



Determinants of Climate Change Disclosure in Carbon-Intensive Firms: Evidence from the GCC Region

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Abstract

This study examines Climate Change Disclosure (CCD) among carbon-intensive firms in the Gulf Cooperation Council (GCC) region and identifies the key firm- and country-level factors shaping such disclosure. Using cross-sectional data from 212 listed firms operating in carbon-intensive sectors in 2022, the study employs a disclosure index tailored to the GCC context and conducts a content analysis of annual and sustainability reports to measure disclosure practices. The results reveal low disclosure levels and limited external assurance of the disclosed information. A multiple regression model is developed to assess the effect of financial attributes, governance characteristics, and national environmental performance on CCD. The results confirm that firm size, leverage, Global Reporting Initiative (GRI) adoption, the presence of sustainability or environmental committees, and countries' Environmental Performance Index (EPI) scores significantly and positively influence CCD, whereas firm age, profitability, and board independence do not have a significant impact on disclosure. To the best of the authors' knowledge, this study provides the first empirical evidence of CCD determinants in the GCC, a carbon-reliant region with limited scholarly attention, and introduces a disclosure index adapted to regional reporting practices. The insights provided by the study offer practical value for regulators and stakeholders aiming to advance corporate transparency and climate accountability.

Keywords:

Climate Change Disclosure;
Carbon-Intensive Industries;
GCC;
Sustainability Reporting;
GRI; Climate Justice.

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1- Introduction

Amid escalating global warming, corporate accountability has become indispensable in addressing the climate crisis. Corporations are responsible for more than 70% of global emissions [1], which places an ethical obligation on them to account for their environmental impact and drive a sustainable transition by adopting environmentally responsible practices. The consequences of climate change are not confined to warmer regions. The planet is already experiencing severe environmental and social impacts. The Earth is experiencing an unprecedented rise in the frequency and intensity of floods, droughts, and sea-level changes [2, 3]. The problem has also increased mortality rates due to intensified heat events [4].

The Intergovernmental Panel on Climate Change (IPCC) warns that the adverse effects of climate change will continue to intensify as global warming progresses. Notably, vulnerable groups contributing the least to climate change will endure the most severe consequences [2]. Scholars have also highlighted the uneven burden of climate change on developing nations, particularly those with minimal historical responsibility for global emissions [2]. The concept of "climate debt" [5, 6] situates this imbalance within a broader discourse on global environmental justice. While these perspectives are not empirically tested in the present study, they provide important context for understanding why voluntary climate disclosures may vary across regions. Specifically, they help to explain how structural and historical inequalities might shape the motivations and capabilities of firms in emerging economies, such as the GCC, to engage in climate change disclosure practices.

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Given the seriousness of climate change, the United Nations recognizes “Climate Action (SDG13)” as a Sustainable Development Goal. Likewise, sustainability reporting has placed a high emphasis on climate change due to its adverse impact on the environment and humankind [7], leading to a significant increase in corporate climate change disclosure (CCD), also known as carbon disclosure. Firms’ motivations for such disclosures are grounded in stakeholder, legitimacy, and institutional theories. These motivations reflect increasing pressure from investors seeking transparency [8], corporations’ desire to maintain social legitimacy [9], and the influence of emerging global reporting norms [10, 11]. Although the effectiveness of these narrative risk disclosures remains controversial due to their boilerplate nature [12], several studies indicate that external stakeholders utilize risk disclosures for decision-making purposes [13-15]. Additionally, the usefulness of qualitative risk disclosures extends to management at the corporate level, enabling managers to adapt their corporate behavior based on their stakeholders’ feedback on disclosure [16]. In this regard, there is empirical evidence that climate change risk reporting improves the disclosure of firms’ environmental performance [17], highlighting the need to understand the determinants of companies’ carbon disclosures.

As firms began to augment their published reports with climate-related disclosures, CCD research has come to dominate the environmental accounting literature [18], especially since the mid-2000s [19, 20]. The rapid growth of CCD as a research topic is driven by a series of IPCC reports that highlight the urgency of climate change and the pressing need to account for carbon emissions, alongside international efforts to address climate change [19]. Despite this expansion [18, 21], three major research gaps remain. First, CCD research exhibits geographic bias toward developed countries [22-26], with limited empirical evidence from emerging economies despite calls to expand similar research efforts to these contexts [18, 21]. Recent systematic reviews similarly report limited research on ESG-related reporting in emerging markets, including the Middle East [27], reinforcing the need for further investigation in these regions. Second, most studies on CCD determinants rely on single-country, cross-sector samples [22, 23, 26, 28, 29], limiting insights into how national contexts influence the disclosure of firms within similar sectors. Third, prior research primarily examines CCD determinants from a single perspective, most commonly corporate governance [8, 24, 26, 30, 31], thereby overlooking the interplay of financial, governance, and country-level factors. These research gaps are particularly relevant in the GCC, where the region’s emerging economies rely heavily on environmentally destructive industries, such as oil and gas, and where sustainability-reporting expectations are evolving rapidly. Understanding CCD in this region is therefore both timely and important for assessing how firms respond to emerging institutional and stakeholder pressures.

The aim of this study, therefore, is to examine the nature and extent of CCD in the GCC region and to identify disclosure’s key drivers. Our study relies on a sample of 212 GCC carbon-intensive firms listed on the GCC stock markets in 2022. Such firms are selected as the focus of the study due to their environmentally detrimental operations, and because carbon-intensive corporations are leaders in environmental disclosure [31], therefore setting a benchmark for best practice that may be applied across other sectors. Unlike most prior studies on CCD determinants, this research incorporates variables that account for firms’ financial metrics, corporate governance, and country-level differences, rather than solely studying the effect of corporate governance on disclosure.

The study contributes to the existing literature by addressing critical gaps by evaluating the status of CCD in the GCC, a region that prior studies have overlooked, and providing empirical evidence of factors influencing such disclosure. Furthermore, we develop a disclosure index tailored to GCC countries, as the current literature lacks a suitable CCD index for the region. Considering the scarcity of carbon disclosure research in the GCC, this study is regarded as a crucial step that lays the foundation for subsequent research on carbon disclosure within the region. The study’s insights are expected to enhance users’ understanding of CCD in the area, enabling them to critically assess such disclosure. Regulators can leverage the research findings to shape policies that enhance disclosure and foster sustainable corporate practices. Meanwhile, businesses can address the disclosure gaps and weaknesses identified by the study to further enhance their disclosure practices. Finally, it is presumed that such research could potentially contribute to a more sustainable future, considering the evidence pertaining to the positive impact of CCD on corporate sustainable behavior [17].

The remainder of the paper is structured as follows. Section 2 provides background on the GCC; Section 3 presents the theoretical framework and develops the study’s hypotheses; Section 4 outlines the study’s methodological approach; Section 5 presents and discusses the research findings; Section 6 draws conclusions, provides relevant recommendations, highlights research limitations, and suggests directions for future research.

2- The GCC: Background and Sustainability Reporting Practices

The GCC comprises six Middle Eastern countries, namely Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates. These countries rely heavily on the oil and gas industry, a sector that significantly contributes to climate change. In 2021, Saudi Arabia was the world’s largest oil exporter and third-largest oil producer, while the United Arab Emirates and Kuwait ranked seventh and ninth in oil production, respectively [32]. Oman and Bahrain are also highly involved in the oil industry, with Oman ranked 19th and Bahrain 35th in oil production [33]. On the other hand, Qatar was the second-largest natural gas exporter and sixth-largest gas producer in 2021 [32]. This places GCC governments under significant pressure to develop and implement rigorous plans to reduce their carbon footprints. This

urgency stems from the consensus that international climate change mitigation targets cannot be achieved unless the global oil and gas industry reduces its emissions by at least 60% by 2030 [34]. Consequently, countries in the region have demonstrated their commitment to the issue by ratifying the Paris Agreement and investing in sustainable projects to mitigate carbon emissions. Additionally, most GCC countries have established a clear timeframe for achieving net-zero emissions. Bahrain, Kuwait, and Saudi Arabia aim to reach net-zero emissions by 2060, while Oman and the United Arab Emirates have set their targets for 2050 [35].

The GCC region's vital role in the global oil and gas industry underscores the importance of a sound accountability system concerning environmental matters. Sustainability reporting is widely recognized as a key tool for promoting transparency and monitoring corporate environmental impacts [7]. Although sustainability reporting remains largely voluntary across the GCC, regional stock exchanges have taken substantial steps to encourage ESG disclosure. These developments may pave the way for mandatory sustainability reporting in the future. In 2021, the UAE Securities and Commodities Authority announced mandatory sustainability reporting aligned with GRI standards for listed firms [36]. In Bahrain, the Bahrain Bourse issued an ESG reporting guide to assist listed firms in embedding environmental, social, and governance (ESG) considerations in their reporting practice [37]. Additionally, the Central Bank of Bahrain (CBB) also launched ESG reporting guidelines and indicated that mandatory ESG reporting for listed firms and other CBB licensees took effect in 2024 [38]. ESG reporting guidelines designed to assist firms in reporting relevant ESG information have also been issued by other GCC stock exchanges, namely Bursa Kuwait [37], Muscat Stock Exchange [39], Qatar Stock Exchange [40], and Saudi Exchange [41].

3- Theoretical Framework and Hypotheses Development

3-1- Theoretical Framework

Although climate change has intensified worldwide, the underlying motives behind firms' engagement in such disclosures remain unclear. The theory of political economy offers a foundational perspective for understanding voluntary disclosures, including CCD. The theory posits that an economic event cannot be analyzed without considering the social, political, and institutional context in which it occurs [42]. Accordingly, firms' reports and disclosures are viewed not merely as economic objects but also as influential social and political documents. Building on this view, the three theories derived from the political economy theory- legitimacy theory, stakeholder theory, and institutional theory are the most widely applied frameworks in research on non- financial disclosure, including ESG and corporate social responsibility [43].

Legitimacy theory is grounded in the assumption that firms must operate in accordance with societal norms and values to secure ongoing approval [44]. As interest in environmental issues intensifies, firms attempt to uphold legitimacy by reporting their environmental performance [45], thereby positioning environmental disclosure, including CCD, as a strategic legitimization practice.

Stakeholder theory assumes that corporate CCD is motivated by pressures from key stakeholder groups rather than society at large [46]. Although balancing the interests of broad groups of stakeholders is inherently challenging, firms can strategically choose to disclose information that reinforces their relationships with multiple stakeholders, despite their varying needs and requirements [47]. For instance, firms may disclose carbon-related details to convey their green initiatives and compliance with laws and regulations [48]. Also, carbon disclosure may assist environmentally conscious customers in making informed purchase decisions or provide financial intermediaries (e.g., rating agencies) with additional information relevant to environmental assessments [49].

Institutional theory posits that organizations adopt certain practices to conform to the regulative, normative, and mimetic pressures present in their institutional environment [50]. In the context of CCD, growing normative pressure on firms to report in accordance with sustainability reporting standards such as the GRI is perceived as a factor contributing to increased corporate climate-related disclosure [10, 11]. Firms may also disclose to mimic peers operating under similar institutional conditions [51], or to comply with emerging regulatory requirements [52].

Agency theory is another commonly applied theory in disclosure research, complementing the political economy-based perspectives [18, 43]. The theory is centered on the relationship between managers, who act as agents for the principals (i.e., capital providers) [53]. Because managers possess more information than shareholders and creditors, voluntary disclosure, such as CCD, is viewed as a mechanism that mitigates information asymmetry and the agency problem [54].

Taken together, these perspectives offer a coherent explanation for the multidimensional determinants of CCD examined in this study. Legitimacy theory explains societal pressures; stakeholder theory captures pressures from specific stakeholder groups; institutional theory encompasses national environmental expectations and evolving sustainability- reporting guidelines; and agency theory explains disclosure drivers aimed at reducing information asymmetry. This integrated framework aligns with the study's examination of financial, governance, and country- level determinants of CCD within the GCC's unique socio- economic and regulatory context.

3-2- Hypotheses Development

The following sections discuss the research hypotheses and justify the selection of variables as potential determinants of CCD in the GCC region.

Size

Large firms are exposed to a broad range of stakeholders since they are more likely to operate across multiple countries and interact with numerous stakeholders. Hence, according to stakeholder theory, large firms voluntarily disclose carbon-related information to meet their stakeholders' expectations [10]. From the perspective of the legitimacy theory, large firms tend to disclose climate-related information to avoid being perceived as environmentally irresponsible, particularly given their high visibility and the great media attention they receive [55].

Despite the existence of some empirical studies that do not identify a significant relationship between firm size and carbon disclosure [10, 56], numerous studies find that size is a significant positive determinant of CCD [22, 25, 28, 57, 58]. Accordingly, the first hypothesis is developed as follows:

H1. *There is a significant positive relationship between firm size and GCC carbon-intensive firms' CCD.*

Age

Since firms' reputations are built over the years of their existence [59], the legitimacy theory posits that older firms are more likely to engage in activities that preserve and reinforce their public image. Within the context of CCD, firms with a longer operating history may be especially inclined to communicate their environmental performance to maintain their legitimacy. Empirical evidence on the relationship between firm age and CCD reveals a significant positive relationship between the two variables [57, 60].

While there is a lack of research directly investigating the impact of firms' age on CCD, empirical evidence from Jordan [61] and Libya [62] indicates that a company's age has a significant positive impact on its non-financial disclosure. On the other hand, a Saudi-based study suggests no significant relationship between age and voluntary corporate social and environmental disclosures [63]. Drawing on the theoretical reasoning supported by most empirical evidence within voluntary disclosure literature, the second hypothesis is developed as follows:

H2. *There is a significant positive relationship between firm age and GCC carbon-intensive firms' CCD.*

Profitability

Firms with high profitability are more likely to be transparent about their environmental impact [64], partly because they possess the financial capacity to absorb potential costs associated with unfavorable disclosures. From a legitimacy- theory perspective, highly profitable firms may also engage in various voluntary disclosures to demonstrate responsible conduct and legitimize their profits [65].

Despite the preceding theoretical discussion, empirical evidence on the impact of profitability on CCD is mixed [21]. Several studies report no significant impact [22, 25, 29], while other studies document either a significant negative [58, 66] or positive relationship between the two variables [28, 56, 57, 60]. Drawing on the legitimacy-based reasoning that profitable firms have stronger incentives to demonstrate responsible conduct, the third hypothesis is developed as follows:

H3. *There is a significant positive relationship between profitability and GCC carbon-intensive firms' CCD.*

Leverage

According to agency theory, highly leveraged firms engage in voluntary disclosure to mitigate information asymmetry and alleviate agency costs by communicating responsible risk management to capital providers [53]. Consistent with this view, empirical evidence from Saudi firms confirms a significant positive relationship between leverage and social and environmental disclosure [63]. In the context of CCD specifically, Kim et al. [17] find that firms funded by environmentally conscious creditors disclose more information and tend to embed environmental considerations into their operations and strategic plans.

Nevertheless, the literature remains inconclusive regarding the effect of leverage on CCD [21]. For instance, a study examining the 100 largest Australian firms finds no significant relationship [22], while other studies report that leverage has a significant negative influence on CCD [25, 28, 56, 58, 67]. Yet, grounded in agency theory, the fourth hypothesis is formed as follows:

H4. *There is a significant positive relationship between leverage and GCC carbon-intensive firms' CCD.*

Board Independence

A board of directors composed of a high percentage of independent directors implies good governance and greater transparency [68]. From an agency theory perspective, independent directors are expected to improve the board's objectivity, restrict the opportunistic behavior of executive managers, scrutinize managers' decisions, and ensure that firms are operating in the best interest of stakeholders. Accordingly, independent directors are likely to encourage firms to operate responsibly and be environmentally friendly [69]. Based on this reasoning, a higher proportion of independent directors is expected to improve carbon disclosure. Most research on the relationship between board independence and CCD finds a positive impact [26, 30, 54]. However, there is some empirical evidence from emerging-market contexts that reports insignificant or even negative effects [70]. A recent meta-analytic work also suggests that board independence does not systematically translate into improved ESG disclosure [71]. Nonetheless, in line with agency-theory reasoning, the fifth hypothesis is proposed as follows:

H5. There is a significant positive relationship between board independence and GCC carbon-intensive firms' CCD.

Board Committees

The existence of an environmental committee is usually driven by firms' interest in seeking legitimacy [72]. Thus, firms with environmental committees tend to use CCD to demonstrate their commitment to climate-related concerns [72, 73]. Since environmental, sustainability, and CSR committees often have overlapping responsibilities, their existence is expected to enhance environmental performance and strengthen climate-related disclosure [69]. Policymakers are therefore encouraged to mandate the creation of sustainability committees, as they have been found to be effective in enhancing firms' commitment to environmental issues and in aligning firms' goals and objectives with society [69]. Evidence from Jordan's energy sector further supports this view, showing that the establishment of sustainability committees enhances the disclosure of sustainability performance [74]. In addition, prior CCD studies report a significant positive relationship between the presence of an environmental committee and CCD [26, 31]. CSR committees have also been found to positively influence both carbon disclosure and performance [70]. Taken together, these findings suggest that specialized board-level committees play an important role in promoting more comprehensive climate-related reporting. Thus, the sixth hypothesis is developed as follows:

H6. There is a significant positive relationship between the presence of an environmental or sustainability committee and GCC carbon-intensive firms' CCD.

GRI Adoption

Corporate adoption of GRI sustainability reporting standards has become a norm [11], and some argue that GRI is now the most adopted reporting framework globally [75]. From an institutional theory perspective, this widespread adoption creates normative pressure on firms to report in accordance with GRI standards to align with prevailing institutional expectations and preserve their institutional legitimacy.

Empirical evidence indicates that GRI adoption enhances the credibility of disclosed information, beyond its effect on the extent of carbon disclosure (CCD) [76]. Several studies further reinforce the role of GRI in expanding the depth and comprehensiveness of firms' carbon disclosure [10, 77]. This positive effect of GRI reporting on CCD is believed to be driven by the fact that GRI standards provide specific guidelines for emissions reporting (GRI 305: Emissions) and other climate-related matters, such as energy consumption (GRI 302: Energy). Thus, the seventh hypothesis is developed as follows:

H7. There is a significant positive relationship between GRI adoption and GCC carbon-intensive firms' CCD.

Country-level Determinants

The country where a firm operates is expected to influence the extent of its CCD. Prior research provides evidence that favorable economic conditions at the country level are associated with higher levels of carbon disclosure [54, 78]. Other national factors linked to improved CCD include strict environmental regulations [78], participation in international climate agreements [79], and high environmental performance index (EPI) scores [60].

It is argued that advancements at the country level increase the likelihood of developing policies, regulations, and frameworks to combat climate change, thereby enhancing CCD [60]. Since all GCC countries have ratified the latest climate change treaty (i.e., the Paris Agreement) and are classified as Emerging Market and Developing Economies by the IMF, this study uses the EPI score as an indicator of country-level development, expected to influence firms' carbon disclosure. This aligns with the institutional theory, which posits that firms' actions are driven by their institutional environment [80]. This leads to the development of the last hypothesis:

H8. There is a significant positive relationship between EPI scores and GCC carbon-intensive firms' CCD.

Figure 1 presents the theoretical framework of the study. It illustrates theories used to explain CCD, along with the research independent variables and their expected impact on CCD.

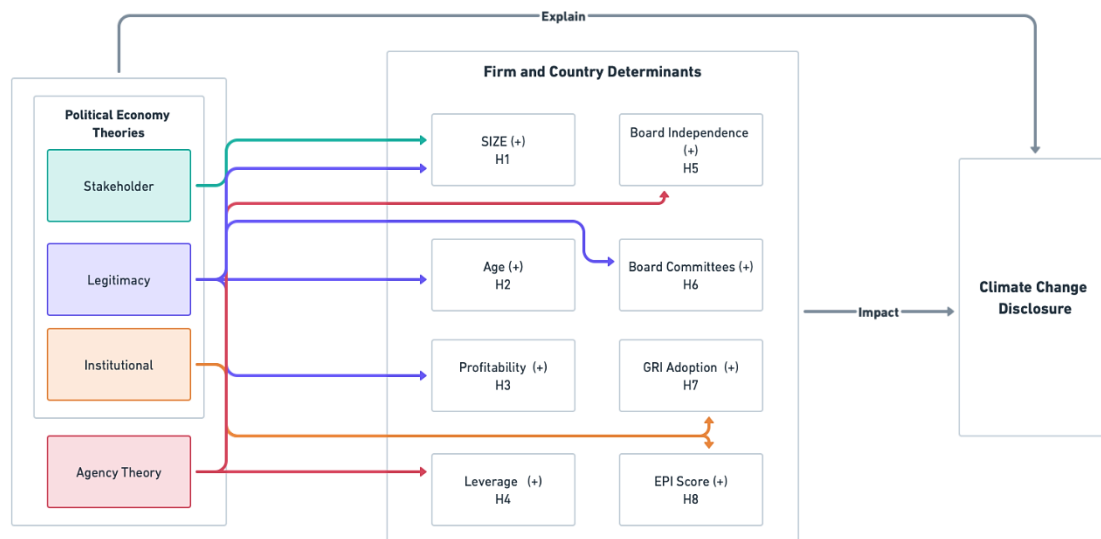


Figure 1. Theoretical framework

4- Research Design and Data

4-1- Study Sample

The study's population is 230 firms, representing the total number of GCC-listed carbon-intensive firms as of 31 December 2022. In this research, carbon-intensive firms refer to those operating in the basic materials, energy, industrials, and utilities sectors, according to Thomson Reuters Business Classification. While the study intended to target the entire population, some firms were excluded due to inaccessible data, resulting in a final sample of 212 firms.

The study is based on cross-sectional data from 2022, the most recent financial period for which annual and sustainability reports, as well as other relevant data, are available to better capture and evaluate CCD's status.

Although the sample includes firms from different carbon-intensive sectors, the analysis focuses on firm- and country-level determinants of CCD within the carbon-intensive category, which is treated as a unified context given these sectors shared exposure to high emissions intensity and climate-related scrutiny.

4-2- CCD Measurement and Index Design

Given its relevance to the scope of this study, the carbon disclosure index provided by Bae Choi et al. [22] is adopted to assess the carbon disclosure characteristics of GCC carbon-intensive firms. However, it has undergone some modifications based on the outcomes of a pilot test to enhance its suitability for the GCC context.

Index Mapping and Pilot Testing

Prior to utilizing the adopted CCD index for content analysis, the index was mapped to two climate change reporting frameworks, namely GRI and CDP, to ensure alignment with relevant reporting frameworks.

Additionally, a pilot test evaluated the index's suitability for the GCC context by analyzing annual and sustainability reports from 23 randomly selected firms for the years 2021 and 2022. The pilot test revealed a 39% improvement in disclosure over one year, indicating that the disclosure practices of carbon-intensive firms in the region are improving annually. This significant improvement is likely influenced by broader regulatory momentum in the GCC during this period, as outlined in Section 2, in which several stock exchanges introduced ESG and sustainability reporting guidelines. These developments, along with announced upcoming reporting mandates, may have encouraged firms to enhance their disclosure practices in anticipation of evolving requirements.

The pilot test also identified certain limitations, which necessitated the addition of some disclosure items and revisions to the index. Specifically, it revealed low levels of disclosure regarding accountability for carbon emissions. In response, the index was refined to include an item for environmental certifications or awards that enhance the credibility of carbon information. This addition remains consistent with the strategic orientation of the original Bae Choi et al. index [22], as it extends the carbon emission accountability category with an item particularly relevant to the GCC context. The inclusion of this item is also supported by prior evidence demonstrating the effectiveness of ISO 41001 in improving

both the extent and credibility of firms' climate disclosures [76], and by its use in other carbon disclosure indices [81]. Additionally, the adapted index separates the disclosure of Scopes 1 and 2 and Scope 3 GHG emissions into three distinct items, each representing a GHG emissions class, to ensure more accurate disclosure scores, given that GCC-listed firms do not always report on these emissions simultaneously. An item that accounts for carbon offsets was also added, considering the region's growing participation in carbon markets [82]. To further validate the refinements, the adapted index was mapped against two climate reporting frameworks, namely CDP and GRI, to ensure alignment with internationally recognized reporting practices. Importantly, the adapted index did not compromise the internal coherence of the original index; Cronbach's alpha, as shown in Table 1, remained high ($\alpha = 0.946$), confirming that the adapted index continues to measure a single underlying construct while capturing region-specific disclosure practices more comprehensively.

Table 1. Cronbach's alpha reliability test

Average interitem covariance	0.467563
Number of items on the scale	22
Scale reliability coefficient	0.9459

Consequently, the amendments resulted in an index comprising 22 items. Table 2 presents this adapted index, sources of disclosure items, and aligns them with the latest reporting guidelines, including GRI 305: Emissions 2016, GRI 302: Energy 2016, GRI 103: Management Approach 2016, and the CDP Climate Change 2023 Questionnaire.

Table 2. CCD index

Category	Code	GRI	CDP	Disclosure item	Reference
Climate change: risks & opportunities	CC1	103-1	C2.1, C2.2, C2.3, & C2.4	Assessment/description of the risks (regulatory, physical or general) relating to climate change and actions taken or to be taken to manage the risks	Bae Choi et al. [22]
	CC2	103-1	C2.1, C2.2, C2.3, & C2.4	Assessment/description of current (and future) financial implications, business implications and opportunities of climate change	
GHG emissions accounting	GHG1	305-1, 305-2, & 305-3	C5.3	Description of the methodology used to calculate GHG emissions (e.g. GHG protocol or ISO)	Bae Choi et al. [22]
	GHG2	103-3	C10.1	Existence of external verification of quantity of GHG emission– if so, by whom and on what basis	Bae Choi et al. [22]
	GHG3	305-1, 305-2, & 305-3	C7.9	Total GHG emissions – metric tonnes CO ₂ -e emitted	
	GHG4a*	305-1	C6.1	Disclosure of Scope 1 direct GHG emissions	
	GHG4b*	305-2	C6.3	Disclosure of Scope 2 indirect GHG emissions	
	GHG4c*	305-3	C6.5	Disclosure of Scope 3 indirect GHG emissions	
	GHG5	305-1: 2.2.5, 305-2: 2.4.5, & 305-3: 2.6.5	C7.4	Disclosure of GHG emissions by sources (e.g. coal, electricity, etc.)	
	GHG6	305-1: 2.2.5, 305-2: 2.4.5, & 305-3: 2.6.5	C7.3 & C7.6	Disclosure of GHG emissions by facility or segment level	
GHG7	305-1: 2.2.5, 305-2: 2.4.5, & 305-3: 2.6.5	C7.9	Comparison of GHG emissions with previous years		
Energy consumption accounting	EC1	302-1	C8.2 & C8.2a	Total energy consumed (e.g. tera-joules or peta-joules)	Bae Choi et al. [22]
	EC2	302-1	C8.2a	Quantification of energy used from renewable sources	
	EC3	302-1: 2.2.6	NA	Disclosure by type, facility or segment	
GHG reduction and cost	RC1	103-2	C4.3, C4.3a, & C4.3b	Detail of plans or strategies to reduce GHG emissions	Bae Choi et al. [22]
	RC2	103-2	C4.1	Specification of GHG emissions reduction target level and target year	
	RC3	103-3 & 305-5	C4.1a	Emissions reductions and associated costs or savings achieved to date as a result of the reduction plan	
	RC4	103-2	C3.4	Cost of future emissions factored into capital expenditure planning	
	RC5*	103-2 & 305-5	C11.2	Use of carbon offsets, including the purchase of carbon credits or any other participation in emissions trading schemes	
Carbon emission accountability	ACC1	103-2	C1.1 & C1.2	Indication of which board committee (or other executive body) has overall responsibility for actions related to climate change	Bae Choi et al. [22]
	ACC2	103-2	C1.1b	Description of the mechanism by which the board (or other executive body) reviews the company's progress regarding climate change	
	ACC3*	NA	C10.1	Mention of certifications or awards relevant to climate change	de Aguiar & Bebbington [81]

Content Analysis

Although users assign different value weights to various disclosure aspects, it is crucial to emphasize that this study does not attempt to investigate the matter from a particular user's perspective. Thus, to avoid the subjectivity associated with utilizing weighted disclosure indices as suggested by Cooke [83], the index used in this study is unweighted. Accordingly, disclosure scores are assigned through a thorough inspection of annual and sustainability reports to determine whether items in the index are present, assigning a score of 1 for existing items and 0 for non-existent items. The total number of disclosed items thereafter results in each firm's overall disclosure score. It is noteworthy that firms' annual and sustainability reports are utilized for content analysis because they are assumed to be firms' primary disclosure channel, given their high accessibility [22].

Index Reliability and Validity

A content validity assessment was performed by comparing the index items with those used in similar studies or frameworks found in the literature. This step ensures comprehensive coverage. As previously discussed, the index items for our study were developed through an extensive literature review, followed by a pilot test with a small sample to refine them for the study context.

CCD data were then gathered using this refined disclosure index. To ensure consistency of the index results across observers, we calculated Cronbach's Alpha to assess internal consistency. As shown in Table 1, the calculated Cronbach's Alpha for the CCD index is approximately 0.946. Based on Hair et al. [84], this high value indicates excellent internal consistency among the items in the index.

In addition to assessing internal consistency, the index's ability to validly measure the CCD construct rather than broader sustainability reporting was evaluated by examining the 22 disclosure items through an extensive literature review and mapping them to established climate-related reporting frameworks, including GRI and CDP. This process ensured that each item specifically captures CCD rather than general sustainability communication.

4-3- Model Specification

An OLS multiple regression model was developed to test the research hypotheses. The model is presented below, and detailed descriptions of the research variables are presented in Table 3.

$$CCD = \beta_0 + \beta_1 SIZE + \beta_2 AGE + \beta_3 ROA + \beta_4 LEV + \beta_5 BIND + \beta_6 BCOM + \beta_7 GRI + \beta_8 EPI + \varepsilon \quad (1)$$

Table 3. Description and measurement of study variables

Type of Variable	Variable	Measurement	Data Collection Source
Dependent variable	Climate Change Disclosure (CCD)	A score is assigned by using a disclosure index that consists of 22 items classified into five main categories	Content analysis using firms' 2022 annual and sustainability reports
	Size (SIZE)	Natural logarithms of total assets	
Independent variables	Age (AGE)	Number of years since the foundation of the firm	A database on the Refinitiv Eikon platform
	Profitability (ROA)	Net income to total assets	
	Leverage (LEV)	Total liabilities to the total assets	
	Board Independence (BIND)	Percentage of independent directors to total number of board directors	
	Board Committees (BCOM)	Dichotomous variable: 1 if the firm has a sustainability or environmental committee, 0 otherwise.	
	GRI Adoption (GRI)	Dichotomous variable: 1 if the firm adopts GRI reporting standards, 0 otherwise	
	Environmental Performance Index score (EPI)	A score that ranges between 0 and 100 and assesses countries based on climate change performance, environmental health, and ecosystem vitality	

5- Results and Discussion

5-1- Nature and Extent of CCD

Content analysis indicates that while CCD is gaining traction in the GCC region, it has not yet become a mainstream practice. Only 89 firms, accounting for 42% of the sample, disclosed at least one item in the CCD index. Most disclosing firms are in Saudi Arabia, which is attributable to the larger number of listed firms in the Saudi market compared to surrounding countries. Nonetheless, Qatar has the highest percentage of firms that disclose carbon, with 58% of its listed companies classified as disclosing firms. Notably, Kuwait shows the weakest engagement in disclosure, with only 6 out of the 33 Kuwaiti firms covered by the study classified as disclosing firms.

The mean disclosure score is approximately 2.82. As depicted in Figure 2, disclosure extent in the UAE is superior, with a mean score of 8.2. In this context, it is essential to note that the UAE also has the highest EPI score in the region. In 2022, the UAE recorded an EPI score of 52.4, while the regional average was about 40. Therefore, in line with institutional theory, it appears that the UAE's environmental initiatives and climate-driven policies have stimulated corporate CCD. Conversely, in line with the findings of disclosure engagement, Kuwaiti firms exhibit a limited level of disclosure, with a mean score of 0.27, warranting further investigation given Kuwait's evident weak CCD practices relative to its peers.

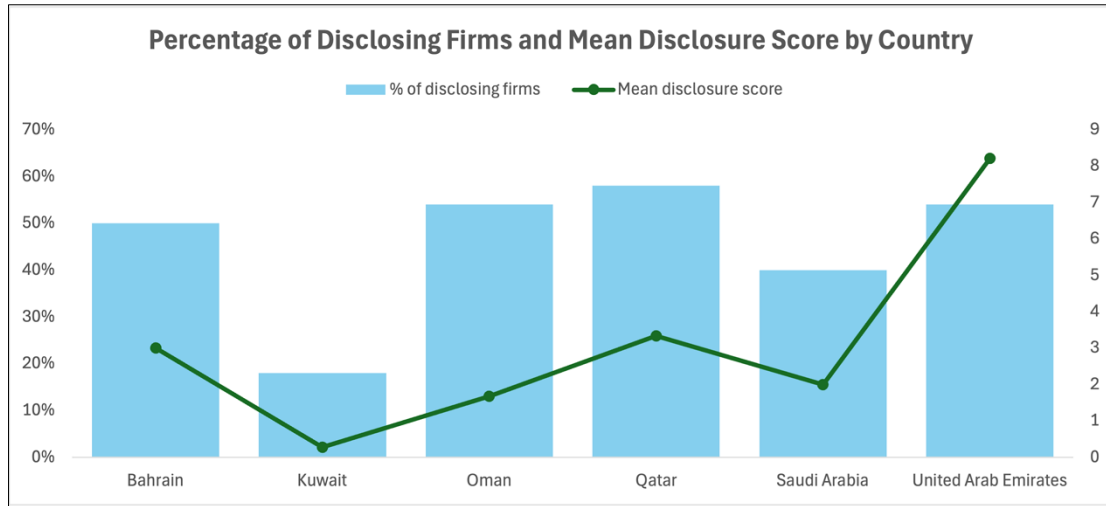


Figure 2. Percentage of disclosing firms and mean disclosure score by country.

Overall, the results suggest that current initiatives by regional stock exchanges to promote ESG and sustainability reporting are insufficient. The limited engagement in CCD and extremely low disclosure scores across the region indicate that GCC countries are struggling to keep pace with rising global demand for carbon disclosure. This challenge seems exacerbated by a regional environment prioritizing economic growth over corporate accountability and transparency. As economies that derive most of their revenues from the oil industry, GCC countries have historically resisted international initiatives promoting sustainability and curbing carbon-emitting activities [85]. Although they have eventually ratified major climate-related treaties, including the Kyoto Protocol and the Paris Agreement [86], their superficial reporting on such agreements suggests that their participation serves merely as a symbolic diplomatic gesture [85]. In this context, the overall low CCD levels observed in the GCC align with climate-justice arguments, which suggest that firms in emerging economies may feel less compelled to adopt extensive voluntary disclosure due to perceptions of unequal historical responsibility for climate change and disproportionate mitigation burdens.

Content analysis results are presented in Table 4 and Figure 3. The findings indicate that firms voluntarily engaging in CCD are more likely to disclose their GHG emissions reduction plans (80% of disclosing firms). Yet the percentage of disclosing firms that provided information on the risks and opportunities of climate change ranges from 39% to 42%. Regarding carbon offsetting programs, firms' engagement is limited, with only 9 firms disclosing their use of carbon offsets to compensate for their GHG emissions.

Furthermore, only a limited number of firms engage in GHG emissions accounting. Only 33 firms reported their Scope 1 direct GHG emissions, while 31 and 15 firms disclosed their Scope 2 and 3 indirect GHG emissions, respectively. Nevertheless, the credibility of these disclosures is questionable since only 25 firms described the methods used to calculate GHG emissions, and only seven firms stated that a reliable third party verifies their calculations. Moreover, efforts to report on energy consumption are relatively weak; only 22 firms disclosed their total energy consumption, and 9 firms quantified their energy consumption from renewable sources.

Concerning carbon emission accountability, firms' possession of climate-related certification or climate-related awards is the most frequently disclosed item (87% of disclosing firms). It is assumed that two primary factors are driving such disclosure. One of which is that most certifications require entitled firms to establish communication channels with internal and external stakeholders [76]. On the other hand, firms might be incentivized to disclose such information because acquiring these awards and certifications can be used as a legitimization tool [87]. Finally, it is imperative to highlight that only 26 firms mentioned the relevant corporate-level body responsible for overseeing climate-related concerns. Only 19 firms provided a detailed description of their adopted mechanism to assess their progress in tackling the matter. In conjunction with the lack of external verification over disclosed information, this absence of a clear accountability structure raises concerns about how climate change is prioritized by these firms and integrated into their governance structures. Undeniably, firms' weak climate accountability increases the risk of greenwashing, enabling

firms to understate their climate impact and misrepresent their decarbonization efforts. Thus, this is expected to erode stakeholders’ trust in firms’ climate action and compromise the credibility of their disclosure. These implications may extend beyond the corporate level as ESG-driven investors begin to deviate from the GCC market due to the region’s notable scarcity of reliable information. In this respect, there is evidence concerning the significance of mandatory external verification in reducing the risk of greenwashing and bridging the information gap between reporting corporations and external users, particularly investors [88].

Table 4. Content analysis: item disclosure absolute and relative frequency.

Category	Code	Disclosure item	Absolute freq.	Relative (%) of the total sample (n= 212)	Relative (%) of disclosing firms (n= 89)
Climate change: risks & opportunities	CC1	Assessment/description of the risks (regulatory, physical or general) relating to climate change and actions taken or to be taken to manage the risks	35	17%	39%
	CC2	Assessment/description of current (and future) financial implications, business implications and opportunities of climate change	37	17%	42%
GHG emissions accounting	GHG1	Description of the methodology used to calculate GHG emissions (e.g. GHG protocol or ISO)	25	12%	28%
	GHG2	Existence of external verification of quantity of GHG emission– if so, by whom and on what basis	7	3%	8%
	GHG3	Total GHG emissions – metric tonnes CO2-e emitted	23	11%	26%
	GHG4a*	Disclosure of Scope 1 direct GHG emissions	33	16%	37%
	GHG4b*	Disclosure of Scope 2 indirect GHG emissions	31	15%	35%
	GHG4c*	Disclosure of Scope 3 indirect GHG emissions	15	7%	17%
	GHG5	Disclosure of GHG emissions by sources (e.g. coal, electricity, etc.)	11	5%	12%
	GHG6	Disclosure of GHG emissions by facility or segment level	11	5%	12%
	GHG7	Comparison of GHG emissions with previous years	31	15%	35%
Energy consumption accounting	EC1	Total energy consumed (e.g. tera-joules or peta-joules)	22	10%	25%
	EC2	Quantification of energy used from renewable sources	9	4%	10%
	EC3	Disclosure by type, facility or segment	13	6%	15%
GHG reduction and cost	RC1	Detail of plans or strategies to reduce GHG emissions	71	33%	80%
	RC2	Specification of GHG emissions reduction target level and target year	37	17%	42%
	RC3	Emissions reductions and associated costs or savings achieved to date as a result of the reduction plan	36	17%	40%
	RC4	Cost of future emissions factored into capital expenditure planning	19	9%	21%
	RC5*	Use of carbon offsets, including the purchase of carbon credits or any other participation in emissions trading schemes	9	4%	10%
Carbon emission accountability	ACC1	Indication of which board committee (or other executive body) has overall responsibility for actions related to climate change	26	12%	29%
	ACC2	Description of the mechanism by which the board (or other executive body) reviews the company’s progress regarding climate change	19	9%	21%
	ACC3*	Mention of certifications or awards relevant to climate change	77	36%	87%

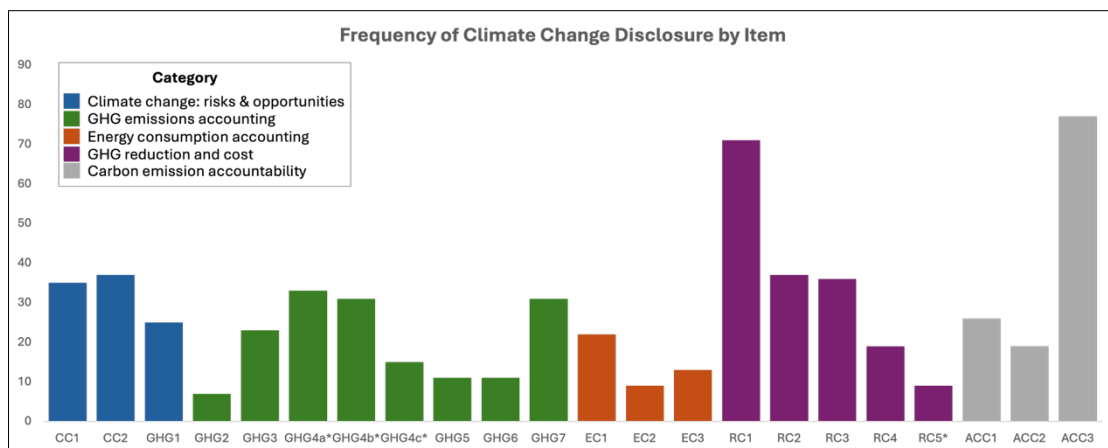


Figure 3. Frequency of climate change disclosure by item

It is important to note that, because this study relies on single-year cross-sectional data, these findings capture CCD practices only for 2022 and do not allow inferences about disclosure trends over time. Additionally, the GCC is in a transitional period, marked by several emerging sustainability-related regulatory reforms. As a result, some of the observed disclosure behaviors may reflect firms' proactive responses to anticipated reporting requirements rather than established practices. This is particularly relevant for the UAE, where relatively high disclosure levels may stem either from more mature reporting practices or from early adjustments prompted by the Securities and Commodities Authority's 2021 announcement that sustainability reporting and GRI compliance would become mandatory for listed firms [36]. These transitional conditions should therefore be considered when interpreting the extent and nature of CCD in 2022 and reinforce the need for longitudinal data to assess how disclosure practices evolve as regulatory frameworks in the region mature.

5-2-Descriptive Statistics

As presented in Table 5, CCD scores range from 0 to 21, with a mean of 2.82 and a standard deviation of 4.89. The average size of firms is measured by the natural logarithm of total assets, which is around 20.06, with a standard deviation of 1.82. Company ages vary from 2 to 69 years, averaging about 31 years with a standard deviation of 16.07, indicating high age variation. Mean profitability, proxied by ROA, is around 3%, with values ranging from -215% to 38.7%. Leverage also varies significantly, ranging from 0.6% to 1174%. On average, independent directors make up about 14% of the board. EPI scores range from 30.7 to 52.4, with a mean of 40.02 and a standard deviation of 6.43.

Table 5. Descriptive statistics of continuous variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
CCDscore	212	2.816	4.891	0	21
SIZE	212	20.055	1.824	16.091	27.221
AGE	212	30.906	16.071	2	69
ROA (%)	212	0.028	0.202	-2.151	0.387
LEV (%)	212	0.516	0.814	.006	11.744
BIND (%)	212	0.142	0.27	0	1
EPI	212	40.018	6.425	30.7	52.4

The descriptive statistics for dichotomous variables, presented in Table 6, indicate that only 13% of sampled firms adopt GRI Standards, and only 24 of the 212 firms have a board committee addressing sustainability or environmental concerns. The findings suggest that corporate sustainable practices remain inadequate despite regional efforts to advance sustainability, as pertinent mandates remain forthcoming.

Table 6. Descriptive statistics of dichotomous variables

Variable	Code	Frequency	%
GRI	1	28	13%
	0	184	87%
BCOM	1	24	11%
	0	188	89%

5-3-Correlation and Collinearity Analysis

The pairwise correlation matrix in Table 7 shows that CCD positively correlates with all independent variables except age. It also indicates no significant multicollinearity, as all correlation coefficients are below 0.8, the threshold for concern. Additionally, the collinearity statistics presented in Table 8 confirm the absence of multicollinearity, as all variance inflation factors (VIFs) are below 5.

Table 7. Pairwise correlation matrix

Variables	CCDscore	SIZE	AGE	ROA	LEV	BIND	BCOM	GRI	EPI
CCDscore	1.000								
SIZE	0.622*	1.000							
AGE	-0.005	0.054	1.000						
ROA	0.081	0.165	0.012	1.000					
LEV	0.134	-0.029	-0.098	-0.310*	1.000				
BIND	0.543*	0.405*	0.077	0.043	-0.051	1.000			
BCOM	0.627*	0.520*	0.020	0.117	-0.031	0.545*	1.000		
GRI	0.686*	0.504*	-0.010	0.104	-0.036	0.590*	0.652*	1.000	
EPI	0.381*	0.140	0.101	-0.115	0.141	0.373*	0.295*	0.383*	1.000

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 8. Collinearity statistics

Variables	VIF	1/VIF
GRI	2.230	0.449
BCOM	2.020	0.496
BIND	1.740	0.573
SIZE	1.520	0.658
EPI	1.310	0.764
ROA	1.160	0.865
LEV	1.150	0.872
AGE	1.040	0.963
Mean VIF	1.520	

5-4-Regression Analysis

As presented in Table 9, the models developed to test the research hypothesis is significant, with an F-statistic of 32.32 and a p-value of 0.00. The model's adjusted R^2 is 0.627, indicating that the model explains around 63% of the variation in CCD.

Table 9. Regression results

CCDscore	Coef.	St.Err.	t-value	p-value	[95% Conf Interval]	Sig
SIZE	0.855	0.142	6.03	0	0.576 1.135	***
AGE	-0.008	0.013	-0.63	0.528	-0.033 0.017	
ROA	0.822	0.645	1.28	0.204	-0.449 2.093	
LEV	0.943	0.149	6.31	0	0.648 1.238	***
BIND	1.882	1.356	1.39	0.167	-0.791 4.555	
BCOM	2.603	1.395	1.87	0.064	-0.148 5.354	*
GRI	4.498	1.395	3.22	0.001	1.746 7.249	***
EPI	0.086	0.051	1.68	0.094	-0.015 0.186	*
Constant	-19.186	3.458	-5.55	0	-26.005 -12.367	***
Mean dependent var		2.816		SD dependent var	4.891	
R-squared		0.641		Number of obs	212	
Adjusted R-square		0.627		F-test	32.320	
Prob > F		0.000				

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

In line with prior studies, the statistical results support H1, confirming a significant positive relationship between firm size and CCD at the 1% significance level [22, 25, 28]. From a legitimacy perspective, large firms face substantial public visibility and therefore experience a strong pressure to demonstrate responsible environmental behavior through voluntary disclosure [55]. Stakeholder theory offers a complementary explanation and reinforces this expectation, as large firms are typically subject to intense scrutiny from diverse stakeholder groups that demand a higher level of transparency on climate-related matters [10], such as investors, regulators, international partners, and NGOs. This effect is particularly relevant to the GCC region, which hosts some of the world's largest oil and gas companies (e.g., Saudi Aramco, Qatar Energy, and Abu Dhabi National Oil Company). Arguably, this strategic importance and international exposure place companies within the region under heightened scrutiny and drive their adoption of CCD practices to maintain legitimacy and manage reputational risk.

H2 is rejected, suggesting that firm age does not meaningfully explain CCD in the region. This is consistent with prior findings from Saudi Arabia [63]. Contrary to expectations, the regression results reveal a negative yet insignificant relationship between age and corporate climate-related disclosure. Although insignificant, the negative relationship suggests that older firms, having already established their reputation, face less pressure to engage in voluntary disclosure aimed at showcasing responsiveness to emerging reporting practices. In contrast, younger firms may be more inclined to adopt contemporary practices such as CCD as part of broader efforts to build legitimacy. H3, which posits a positive effect of ROA on CCD, is also rejected, aligning with several studies [22, 25, 29]. One interpretation, particularly relevant for carbon-intensive sectors, is that firms disclose primarily to manage legitimacy pressures rather than because they possess excess financial resources to support voluntary reporting. Consequently, profitability does not appear to be a meaningful driver of CCD in this context.

H4, which posits a positive impact of leverage on CCD, is supported at the 1% significance level. This result aligns with prior evidence, including a Saudi study indicating a significant positive relationship between leverage and voluntary disclosure [63]. From an agency perspective, firms with a high proportion of debt disclose non-financial information to mitigate agency costs [53]. This is because creditors typically rely on voluntary disclosure to assess firms' overall risk profile, which helps them make more informed decisions [89]. This insight is particularly pertinent to the study's sample, as carbon-intensive firms face substantial environmental liabilities and transition risks [90].

Although independent directors are generally expected to strengthen board oversight and promote greater transparency [91], our regression results do not identify board independence as a significant determinant of CCD; thus, H5 is rejected. While this contradicts many prior empirical findings reporting a positive association between board independence and CCD [26, 30, 54], it is consistent with empirical evidence from emerging markets, documenting an insignificant or negative relationship between the two variables [70]. Similarly, it is consistent with prior findings, revealing that board independence often has little to no measurable effect on ESG reporting [71]. In the GCC setting, independent directors may lack the incentives or environmental expertise needed to influence climate-related reporting practices. Additionally, independent directors may deliberately avoid engagement in complex or sensitive voluntary disclosure topics due to reputational concerns [92], which could further limit their influence on CCD.

H6 is accepted at the 10% significance level, which is consistent with the findings of [26]. Sustainability committees are typically established as part of firms' efforts to gain or maintain legitimacy by demonstrating their awareness of, and responsiveness to, environmental concerns [72]. When such committees exist, their commitment to environmental matters translates into more comprehensive climate-related reporting [26].

Consistent with the findings of prior research [10, 77], H7 concerning the positive impact of GRI adoption is accepted at the 1% significance level. This reflects the normative pressure on firms to align their reporting with GRI reporting guidelines, which have become the most recognized sustainability reporting standards [75]. Within the GCC, this pressure is reinforced by the region's growing emphasis on sustainability reporting and the multiple ESG reporting guidelines issued by stock exchanges that reference GRI as a recommended reporting framework. Accordingly, firms that adopt GRI tend to report more extensively on climate-related matters because GRI topic standards offer guidelines for disclosing a broad range of climate-related information, including "GRI 305: Emissions" and "GRI 302: Energy".

Finally, H8 concerning the positive impact of EPI scores on CCD is accepted, although only at the 10% significance level. This is consistent with prior studies that document the influence of country-level environmental performance on firms' disclosure practices [60]. This relationship can be interpreted through the lens of the institutional theory, which posits that firms adapt their practices in response to external pressures that shape the institutional environment in which they operate [80]. Countries with higher EPI scores typically exhibit stronger national commitments to environmental matters, creating regulatory and normative pressures that encourage firms to align with national environmental priorities. Consequently, firms operating in higher-EPI contexts are more likely to disclose climate-related information to demonstrate conformity with the environmental expectations embedded in their institutional setting. Our content analysis results support this interoperation as the UAE, which recorded the highest EPI score in the region, also exhibited the highest average CCD score, far exceeding those of other GCC countries.

6- Conclusion

The paper examines CCD among carbon-intensive firms in the GCC and identifies the determinants of disclosure. The findings unveil a prevailing weakness in CCD and limited use of external verification, indicating that such disclosure has not yet reached a mature stage in the GCC. Regression results show that firm size, leverage, the presence of sustainability or environmental committees, GRI adoption, and countries' EPI scores significantly and positively influence CCD. Conversely, firm age, profitability, and board independence are not significant determinants, suggesting that CCD in the GCC is driven by legitimacy and institutional pressures rather than by corporate maturity or financial capacity. This study contributes to the literature by providing the first empirical evidence on CCD determinants in the GCC and introducing a disclosure index adapted to the region's context. Our results carry practical insights for policymakers and practitioners, highlighting that wider GRI adoption, stronger sustainability governance, national-level environmental initiatives, and external verification mechanisms could substantially enhance CCD quality.

Several limitations should be considered when interpreting these findings. First, the study relies solely on annual and sustainability reports to measure CCD, overlooking other communication channels. Second, the sample includes only carbon-intensive sectors, restricting the generalizability of the findings. Third, the study focuses on average disclosure patterns and drivers within carbon-intensive firms, ignoring sector-level heterogeneity. Fourth, the use of single-year cross-sectional data prevents an assessment of disclosure trends over time. Finally, the study is conducted during a period of regulatory transition in the GCC, which may affect disclosure behavior. Future research could address these limitations by employing longitudinal data to assess how CCD evolves as institutional environments change, including sector-level comparisons or controlling for industry effects, and incorporating qualitative methods such as interviews with managers to uncover internal motivations that cannot be captured quantitatively. Furthermore, exploration of fairness-related considerations, including historical emissions responsibility and variation in national capacity, may deepen our understanding of how climate justice concerns influence CCD in emerging economies.

7- Declarations

7-1- Author Contributions

Conceptualization, R.A.; methodology, R.A.; software, R.A.; validation, R.A. and H.F.; formal analysis, R.A.; resources, H.F.; data curation, R.A.; writing—original draft preparation, R.A.; writing—review and editing, R.A. and H.F.; visualization, R.A.; supervision, H.F. All authors have read and agreed to the published version of the manuscript.

7-2- Data Availability Statement

The data presented in this study are available on request from the corresponding author.

7-3- Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

7-4- Institutional Review Board Statement

Not applicable.

7-5- Informed Consent Statement

Not applicable.

7-6- Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors.

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