytical technique is particularly advantageous in mitigating the potential for multicollinearity and circumventing any estimation biases that might otherwise compromise the integrity of the research outcomes. Post-estimation tests, including the F-test, Breusch & Pagan Lagrange Multiplier (LM) test, and Hausman's test, guide the selection of our regression analysis method. The F-test and Hausman's test results suggest a preference for fixed-effects (FE) panel regression over ordinary regression and random-effects (RE) panel regression, respectively (not reported due to brevity, but available upon request). Consequently, FE panel regression is determined to be the most suitable method for our research models and hypotheses testing. The FE panel regression also helps to mitigate the risk of omitted variable bias. This methodology is also adopted in similar studies (Elbardan et al., 2023; Orazalin et al., 2023).

3.3.1 Baseline models

The following equations are employed to examine the effects of CG mechanisms such as EC and SCAI on both GHGO measures. Additionally, we examine the moderating role of SCAI on the various relationships. As expressed in Equation 1, the CG mechanisms are regressed on GHGP.

$$\mathrm{GHGP}_{it} = \alpha_0 + \beta_1 * \mathrm{EC}_{it} + \beta_2 * \mathrm{SCAI}_{it} + \beta_3 * (\mathrm{EC}_{it} * \mathrm{SCAI}_{it}) + \beta_4 * \mathrm{BMEET}_{it} + \beta_5 * \mathrm{BSIZE}_{it} + \beta_6 * \mathrm{BIND}_{it} + \beta_7 * \mathrm{BGEN}_{it} + \beta_8 * \mathrm{CEOCD}_{it} + \beta_9 * \mathrm{FSIZE}_{it} + \beta_{10} * \mathrm{PROF}_{it} + \beta_{11} * \mathrm{LEVE}_{it} + \beta_{12} * \mathrm{SLACK}_{it} + \beta_{13} * \mathrm{CAPIN}_{it} + \beta_{14} * \mathrm{GDP}_{kt} + \beta_{15} * \mathrm{INF}_{kt} + \beta_{16} * \mathrm{WGI}_{kt} + \gamma_i + \mu_t + \varepsilon_{it} \quad (1)$$

Similar to the preceding equation, the CG mechanisms are regressed on GHGRP. Thus, Equation 2 is expressed as:

$$\mathrm{GHGRP}_{it} = \alpha_0 + \beta_1 * \mathrm{EC}_{it} + \beta_2 * \mathrm{SCAI}_{it} + \beta_3 * (\mathrm{EC}_{it} * \mathrm{SCAI}_{it}) + \beta_4 * \mathrm{BMEET}_{it} + \beta_5 * \mathrm{BSIZE}_{it} + \beta_6 * \mathrm{BIND}_{it} + \beta_7 * \mathrm{BGEN}_{it} + \beta_8 * \mathrm{CEOCD}_{it} + \beta_9 * \mathrm{FSIZE}_{it} + \beta_{10} * \mathrm{PROF}_{it} + \beta_{11} * \mathrm{LEVE}_{it} + \beta_{12} * \mathrm{SLACK}_{it} + \beta_{13} * \mathrm{CAPIN}_{it} + \beta_{14} * \mathrm{GDP}_{kt} + \beta_{15} * \mathrm{INF}_{kt} + \beta_{16} * \mathrm{WGI}_{kt} + \gamma_i + \mu_t + \varepsilon_{it} \quad (2)$$

After assessing the effects of the CG mechanisms on GHGP on GHGRP, we assess whether linking SCAI to GHGRP aids in improving GHGRP. Therefore, Equation 3 is expressed as:

$$\mathrm{GHGP}_{it} = \alpha_0 + \beta_1 * \mathrm{GHGRP}_{i[t|t-1]} + \beta_2 * \mathrm{SCAI}_{i[t|t-1]} + \beta_3 * (\mathrm{GHGRP}_{i[t|t-1]} * \mathrm{SCAI}_{i[t|t-1]}) + \beta_4 * \mathrm{BMEET}_{i[t|t-1]} + \beta_5 * \mathrm{BSIZE}_{i[t|t-1]} + \beta_6 * \mathrm{BIND}_{i[t|t-1]} + \beta_7 * \mathrm{BGEN}_{i[t|t-1]} + \beta_8 * \mathrm{CEOCD}_{i[t|t-1]} + \beta_9 * \mathrm{FSIZE}_{i[t|t-1]} + \beta_{10} * \mathrm{PROF}_{i[t|t-1]} + \beta_{11} * \mathrm{LEVE}_{i[t|t-1]} + \beta_{12} * \mathrm{SLACK}_{i[t|t-1]} + \beta_{13} * \mathrm{CAPIN}_{i[t|t-1]} + \beta_{14} * \mathrm{GDP}_{k[t|t-1]} + \beta_{15} * \mathrm{INF}_{k[t|t-1]} + \beta_{16} * \mathrm{WGI}_{k[t|t-1]} + \gamma_i + \mu_t + \varepsilon_{it} \quad (3)$$

In the above Equations, β represents the estimate of each independent variable on the dependent variable. γ_i and μ_t represent the industry fixed effects and year fixed effects respectively. EC*SCAI represents the interaction between EC and SCAI while GHGRP*SCAI represents the connection between GHGRP and SCAI of firm *i* at period *t*. Table 1 presents the variable definitions and sources of data.

4. Results

4.1 Summary statistics

Table 3 presents descriptive statistics for all variables. The GHGRP index ranges from 0 to 37, averaging at 10. GHGP scores fluctuate between 2.71 and 21.79, with an average of 15.49 and a standard deviation of 2.43. Additionally, about 20% of firms have tied a portion of their top executives' compensation to sustainability targets. In line with studies such as Adu et al., 2022b and Haque and Ntim, 2020, pairwise correlation coefficients in Table 3 show a positive correlation between GHGP and GHGRP, and both are positively associated with the extent of EC. Figures 2 and 3 depict the yearly distribution of GHGP and GHGRP from 2002 to 2022. The yearly average of GHGP demonstrates a rising trend from 2002 to 2018, followed by stabilization from 2018 to 2020, a sharp uptick in 2021, and then a return to earlier levels in 2022. Figure 3 reveals a consistent gradual increase in GHGRP across the same period, aligning with findings from Haque (2017) and Orazalin et al. (2023).

Table 3

Summary statistics

Variable	Observations	Mean	Standard Dev.	Minimum	Maximum
GHGP (ln)	22681	12.86	2.43	2.71	21.79
EC (ln)	21750	15.49	1.32	4.18	24.41
GHGRP	41370	10.68	9.74	0.00	37.00
SCAI	29741	0.20	0.40	0.00	1.00
BMEET (ln)	23821	2.17	0.47	0.00	5.04
BSIZE (ln)	29620	2.31	0.35	0.00	3.66
BIND (%)	27123	48.87	25.83	0.00	100.00
BGEN (%)	27123	48.87	25.83	0.00	100.00
CEOCD	29741	0.29	0.45	0.00	1.00
FSIZE (ln)	38975	22.27	1.58	6.06	28.04
PROF (%)	38975	0.05	0.30	-34.45	17.42
LEVE (%)	38975	0.11	7.25	0.00	1109.76
SLACK (ratio)	38975	0.10	0.10	-0.15	1.03
CAPIN (ratio)	38975	0.39	6.27	-379.65	681.69
GDP (%)	38846	426.02	258.57	1.00	958.00
INF (%)	39400	8.31	11.83	-4.48	49.00
WGI (%)	41730	0.67	0.20	0.00	0.89

4.1 Correlation analysis

The correlation coefficients across independent variables that do not surpass 0.80, the upper limit of allowable correlation might indicate the integrity of the multicollinearity problems (Shrestha, 2020). Further, the VIF[3] of 1.87 and 1.73 for GHGRP and BSCI, respectively, are well below the threshold of 10.

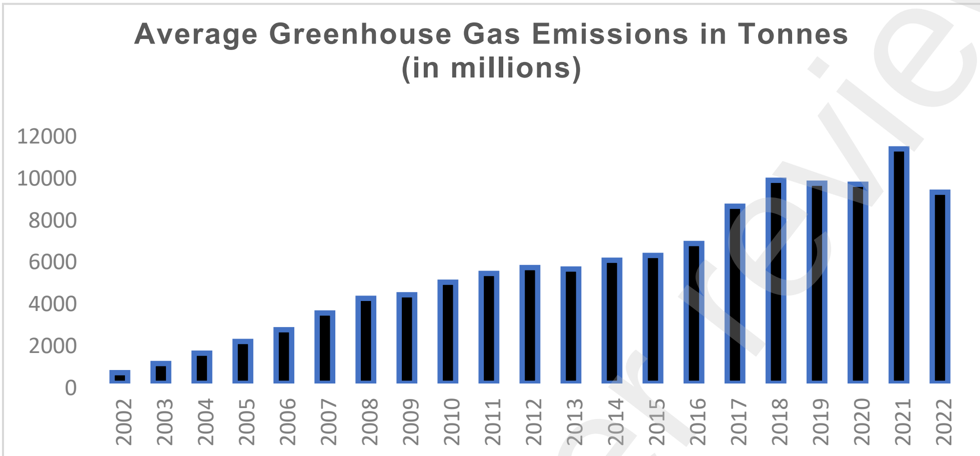

Figure 2. Average Greenhouse Gas Emissions in tonnes (millions) by year

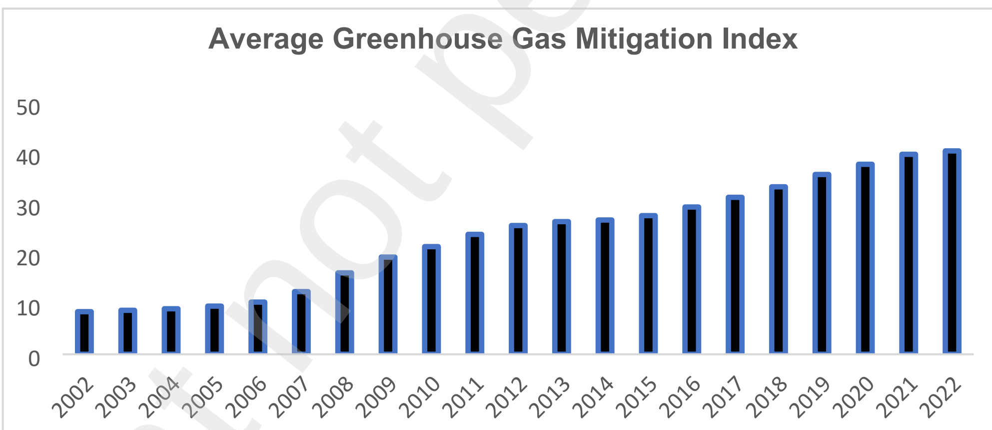

Figure 3. Average Greenhouse Gas Mitigation index by year

(Source: authors' construct based on data obtained from Refintiv Eikon)

[3] For each variable, the Variation Inflation Factor (VIF) is estimated. A VIF value larger than ten suggests the presence of multicollinearity (Vatcheva et al., 2016). The results (unpublished) demonstrate that the largest VIF is 2.29 and the average VIF is 1.34, establishing that multicollinearity is not an issue in this investigation.

Table 4

Correlation matrix

Variables	GHGP	EC	GHGRP	BSCI	SCAI	BMEET	BSIZE	BIND	BGEN	CEOCD	SLACK	LEVE	PROF	CAPIN	GDP	INF	WGI
GHGP	1.00																
EC	0.13**	1.00															
GHGRP	0.32**	0.22**	1.00														
SCAI	0.03**	0.19**	0.18**	0.29**	1.00												
BMEET	0.06**	-0.01	0.13**	0.08**	0.04**	1.00											
BSIZE	0.29**	0.18**	0.23**	0.16**	-0.02**	-0.06**	1.00										
BIND	-0.03**	0.19**	0.05**	0.25**	0.30**	-0.03**	-0.22**	1.00									
BGEN	-0.13**	0.16**	0.21**	0.35**	0.32**	0.02**	-0.03**	0.38**	1.00								
CEOCD	0.03**	0.03**	0.04**	-0.04**	-0.08**	-0.04**	0.09**	-0.12**	-0.11**	1.00							
SLACK	-0.19**	-0.04**	-0.04**	-0.08**	-0.09**	0.01	-0.07**	-0.15**	-0.10**	0.08**	1.00						
LEVE	0.01*	-0.004	0.01	0.01	-0.003	0.004	-0.01	0.012*	0.01	-0.01	0.001	1.00					
PROF	-0.05**	-0.01	-0.01	-0.003	0.001	-0.05**	-0.004	0.01	-0.02**	0.01	0.05**	0.13**	1.00				
CAPIN	0.42**	-0.01	-0.01*	-0.01*	0.01	-0.001	-0.01	0.01	-0.0002	-0.001	-0.02**	-0.0003	0.0002	1.00			
GDP	0.04**	-0.13**	-0.19**	-0.16**	-0.05**	-0.12**	-0.05**	-0.03**	-0.05**	-0.02**	0.01	0.001	0.03**	0.01**	1.00		
INF	0.03**	-0.01	-0.36**	-0.34**	0.03**	-0.04**	-0.03**	0.11**	0.50**	-0.10**	-0.04**	-0.01	0.02**	0.02**	0.33**	1.00	
WGI	-0.05**	0.10**	-0.14**	-0.15**	-0.08**	-0.03**	-0.05**	0.001	-0.11**	0.02**	0.02**	-0.001	-0.002	0.0001	-0.24**	-0.26**	1.00

*** p < 0.01; ** p < 0.05 (2-tailed)

4.3 Baseline analysis

4.3.1 The impact of executive compensation and sustainable compensation adoption indicator on greenhouse gas reduction procedures

Table 5 displays the results of the FE panel regression of EC, SCAI and EC*SCAI against GHGRP with each column representing different models. Model (1) shows that EC has a statistically significant positive relationship with GHGRP ($p < 0.01$), demonstrating that EC is has a significant impact in improving the GHGRP of firms worldwide. Thus, supporting H1a, which consistent with the findings of Adu et al. (2022b), and Haque and Ntim (2020), suggesting that increase in EC can further motivate business executives to engage in certain initiatives to enhance their firms' environmental performance. Similarly, Model (2) reveals a positive relationship between SCAI and GHGRP which reveals that linking a part of the EC to sustainability targets forces corporate executives to engage in certain initiatives to enhance their firms' environmental performance. However, Model (3) rejects the prediction of H3a that SCAI influences the association between EC and GHGRP.

Table 5
The relation of executive compensation, sustainable compensation adoption indicator and greenhouse gas reduction procedures

Models	(1) GHGRP	(2) GHGRP	(3) GHGRP
EC	0.428***		0.361***
	(11.15)		(8.89)
SCAI		1.711***	0.208
		(19.48)	(0.18)
EC*SCAI			0.080
			(1.08)
BMEET	0.802***	0.615***	0.741**
	(6.54)	(5.29)	(6.08)

BSIZE	-0.771***	-0.849***	-0.871***
	(-3.32)	(-4.24)	(-3.79)
BIND	0.030***	0.037***	0.029**
	(10.26)	(13.58)	(9.93)
BGEN	0.151***	0.154***	0.144**
	(41.24)	(43.84)	(39.66)
CEOD	0.144	-0.008	0.161***
	(1.12)	(-0.08)	(1.26)
FSIZE	3.802***	3.965***	3.672**
	(43.31)	(48.2)	(42.02)
PROF	0.651***	0.078	0.646**
	(3.6)	(0.59)	(3.61)
LEVE	0.007*	0.012***	0.007*
	(1.72)	(3.09)	(1.69)
SLACK	3.657***	3.056***	3.401**
	(5.66)	(5.05)	(5.31)
CAPIN	0.118	0.016	0.018
	(1.59)	(1.43)	(1.63)
GDP	-0.002***	-0.002***	-0.002***
	(-10.11)	(-11.63)	(-10.16)
INF	-0.047***	-0.061***	-0.048***
	(-9.76)	(-13.74)	(-10.03)
WGI	-17.689***	-10.488***	-16.480***
	(-9.8)	(-6.43)	(-10.03)
Constant	-68.004***	-69.970***	-65.753***
	(-28.36)	(-31.75)	(-27.00)
Country effects	Fixed	Fixed	Fixed
Industry effects	Fixed	Fixed	Fixed
Year effects	Fixed	Fixed	Fixed
Observations	17,011	20,091	17,011
R-squared	0.315	0.332	0.327

Note: This table presents the regression analysis of executive compensation and sustainable compensation adoption indicator on greenhouse gas reduction procedures. Robust t-statistics are reported in parentheses. *** p < 0.01; ** p < 0.05 ; * p < 0.1. For variable definitions, see Table 1.

4.3.2 The impact of executive compensation and sustainable compensation adoption indicator on greenhouse gas performance

Table 6 displays the results of the FE panel regression of EC, SCAI and EC*SCAI on GHGP. Contrary to the results in Table 5, Models (1) and (2) show that both EC and SCAI have a statistically insignificant relationship with GHGP. Expectedly, Model (3) also indicates that the interaction term EC*SCAI has a statistically insignificant relationship with GHGP. These findings align with the concept of legitimization, suggesting that CG mechanisms such as EC and SCAI may enhance the symbolic aspect of GHGO while not necessarily impacting the actual GHG performance. This occurs as firms tend to implement process-oriented sustainability initiatives such as the GHGRP which might be seen favourably by stakeholders (Haque and Ntim, 2020; Orazalin et al., 2023).

Table 6
The relation of executive compensation, sustainable compensation adoption indicator and greenhouse gas performance

Models	(1) GHGP	(2) GHGP	(3) GHGP
EC	0.004 (0.72)		0.005 (0.79)
SCAI		-0.013 (-1.14)	0.005 (0.03)
BSCI			
EC*SCAI			-0.001 (-0.10)
BMEET	-0.070*** (-3.53)	-0.071 (-3.91)	-0.069*** (-3.50)
BSIZE	0.181*** (4.74)	0.111*** (3.57)	0.182*** (4.76)
BIND	0.000 (-1.00)	0.000 (-0.90)	0.000 (-0.99)
BGEN	-0.003***	-0.003***	-0.003***

	(-5.38)	(-5.84)	(-5.29)
CEOD	0.044**	0.032*	0.044**
	(2.10)	(1.86)	(2.09)
FSIZE	0.534***	0.543***	0.536***
	(31.14)	(35.1)	(31.09)
PROF	-0.060*	-0.079***	-0.061*
	(-1.87)	(-4.06)	(-1.88)
LEVE	-0.023	-0.006	-0.024
	(-0.63)	(-0.17)	(-0.65)
SLACK	-0.496***	-0.404***	-0.493***
	(-4.49)	(-4.08)	(-4.47)
CAPIN	0.181***	0.207***	0.180***
	(3.59)	(4.50)	(3.57)
GDP	0.000	0.000***	0.000
	(-1.53)	(-2.65)	(-1.54)
INF	-0.003***	-0.002***	-0.003***
	(-4.12)	(-3.42)	(-4.07)
WGI	1.710***	1.618***	1.700***
	(5.87)	(6.4)	(5.83)
Constant	-0.894**	-0.767*	-0.932**
	(-2.00)	(-1.93)	(-2.07)
Country effects	Fixed	Fixed	Fixed
Industry effects	Fixed	Fixed	Fixed
Year effects	Fixed	Fixed	Fixed
Observations	13,428	15,838	13,428
R-squared	0.317	0.317	0.317

Note: This table presents the regression analysis of executive compensation and sustainable compensation adoption indicator on greenhouse gas reduction procedures. Robust t-statistics are reported in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$. For variable definitions, see Table 1.

4.3.3 The impact of greenhouse gas reduction procedures and sustainable compensation adoption indicator on greenhouse gas performance

Table 7 displays the results of the FE panel regression of GHGRP, SCAI and GHGRP*SCAI on GHGP. In Models (1) to (6), GHGRP and $\text{GHGRP}_{(t-1)}$ have a statistically significant positive relationship with GHGP (p<0.01). The findings imply that firms that engage in GHGRP keep producing substantial levels of pollution. Some GHGP reduction measures may take longer to execute. Theoretically, these results support the symbolic legitimation/greenwashing hypothesis, given that firms are inclined to undertake GHGRP to preserve legitimacy, yet such efforts have no impact on actual emission reductions (Orazalin et al., 2023). Supported by previous studies (Issa, 2023; Orazalin et al., 2023), symbolic sustainable practices by way of participation in SBOs and thorough sustainability disclosures are popular, but these symbolic pledges may not always enhance actual GHGP (Shevchenko, 2021; Orazalin et al., 2023). Notwithstanding the insignificant impact of GHGRP*SCAI on GHGP, $\text{GHGRP}_{(t-1)}, * \text{SCAI}_{(t-1)}$ confirm H3a as they significantly impact GHGP. The observed significance of the lagged effects may arise because the adoption of new processes and technologies, encouraged by SCAI, generally necessitates an extended timeframe before noticeable impacts on emissions reduction become apparent (Sarkodie & Strezov, 2019). Over time, as stakeholders continue to engage and monitor the firm's sustainability practices, the first lag of GHGRP*SCAI may reflect more substantive actions taken by the firm to reduce emissions, aligning with stakeholder expectations (Jones, 1995). Moreover, early initiatives often target simpler changes that have a minor effect on emissions, whereas the implementation of more intricate and impactful measures might require a longer period to be fully established and yield results (Dahlmann et al., 2017).

Table 7
The relation of greenhouse gas reduction procedures, sustainable compensation adoption indicator and greenhouse gas performance

Models	(1) GHGP	(2) GHGP	(3) GHGP	(4) GHGP	(5) GHGP
GHGRP	0.005***	0.006***	0.006***		
	(4.25)	(4.45)	(4.63)		
SCAI		-0.022*	0.018		
		(-1.75)	(0.53)		
GHGRP*SCAI			-0.002		
			(-1.27)		
GHGRP_{t-1}				0.003***	0.008***

				(2.89)	(3.52)
$SCAI_{t-1}$				-0.034***	0.022***
				(-2.73)	(3.23)
$GHGRP_{t-1}*SCAI_{t-1}$					-0.001***
					(-3.20)
$BMEET_{[t\|t-1]}$	-0.074***	-0.073***	-0.073**	-0.040**	-0.042**
	(-4.08)	(-4.03)	(-4.04)	(-2.26)	(-2.35)
$BSIZE_{[t\|t-1]}$	0.109***	0.110***	0.111***	0.101***	0.097***
	(3.50)	(3.55)	(3.57)	(3.33)	(3.20)
$BIND_{[t\|t-1]}$	-0.001	-0.001	-0.001	-0.001	-0.001
	(-1.25)	(-1.25)	(-1.28)	(-1.33)	(-1.42)
$BGEN_{[t\|t-1]}$	-0.004***	-0.004***	-0.004***	-0.006***	-0.006***
	(-6.86)	(-6.79)	(-6.76)	(-10.97)	(-10.92)
$CEOD_{[t;\ t-1]}$	0.033*	0.032*	0.032*	0.018	0.018
	(1.87)	(1.86)	(1.87)	(1.08)	(1.09)
$FSIZE_{[t\|t-1]}$	0.524***	0.526***	0.526***	0.503***	0.500***
	(32.91)	(32.96)	(32.95)	(33.05)	(32.79)
$PROF_{[t\|t-1]}$	-0.075***	-0.075***	-0.075***	-0.064***	-0.064***
	(-3.84)	(-3.85)	(-3.85)	(-3.36)	(-3.37)
$LEVE_{[t\|t-1]}$	-0.010	-0.11	-0.011	0.002***	0.002***
	(-0.29)	(0.34)	(-0.31)	(3.84)	(3.84)
$SLACK_{[t\|t-1]}$	-0.415***	-0.411***	-0.408***	-0.579***	-0.574***
	(-4.18)	(-4.15)	(-4.12)	(-6.03)	(-5.98)
$CAPIN_{[t\|t-1]}$	0.213***	0.210***	0.211***	0.199***	0.204***
	(4.63)	(4.58)	(4.59)	(4.51)	(4.63)
$GDP_{[t\|t-1]}$	-0.00006**	0.0001***	-0.0001**	-0.0001	0.000
	(-2.30)	(-2.30)	(-2.27)	(-0.49)	(-0.55)
$INF_{[t\|t-1]}$	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***
	(-3.46)	(3.40)	(-3.38)	(-2.86)	(-2.80)
$WGI_{[t\|t-1]}$	1.675***	1.655***	1.649***	1.812***	1.868***
	(6.63)	(6.55)	(6.52)	(7.42)	(7.65)
Constant	-0.448	-0.476	-0.479	-0.050	-0.083
	(-1.12)	(-1.18)	(-1.19)	(-1.13)	(-0.21)

Country effects	Fixed	Fixed	Fixed	Fixed	Fixed
Industry effects	Fixed	Fixed	Fixed	Fixed	Fixed
Year effects	Fixed	Fixed	Fixed	Fixed	Fixed
Observations	15,838	15,838	15,838	16,567	16,567
R-squared	0.321	0.321	0.322	0.311	0.310

Note: This table presents the regression analysis of greenhouse gas reduction procedures and sustainable compensation adoption indicator on greenhouse gas reduction procedures. Robust t-statistics are reported in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$. For variable definitions, see Table 1.

4.4 Further tests

Previous literature has shown that variations in environmental regulations, institutional frameworks, and governance structures across different countries and industries significantly influence environmental management systems, CGS, and overall organizational performance (Bianchini & Croce, 2022; Orazalin et al., 2023). It is vital to consider these different contexts when analysing the factors affecting businesses' GHGO (Aslam et al., 2021; Liu et al., 2021). Therefore, our study explores these relationships across diverse contexts.

First, this study estimates Equations (1) and (2), replacing the variable GHGP with TGHGP (total greenhouse gas performance). The introduction of GHGPF to include Scope 3 emissions is imperative to capture the effect of other indirect emissions. According to Deloitte (2023), Scope 3 emissions constitute over 70% of carbon impact for many businesses. For example, the extraction, production and processing of raw materials will frequently result in large carbon emissions in manufacturing companies. However, research on TGHGP is scant due to inadequate data on Scope 3 emissions in the previous years. In Table 8, Model (4) shows that EC and SCAI independently aid in reducing TGHGP. These results are in contrast with those in Table 6 where the variables are not statistically significant. Overall, the findings indicate that linking a part of EC to sustainability objectives leads to their active involvement in GHGRP such as collaborating with suppliers to reduce emissions, underscoring the benefits of decarbonizing the supply chain at a community level. Additionally, these results may suggest that executives are likely to enact policies or motivate employees to reduce emissions related to commuting, business travel, waste, and water usage.

Table 8
The relation of executive compensation, sustainable compensation adoption indicator and greenhouse gas performance

Models	(1)	(2)	(3)
	TGHGP	TGHGP	TGHGP
EC	0.005**		-0.005**
	(0.24)		(-0.22)
SCAI		0.164***	-0.207**
		(3.74)	(-0.35)
EC*SCAI			0.021**
			(0.58)
Constant	-4.316**	-5.590***	-3.805**
	(-2.40)	(-3.32)	(-2.09)
Control variables	Fixed	Fixed	Fixed
Country effects	Fixed	Fixed	Fixed
Industry effects	Fixed	Fixed	Fixed
Year effects	Fixed	Fixed	Fixed
Observations	3222	3977	3222
R-squared	0.364	0.272	0.361

Note: This table presents the regression analysis of greenhouse gas reduction procedures and sustainable compensation adoption indicator on total greenhouse gas performance (Scope 1, 2 and 3). Scope 3 emissions includes emissions that are not created by the firm themselves, but rather emissions that are indirectly accountable in its value chain. This includes emissions from contractor-owned cars, staff company trips (by rail or air), waste disposal, contracted services; emissions from client product use, emissions from the manufacturing of purchased materials, and emissions from power purchased for resale. Robust t-statistics are reported in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$. For variable definitions, see Table 1

Third, to assess the effects of global climate change reforms, Equation (1) are estimated for the following subsamples in this study: Paris (2022-2016), Kyoto (2015-2005), and pre-reforms (2004-2002). The results in Table 9[4] display a statistically significant link between all the independent variables EC, SCAI and EC*SCAI and the dependent variables GHGRP and GHGP across the Paris Kyoto and pre-reform subsamples. The data presented in the table illustrate a progressive escalation in the significance of variables, transitioning from being insignificant during the pre-reform period to highly significant in the era of the Paris Agreement. This implies that since the pre-reforms, firms have adopted robust SCAI, thus emphasising the necessity of worldwide initiatives in enhancing awareness amid stakeholders and institutions about the detrimental effects of GHGP.

Finally, the study estimates Equation (2) for countries with national carbon tax implementation. The findings (which, for brevity, are not reported but are available upon request) show that for countries with carbon taxes, BSCI ensures that the GHGRP are substantive and actually lead to a reduction in GHGP, however, this relationship is statistically insignificant for countries with no carbon taxes.

[4] See Appendix for the results of panel B and C

Table 10

Panel A: The relation of executive compensation, sustainable compensation adoption indicator and greenhouse gas reduction procedures

	PARIS (2022 - 2016)			KYOTO (2015 - 2005)			PRE-REFORM (2004 - 2002)		
Models	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	GHGRP	GHGRP	GHGRP	GHGRP	GHGRP	GHGRP	GHGRP	GHGRP	GHGRP
EC	0.198***		0.214***	0.344***		0.235***	-0.418		-0.446
	(5.53)		(5.66)	(6.83)		(4.42)	(-1.02)		(-1.07)
SCAI		0.370***	2.683**		1.547***	-2.438*		-1.307	-33.466
		(3.86)	(2.36)		(14.88)	(-1.73)		(-0.48)	(-0.72)
EC*SCAI			-0.150**			0.242***			2.183
			(-2.08)			(2.74)			(0.70
Controls	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
Country effects	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
Industry effects	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
Year effects	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
Observations	8,213	9,541	8,213	8,518	10,153	8,518	280	397	280
R-squared	0.168	0.160	0.168	0.250	0.199	0.255	0.170	0.107	0.172

Note: This table presents the regression analysis of executive compensation and sustainable compensation adoption indicator on greenhouse gas reduction procedures for three different climate reforms: PARIS (2022-2016), KYOTO (2015-2005) and PRE-REFORM (2004-2002).. Robust t-statistics are reported in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$. For variable definitions, see Table 1.

4.5 Robustness checks

4.5.1 Generalised method of moments

A variety of additional analyses are performed in this study to ensure the reliability of the results. To start with, Equations (1) and (2) are estimated using a dynamic two-step system generalised method of moments (GMM), developed by Arellano and Bond (1991) and, Blundell and Bond (1998). In the GMM regression of carbon performance (GHGP and GHGRP), EC is utilised as an endogenous variable; the specification of GHGP also includes EC as an endogenous variable. The results from GMM (in Table 11) are comparable to those reported in Table 5, demonstrating the robustness of the main results to sample selection bias and endogeneity.

Table 11
GMM results

	(1) (GHGP)	(2) (GHGP)	(3) (GHGRP)	(4) (GHGRP)	(5) (GHGP)
L.GHGP	0.856***	0.921***			1.027***
	(16.75)	(18.36)			(17.64)
L.GHGRP			0.916***	1.146***	
			(32.17)	(21.24)	
GHGRP					0.215**
					(2.19)
EC	-0.079		1.712***		
	(-0.73)		(2.69)		
SCAI	-0.346**	-0.085	-5.069***	-1.361**	
	(-2.54)	(-0.54)	(-4.71)	(-2.19)	
Control variables	Fixed	Fixed	Fixed	Fixed	Fixed
Country effects	Fixed	Fixed	Fixed	Fixed	Fixed
Industry effects	Fixed	Fixed	Fixed	Fixed	Fixed
Year effects	Fixed	Fixed	Fixed	Fixed	Fixed
Observations	13,175	15,537	17,011	20,091	15,537
Arellano-Bond (AR-1)	0.000	0.000	0.000	0.000	0.000
Arellano-Bond (AR-2)	0.602	0.463	0.207	0.408	0.463
Hansen test (*p-value)*	0.403	0.807	0.550	0.309	0.721

Note: This table presents the estimation results for the generalised method of moments (GMM) regressions for the effects of executive compensation, sustainability-based initiatives and board sustainability committee index on both total greenhouse mitigation index and process-oriented GHG mitigation initiatives The definitions for all variables are provided in Table 2. The t-*statistics* calculated with robust standard errors are shown in brackets. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

4.5.1 Two-stage least squares

Second, the analysis adopts two-stage least squares (2SLS) to ensure that the primary results (in Table 12) are not influenced by any endogeneity. In line with previous research (Martinez-Garca and Gomez-Anson, 2022; Orazalin et al., 2023) the first lag and industry average values of the main independent variables are utilised as instruments. These instruments are relied on as a result of these studies as they are not likely to be linked with the error term and may not have a direct effect on the dependent variables. The test statistics indicate that the chosen variables are appropriate.

Table 12
2SLS results

	First stage (1) (GHGP)	Second stage (2) (GHGP)	First stage (3) (GHGRP)	Second stage (4) (GHGRP)
GHGP	8.11*** (42.52)	-0.040*** (-3.12)	0.813*** (47.46)	0.130*** (10.90)
GHGP_Industry	3.50*** (6.03)		0.145*** (4.44)	
GHGRP				0.130*** (10.90)
GHGRP_Industry				
SCAI	0.087*** (2.69)	0.087*** (2.69)	0.171* (1.93)	0.096***
BMEET	0.002** (2.14)	-0.008 (-0.24)	0.406*** (4.96)	0.557*** (18.58)
BSIZE	0.314*** (5.74)	0.314*** (5.74)	0.706*** (5.13)	0.929*** (18.43)
BIND	-0.135*** (-12.15)	0.002** (0.32)	-0.020*** (-10.80)	-0.019*** (-27.93)
BGEN	-0.013*** (-12.15)	-0.013*** (-12.15)	0.041*** (14.28)	0.033*** (31.24)
CEOD	-0.164*** (-4.79)	-0.164*** (-4.79)	0.624*** (7.20)	0.763*** (24.02)
FSIZE	0.952*** (75.23)	0.952*** (75.23)	1.123*** (34.79)	1.215*** (103.03)
PROF	-0.378*** (-6.1.6)	-0.378*** (-6.1.6)	0.745*** (4.25)	0.639*** (9.95)
LEVE	-0.408*** (-5.86)	-0.408*** (-5.86)	0.002 (0.59)	0.004*** (2.71)

SLACK	0.398** (2.16)	0.398** (2.16)	2.693*** (5.94)	4.575*** (27.65)
CAPIN	3.925*** (67.32)	3.925*** (67.32)	0.015 (1.21)	0.012*** (2.71)
GDP	0.0002*** (2.86)	0.0002*** (2.86)	-0.002*** (-10.74)	-0.002*** (-24.77)
INF	-0.004* (-1.78)	-0.004* (-1.78)	-0.010** (-1.97)	-0.014*** (-7.46)
WGI	-1.822*** (-14.75)	-1.822*** (-14.75)	0.634** (2.09)	0.519*** (4.67)
Constant	-9.314*** (-33.29)	-9.314*** (-33.29)	-33.219*** (-44.72)	-28.034*** (-104.17)
Observations	13,428	17,011	17,011	17,011
Control variables	Fixed	Fixed	Fixed	Fixed
Country effects	Fixed	Fixed	Fixed	Fixed
Industry effects	Fixed	Fixed	Fixed	Fixed
Year effects	Fixed	Fixed	Fixed	Fixed
R^2	0.608	0.925	0.000	0.000
Wald chi^2	20803.97	210581.96	30522.39	210581.96
Prob > chi2	0.000	0.000	0.000	0.000

Note: This table presents the estimation results for the two-stage least square (2SLS) regressions for the effects of executive compensation, sustainability-based initiatives and board sustainability committee index on both total greenhouse mitigation index and process-oriented GHG mitigation initiatives The definitions for all variables are provided in Table 2. The t-*statistics* calculated with robust standard errors are shown in brackets. *** p < 0.01; ** p < 0.05; * p < 0.1

5. Discussion and conclusion

The global community faces challenges in establishing sustainable business practices to enhance sustainability and lower GHG emissions. Various initiatives have been developed and implemented in the recent past by non-governmental bodies, policy organisations and governments with the aim of tackling climate change by reducing GHGP. These efforts include international agreements such as the Paris Agreement and the Net Zero Coalition, which aim to reduce GHGP while encouraging sustainable economic practises. There is, however, minimal evidence on the potential of CG processes such as SCAI in tackling and/or mitigating climate change risks. This study aimed to remedy this void by evaluating the interrelationships between EC, SCAI, GHGP, and GHGRP utilising a dataset of 1970 enterprises from 50 industries representing 41370 firm-year observations from 2002 to 2022.

First, the results contribute to an emergent literature (Haque and Ntim, 2020; Orazalin et al., 2023) by suggesting that EC has a positive impact on process oriented GHG reduction initiatives such as GHGRP but has no impact on actual GHGP, thereby confirming the symbolic legitimation view. Second, this study is one of the first to establish that engaging in GHGRP does not necessarily reduce GHGP, further confirming the symbolic legitimation view. Third, firms that engage in symbolic GHGRP may use CG instruments such as SCAI separately as impression management tools to promote positive perceptions among stakeholders and protect their legitimacy. However, the results demonstrate that when SCAI are linked with GHGRP, GHGP can be meaningfully reduced after some period of time thus, meeting stakeholder expectations.

Our findings have implications for international business managerial practice. The inductive insights from this study yield valuable lessons for firms in a challenging business environment regarding climate change risks and regulation. First, to ensure that GHGP is sufficiently integrated into the core business of companies, managers in firms ought to consider actual GHGP cut related targets in compensation contracts, with the aim of motivating both boards and executives to achieve goals which will have a positive impact on climate threat. Second, firms are encouraged to be transparent and communicate the actual GHG emission reduction to their stakeholders, investors and the society. Such initiatives will promote trust, help them gain legitimacy and in so doing expose them to opportunities in different institutional and country environments. Third, corporate executives could promote their job security by embedding CGS such as SCAI in the operations of firms. This has been shown to improve corporate image and prevent GHG regulation risks, leading to long-term sustainable value creation. Fourth, corporate executives are encouraged to integrate GHG initiatives into their operations instead of considering them as peripheral corporate activity. To that effect, management of firms should consider climate change investments as win-win business model.

Further, the findings of the paper are of relevance to various governments and regulators. In particular, at the recent COP28 held in Dubai, global leaders and regulators pledged to accelerate efforts towards net zero emissions and transition away from fossil fuels in energy systems. Certainly, when creating and implementing GHGP-related initiatives, firms have incentives to include board sustainability committees and sustainability-based compensation policies in their strategies, as these measures have proven to limit GHG emissions. In addition, our findings suggest that regulators should put in place an independent external assurance mechanism over the sustainability reports of firms to enhance the quality of GHG emission reporting. Finally, given that GHG abatement projects demand large financial outlay, voluntary legislative actions will likely not be sufficient. In this case, there is a need for mandatory GHG targets at the global, national, and corporate levels.

Notwithstanding, our study has some limitations which provide opportunities for further research. First, due to data restrictions, this study utilises a binary variable for SCAI therefore does not assess the degree of how SCAI is implemented. Different levels or types of sustainability incentives might have varying impacts on corporate behaviour and outcomes which are not captured in a binary format. Second, the measures for EC, SCAI, GHGP and GHGRP might not accurately represent real-world practices. Finally, this study is limited to firms openly listed on stock exchanges across the globe. Therefore, future studies could examine the relationships within the scope of non-publicly listed firms.

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