

Comparative analysis of carbon emission disclosure in the Asian Cement Industry

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Abstract

The significant carbon footprint of the cement sector is still accompanied by limited number of systematic comparative assessments of corporate carbon disclosure practices across Asian regions. This study addresses this gap by analyzing carbon emission disclosure practices among 60 listed cement companies across four Asian sub-regions in 2024. The Global Reporting Initiative (GRI) 305: Emissions 2016 standard was adopted as the assessment benchmark due to its globally recognized metric framework for evaluating Scope 1, Scope 2, and Scope 3 emissions, as well as reduction initiatives. Utilizing a descriptive content analysis approach, the results reveal an overall average disclosure rate of 50% across the sample. Sub-regional analyses indicate substantial disparities in disclosure levels: Southeast Asia recorded the highest disclosure rate at 82%, followed by East Asia at 71%, West Asia at 46%, and South Asia at 33%. By identifying these regional disclosure asymmetries and specific reporting deficits, particularly regarding Scope 3 and ODS reporting, this study contributes to the environmental accounting literature by providing empirical evidence of regional disclosure heterogeneity and offering a practical reference for policymakers seeking to standardize sustainability reporting frameworks in high-emission industries.

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1. Introduction

ESG-oriented investment has grown significantly, becoming one of the primary approaches for investors to promote sustainable financial practices (OECD, 2023), thereby positioning ESG disclosure as a vital instrument for enhancing corporate transparency, accountability, and legitimacy among stakeholders. However, companies in Asia frequently face challenges in balancing the adoption of international frameworks, such as the Global Reporting Initiative (GRI), with domestic regulatory constraints and cost pressures (OECD, 2023). According to Frankel et al. (2025), global pressure from investors, regulators, and consumers

drives companies to place greater emphasis on their environmental, social, and governance impacts rather than focusing solely on financial performance. Meanwhile, global climate data highlights the urgency of these commitments; the National Oceanic and Atmospheric Administration (NOAA, 2023) reported that monthly global temperatures throughout 2023 reached record highs, averaging 1.18°C above the twentieth-century average. In addition, atmospheric greenhouse gas concentrations have risen substantially since the industrial era, with carbon dioxide levels increasing by more than 30% (Khatib et al., 2023).

Among various industrial sectors in Asia, as the primary region of global cement production growth, the cement industry presenting a critical environmental challenge. Cement manufacturing is highly carbon-intensive, accounting for approximately 8% of total anthropogenic global CO₂ emissions (Favier et al., 2019; Olsson et al., 2023). Most of these emissions originated from the limestone calcination process, with the remainder generated by intensive thermal energy consumption during production (S&P Global, 2022). Emissions particularly arise from two main sources: process-related (mineral-based) emissions during clinker production and energy-related emissions from fuel combustion for process heat and electricity (Olsson et al., 2023). Recent studies indicate that mineral-based and energy-based sources account for approximately 54% and 46% of production-stage emissions, respectively, highlighting that emission reductions cannot rely solely on energy efficiency improvements (Van Roijen et al., 2024). Globally, emissions from cement production processes have reached approximately 1.6 Gt of CO₂ (Niu et al., 2024).

In the context of the Asian cement sector, effective decarbonization requires greater transparency and consistency in reporting key operational metrics, such as clinker ratios, alternative fuel and biomass utilization, energy efficiency optimization, clinker substitutes, including Supplementary Cementitious Materials (SCMs) and Limestone Calcined Clay Cement (LC3), and Carbon Capture, Utilization, and Storage (CCS/CCUS) technologies. Recent literature highlights that successful decarbonization depends on technological innovation accompanied by robust monitoring, reporting, and policy frameworks that ensure corporate accountability (Barbhuiya et al., 2024). Additionally, capital market pressures continue to intensify, as analysts observe investors progressively divesting from carbon-heavy cement firms in favor of enterprises focused on renewable energy and decarbonization (Dicorrado & Woolley, 2022).

Despite the urgent demand for transparency, carbon disclosure practices across Asia are shaped by substantial regional heterogeneity in regulatory mandates, market incentives, and institutional maturity. As of September 2024, 14 Asian jurisdictions had adopted or planned to adopt reporting standards aligned with the International Sustainability Standards Board (ISSB) framework (HSBC, 2024). A study by the Asia Investor Group on Climate

Change reported that 54% of institutional investors in Asia now disclose climate-related information in accordance with ISSB standards or the Task Force on Climate-related Financial Disclosures (TCFD) framework (Groves, 2025). Furthermore, the EY Global Institutional Investor Survey indicated that 90% of investors view ESG disclosures as essential for assessing long-term risks and opportunities (Nelson, 2021). Similarly, the Carbon Disclosure Project (CDP) reported that by 2016, 97% of the world's leading companies had established carbon reduction initiatives, with 85% reporting specific absolute or relative targets (CDP, 2016).

Nevertheless, empirical research focusing specifically on the Asian cement sector remains scarce. For instance, Tantri et al. (2023) examined sustainability report compliance in only two Indonesian cement companies, leaving a broader regional perspective unexplored. Prior literature suggests that improvements in carbon disclosure led to subsequent reductions in actual emissions (Qian & Schaltegger, 2017), while evidence from other extractive industries demonstrates how companies utilize climate reporting to address stakeholder scrutiny and communicate mitigation efforts (Pellegriño & Lodhia, 2012).

Legitimacy Theory provides a robust conceptual framework for understanding why organizations disclose specific environmental information in response to societal expectations and institutional pressures (Dowling & Pfeffer, 1975). Social and environmental disclosures are frequently deployed to counteract threats to institutional legitimacy, such as environmental crises, heightened media scrutiny, or non-governmental advocacy campaigns (Deegan, 2002). From this perspective, business entities act adaptively to manage stakeholder concerns. Consequently, empirical studies applying Legitimacy Theory argue that firms with weaker environmental performance tend to provide more extensive disclosures to legitimize their operations and compensate for unfavorable environmental impacts (Cho & Patten, 2007; Cho et al., 2012; Clarkson et al., 2011; Patten, 2002).

To address this empirical gap, this study aims to examine and compare the extent of carbon emission disclosures among listed cement companies across Asian sub-regions based on the GRI 305: Emissions 2016 standard. Specifically, it evaluates overall disclosure levels, identifies sub-regional reporting disparities, and analyzes specific disclosure metrics, including Scope 1, Scope 2, and Scope 3 emissions, as

well as mitigation initiatives, across Southeast Asia, East Asia, West Asia, and South Asia. As a result, this study contributes to the sustainability accounting literature by offering empirical insights into sub-regional disclosure asymmetries and providing actionable guidance for policymakers seeking to harmonize carbon reporting practices in carbon-intensive industries.

2. Literature Review and Research Question

Legitimacy Theory is one of the most widely used theoretical frameworks in sustainability and environmental accounting research. It offers key insights into why organizations disclose specific information in response to societal expectations and external pressures. According to Legitimacy Theory, organizations must continuously evaluate the implications of their operational decisions relative to the expectations of the broader social environment (Dowling & Pfeffer, 1975). Under such exposure, companies actively prepare sustainability reports not only for regulatory compliance but also to strategically construct a narrative of legitimacy amidst evolving societal norms (Hasiah et al., 2025).

In corporate reporting, Legitimacy Theory is frequently applied to climate and carbon emission disclosures. Companies fulfill environmental and social obligations, including carbon reporting, by which to gain public recognition and ensure long-term operational continuity (Ummah & Setiawan, 2021). Empirical studies adopting this perspective argue that corporate disclosures serve as adaptive responses to external institutional pressures. Consequently, firms facing greater environmental scrutiny or exhibiting lower environmental performance often provide more extensive disclosures to legitimize their operations and offset adverse environmental impacts (Cho & Patten, 2007; Cho et al., 2012; Clarkson et al., 2011; Patten, 2002).

Although Legitimacy Theory explains the general driver for corporate transparency, institutional pressures and regulatory mandates are not uniform across geographical settings. In Asia, cement manufacturing firms operate under diverse regulatory environments, market incentives, and societal expectations across sub-regions, including Southeast Asia, East Asia, West Asia, and South Asia. Sub-regions are characterized by stringent sustainability mandates and active capital markets, while threats to institutional legitimacy are high, thereby prompting companies to adopt comprehensive carbon reporting

aligned with international standards such as GRI 305: Emissions 2016. Conversely, in sub-regions with emerging regulatory enforcement, institutional pressures to justify carbon-intensive operations are comparatively lower. Given the descriptive-comparative nature of this study and the institutional heterogeneity across Asian sub-regions, this study formulates explicit research questions rather than conventional statistical hypotheses.

RQ1: What is the overall level of carbon emission disclosure among listed cement companies in Asia based on the GRI 305 standard?

RQ2: How does the extent of carbon emission disclosure differ across Asian sub-regions (Southeast Asia, East Asia, West Asia, and South Asia)?

RQ3: Which GRI 305 emission indicators (Scope 1, Scope 2, Scope 3, GHG intensity, GHG reduction, ODS, and air emissions) are most and least frequently disclosed by cement companies across these sub-regions?

3. Methodology

This study employs a quantitative content analysis approach to measure and compare corporate carbon emissions disclosure practices among publicly listed cement companies in Asia. Content analysis integrates systematic categorization with empirical measurement, enabling textual disclosure data to be transformed into quantitative metrics for statistical evaluation (Kondracki et al., 2002; Rozali, 2022). By operationalizing textual information into structured scores, this method provides an objective basis for evaluating regional differences in disclosure practices and indicator-specific reporting trends across the sample.

The Global Reporting Initiative (GRI) 305: Emissions 2016 Standard was adopted as the primary reference framework to assess the extent of which companies disclose information related to greenhouse gas (GHG) emissions, or carbon emissions. GRI 305 provides a structured framework for reporting quantitative and qualitative information on direct emissions (Scope 1), energy indirect emissions (Scope 2), and other indirect emissions (Scope 3) resulting from a company's activities (Global Reporting Initiative, 2021). According to KPMG (2022), the GRI reporting standards enable companies to present sustainability information in a more transparent and comparable manner, thereby facilitating investors and other stakeholders in assessing the economic,

social, and environmental impacts of corporate activities. The application of this framework is particularly relevant to the cement industry, which is widely recognized as one of the major contributors to global carbon emissions.

Each report was examined using an emissions disclosure checklist developed based on the indicators specified in GRI 305: Emissions. Carbon emissions disclosure was assessed by comparing seven checklist items with the carbon-related information disclosed by each company. A score of 1 was assigned when an item was disclosed in the company's annual report or sustainability report, whereas a score of 0 was assigned when the item was not disclosed. Partial or incomplete disclosure was still assigned a score of 1. As long as the company provided relevant information corresponding to the assessed GRI indicator, for example, disclosing an emissions reduction target or mitigation project despite incomplete historical emissions data, the indicator was considered fulfilled. Furthermore, quantitative and qualitative disclosures were treated equally in the scoring process. A score of 1 was assigned both when a company presented verified quantitative data, such as emissions quantities expressed in metric tonnes of CO₂, and when it provided descriptive qualitative information regarding its operational practices, such as a description of air-emission control technologies or the operational boundaries of Scope 3 emissions. A score of 0 was assigned only when the company provided no information relevant to the respective indicator.

The initial population consisted of 95 cement companies listed on national stock exchanges across Asia. Purposive sampling was employed based on three explicit criteria: (1) The company operates in the cement manufacturing sector and remained

listed on its respective national stock exchange during the 2024 reporting period; (2) The company published a complete annual report or a standalone sustainability report for fiscal year 2024; and (3) The report was publicly accessible through the company's official website or the respective stock exchange portal. Following the application of these criteria, 35 companies were excluded, resulting in a final sample of 60 cement companies across four Asian sub-regions: Southeast Asia (n = 11), East Asia (n = 10), West Asia (n = 9), and South Asia (n = 30).

This sub-regional distribution reflects the actual population density and public reporting availability of listed cement firms across the selected Asian stock markets, where South Asia comprises 50% of the final sample (n=30) due to the high listing density of cement manufacturers in India. Given the varying regional sample sizes, cross-regional comparisons are treated strictly as descriptive reporting patterns rather than inferential claims. The disclosure scores were then summed and divided by the total number of indicators to determine the carbon emissions disclosure level for each company. The analysis relied on secondary data obtained from annual reports and sustainability reports collected from the official websites of the respective companies and national stock exchanges. Table 1 presents the sample selection process.

Table 1. Sample selection process

Sample Selection	Number of Firms
Initial population	95
No 2024 annual/sustainability report	(24)
Other exclusion criteria	(11)
Final sample	60

Table 2. The GRI 305 Index: Emissions 2016

GRI 305	Scope
305-1	Direct (Scope 1) GHG emissions
305-2	Energy indirect (Scope 2) GHG emissions
305-3	Other indirect (Scope 3) GHG emissions
305-4	GHG emissions intensity
305-5	Reduction of GHG emissions
305-6	Emissions of ozone-depleting substances (ODS)
305-7	Nitrogen oxides (NOX), sulfur oxides (SOX), and other significant air emissions

(Global Reporting Initiative, 2016)

$$CED = \frac{\text{Number of items disclosed}}{7}$$

Table 3. Descriptive statistical analysis results for carbon emission disclosure

Region	Min	Max	Mean	Median	Std.Deviation
Southeast Asia	0.14	1.00	0.82	0.86	0.25
West Asia	0.00	1.00	0.46	0.43	0.40
East Asia	0.14	0.86	0.71	0.71	0.21
South Asia	0.00	1.00	0.33	0.14	0.36
Asia (Overall)	0.00	1.00	0.50	0.57	0.38

4. Results

Table 3 outlines the descriptive statistics for corporate carbon emission disclosure across the 60 sampled Asian cement companies based on the GRI 305: Emissions (2016) standard.

In response to RQ1, the overall mean carbon emission disclosure score across Asian cement firms is 0.50 (50%), indicating that sampled firms report, on average, half of the baseline metrics recommended by GRI 305. The aggregated scores show substantial variation, ranging from non-disclosure (0.00) to full disclosure (1.00), with a standard deviation of 0.38. In general, cement industry companies in Asia have disclosed approximately half of the carbon-related aspects that should be reported in their accountability reports. Indicating that, on average, companies report at least half of the indicators specified under the GRI 305: Emissions standard. Although several companies demonstrate high levels of disclosure, the overall pattern displays substantial descriptive variations across sub-regions.

To address RQ2, disclosure scores were disaggregated into four Asian sub-regions. As presented in Table 3, substantial descriptive differences in disclosure levels are observed across regional boundaries. Readers should interpret these sub-regional comparisons solely as descriptive patterns rather than inferential statistical claims. Southeast Asia demonstrates the highest average disclosure rate at 82% (0.82), followed by East Asia at 71% (0.71), West Asia at 46% (0.46), and South Asia at 33% (0.33). (Note: The sample distribution reflects the underlying population structure of listed cement companies in Asia, where South Asia comprises 50% of the sample (n=30) due to high listing density in India. Readers should interpret sub-regional comparisons as descriptive patterns rather than inferential claims).

In most regions of Asia, including Southeast Asia, West Asia, and South Asia, the highest disclosure score reaches 1.00 (100%), indicating that some companies fully disclose all carbon emission indicators. However, in East Asia, the highest level

of disclosure reaches only 0.86 (86%). At the lower end, the minimum disclosure values are observed in West Asia and South Asia, where at least one company in each region does not disclose any carbon emission information at all. Generally, the highest percentage of carbon emission disclosure reaches 100%, indicating that several companies across Asia fully disclose their carbon emission information. Across different regions in Asia, there are companies that report all carbon emission indicators in their corporate disclosures.

In Southeast Asia, the highest level of disclosure is achieved by several companies. Specifically in Indonesia, most cement companies disclose their carbon emission information comprehensively. Several cement companies in Indonesia fully disclose all carbon emission indicators, including PT Semen Indonesia Tbk, PT Indocement Tungal Prakarsa Tbk, PT Semen Baturaja Tbk, and PT Solusi Bangun Indonesia Tbk. In contrast, the lowest level of carbon emission disclosure in Southeast Asia is 14%, reported by Vicem Ha Tien Cement JSC, a cement company based in Vietnam.

In West Asia, the highest level of carbon emission disclosure, reaching 100%, is reported by CIMSA, a company from Turkey, and EMSTEEL, based in the United Arab Emirates. On the other hand, the lowest level of disclosure is 0%, indicating that a company does not disclose any information related to carbon emissions. The company identified with this level of disclosure is Raysut Cement Company (RCC). In East Asia, many cement companies disclose carbon emissions; however, none of them provide full disclosure. Several companies from different countries report relatively high levels of carbon emission disclosure, with the maximum value reaching 86%.

In South Asia, the highest level of carbon emission disclosure also reaches 100%. Companies with the highest level of disclosure are primarily from India, including UltraTech Cement, Shree Cement Ltd., and JK Lakshmi Cement Ltd. Although the cement industry in South Asia includes a relatively large number of companies, several firms

do not disclose their carbon emissions. These include Confidence Cement PLC and Aramit Cement from Bangladesh; Kakatiya Cement Sugar & Industries and Mangalam Cement Ltd. from India; as well as Attock Cement Pakistan Ltd., Dandot Cement Co. Ltd., Dewan Cement Ltd., and Fecto Cement Ltd. from Pakistan.

Table 4 outlines the reporting frequencies for each GRI 305 indicator across sub-regions to answer RQ3. The data presented in Table 4 provide a detailed breakdown of each indicator examined in carbon emission disclosure. Carbon emission disclosure presents information regarding the amount of greenhouse gas (GHG) emissions generated by a company as well as the efforts undertaken to reduce them. More comprehensive carbon emission disclosure can benefit businesses by highlighting the environmental impacts associated with their operations (Ramadani & Mukhtaruddin, 2025). Such transparency can also encourage support from stakeholders and may influence firm value (Agatha & Aryati, 2024).

In southeast Asia, all sampled companies, which include 11 companies, disclose information related to GHG emission reductions, representing 100% disclosure. In West Asia, 8 out of 9 companies disclose this indicator, equivalent to 89%. Similarly, in East Asia, 9 out of 10 companies report GHG emission reductions, accounting for 90% disclosure. In contrast, South Asia shows a lower level of disclosure, where 20 out of 30 companies report this indicator, representing 67%. These results indicate that the disclosure of GHG emission reduction is relatively high across all regions compared to

other indicators. However, substantial descriptive variations in disclosure proportions are observed across regions, with Southeast Asia demonstrating full disclosure among sampled companies, while South Asia displays the lowest proportion among the four regions.

5. Discussion

The findings of this study indicate that the overall level of carbon emission disclosure among cement companies in Asia remains moderate, with an average disclosure rate of 50%, as presented in Table 3. Certain number of firms have begun to engage in carbon emission reporting, while the extent of disclosure is not yet comprehensive, since the observed variation in disclosure levels across regions highlights the uneven adoption of carbon reporting practices within the Asian cement industry. Descriptive disparities in disclosure levels across regions may reflect differences in regulatory environments, stakeholder pressure, and the degree of environmental awareness across countries; however, these institutional factors were not empirically tested in the present study.

Compared to previous studies, these results demonstrate a considerable improvement in the level of carbon emission disclosure. Simamora & Mulyani (2023) found that carbon emission disclosure among companies in the basic and chemical industry sector in Indonesia remained relatively low, with only about 17% of companies disclosing carbon emission information. The higher disclosure level observed in this study suggests that cement companies in Asia tend to demonstrate greater awareness and

Table 4. Number of carbon emission disclosures per indicator

GRI 305: Emissions 2016	Southeast Asia		West Asia		East Asia		South Asia	
	Total	Percent	Total	Percent	Total	Percent	Total	Percent
Direct (Scope 1) GHG emissions	10	91%	5	56%	9	90%	8	27%
Energy indirect (Scope 2) GHG emissions	10	91%	5	56%	9	90%	8	27%
Other indirect (Scope 3) GHG emissions	9	82%	3	33%	8	80%	7	23%
GHG emissions intensity	9	82%	3	33%	7	70%	8	27%
Reduction of GHG emissions	11	100%	8	89%	9	90%	20	67%
Emissions of ozone-depleting substances (ODS)	5	45%	2	22%	0	0%	4	13%
Nitrogen oxides (NOX), sulfur oxides (SOX), and other significant air emissions	9	82%	3	33%	9	90%	14	47%
Average Carbon Emission Disclosure		82		46		73		33
Total Sample Companies		11		9		10		30

commitment toward carbon emission transparency. The achievement of a 50% disclosure level can therefore be considered relatively satisfactory when compared with prior research that highlights the generally low level of carbon emission disclosure across industrial sectors. However, the standard deviation of carbon disclosure in Asia is recorded at 0.39, indicating that the variation in disclosure practices among companies is relatively high. This variation suggests that there is still no uniform standard governing carbon emission disclosure practices among cement companies in Asia. To further illustrate this variation, selected companies with relatively high levels of disclosure are discussed in more detail.

PT Semen Indonesia Tbk is a state-owned cement holding company in Indonesia that oversees several cement subsidiaries. In its sustainability report, the company establishes a sustainability strategy framework that includes carbon emission reduction initiatives. For instance, the company sets a specific CO₂ emission target of 520 kg CO₂ per ton of cement, along with a stretch target of 493 kg CO₂ per ton of cement by 2032. These targets reflect the company's commitment to reducing carbon emissions generated from its operational activities.

Similarly, PT Indocement Tungal Prakarsa Tbk is one of the largest cement producers in Indonesia and also publishes sustainability reports, including disclosures on greenhouse gas (GHG) emissions. According to the company's annual report, the United Nations Framework Convention on Climate Change (UNFCCC) issued Certified Emission Reductions (CER) to Indocement for its success in reducing emissions through the implementation of the blended cement project. In addition, the company has introduced cement products with lower clinker content, namely Portland Composite Cement (PCC), which produces approximately 200–250 kg less CO₂ per ton of cement compared to conventional Ordinary Portland Cement (OPC).

PT Semen Baturaja Tbk also fully disclosed its carbon emissions in 2024. According to information available on the company's official website, PT Semen Baturaja continues to develop innovations in the use of alternative fuels to reduce carbon emissions and support the national energy transition program. In 2024, the company successfully increased its Thermal Substitution Rate (TSR) to 3.18%, exceeding the company's target of 2.63%. This achievement demonstrates the company's commitment to reducing dependence on fossil fuels while supporting

the decarbonization targets of the cement industry in Indonesia. PT Solusi Bangun Indonesia Tbk (SBI), which operates as part of the Semen Indonesia Group (SIG) holding company following its acquisition, also shows a strong commitment to reducing carbon emissions. In its sustainability report, the company states that it has contributed to a 16.5% reduction in carbon emissions in its operational activities. Furthermore, the company has achieved a Thermal Substitution Rate (TSR) of 13% and aims to increase this figure to 25% by 2030.

At the lower end, the carbon emission disclosure level in Southeast Asia is recorded at 14%, as reported by Vicem Ha Tien Cement JSC in Vietnam, highlighting the presence of firms with minimal reporting practices. The company does not publish a sustainability report, which may partly explain the limited disclosure of carbon emission information. According to the Report on National GHG Inventory for 2016 – Vietnam, the Industrial Processes and Product Use (IPPU) sector, which includes the cement industry, faces challenges in collecting activity data and determining appropriate emission factors. Indicating that measuring emissions in industries such as cement requires complex technical data and methodologies, which have not yet been fully standardized in Vietnam. Consequently, the limited availability of standardized emission measurement systems may contribute to the relatively low level of carbon emission disclosure by companies such as Vicem Ha Tien Cement JSC.

In West Asia, the achievement of full carbon emission disclosure (100%) by CIMSA and EMSTEEL highlights that some firms in the region have reached a high level of transparency in reporting environmental information. CIMSA is a cement company in Turkey and part of the Sabanci Holding Group. The company regularly publishes integrated annual reports and ESG reports through its Global Reports platform. CIMSA has also received support from the International Finance Corporation (IFC) for its decarbonization initiatives, which include energy efficiency improvements, the installation of solar panels, and the utilization of waste heat. In its 2024 Integrated Annual Report, CIMSA states that it has reduced CO₂ emission intensity for Scope 1 and Scope 2 by 14.6% per ton of cement product compared with the 2021 baseline, as part of its efforts to achieve more ambitious emission reduction targets by 2033.

Another company with a high level of disclosure is EMSTEEL, which has committed to reducing greenhouse gas (GHG) emissions by

30% in its cement business by 2030 compared with the 2019 baseline and aims to achieve net-zero emissions by 2050. In 2024, 86% of Emirates Steel's total electricity consumption was sourced from renewable energy, accompanied with a growing emphasis on decarbonization and further extending the use renewable energy, EMSTEEL aims to reduce its carbon footprint through a range of strategic and operational initiatives in support of the Net Zero 2050 agenda and the UAE's climate goals.

On the other hand, Raysut Cement Company (RCC) records a disclosure level of 0%, suggesting that no carbon emission information is reported by the firm. RCC is the largest cement producer in Oman, with clinker and cement production facilities that export to markets across the Middle East, East Africa, and the Indian Ocean island. While the absence of disclosure might theoretically relate to early-stage internal carbon accounting practices, the underlying reasons for non-disclosure remain outside the empirical scope of this paper.

In East Asia, a considerable number of cement companies disclose carbon emissions, although none achieved a full disclosure. However, several firms across the region demonstrate relatively high levels of carbon emission reporting. The highest disclosure level is 86%, achieved by China National Building Material Group (CNBM), Taiwan Cement Corporation, and China Tianrui Group Cement Co. from China, as well as Sumimoto Osaka Cement and Mitsubishi Materials from Japan. According to its 2024 ESG report, China National Building Material Group (CNBM) reported a 15% reduction in total greenhouse gas emissions compared with the previous year. The company has also achieved reductions in CO₂ emissions through the development of photovoltaic power generation and waste heat power generation. In terms of revenue, CNBM generated 44.8 billion yuan from environmentally friendly products and 44.6 billion yuan from products that support the development of a green society.

Another company with relatively high levels of carbon emission disclosure is Taiwan Cement Corporation (TCC). TCC is a major cement and construction materials company in Taiwan with global operations, including activities in mainland China and Europe. The company's business extends beyond traditional cement production to low-carbon construction materials, green energy, material recycling, and related products. TCC has set a target to reduce emissions, particularly Scope 1 and Scope 2 emissions, by 26.8% compared with the 2016

baseline by 2030. The company has also obtained validation from the Science Based Targets initiative (SBTi) for the 1.5 °C pathway and has committed to achieving net-zero emissions by 2050 for its cement and concrete business units.

China Tianrui Group Cement is another cement company listed on the Hong Kong Stock Exchange. The company produces clinker and cement and has a relatively large production capacity within China's cement industry. It has implemented wet desulfurization technology to absorb and reduce sulfur emissions generated during clinker combustion in the cement production process, while also complying with environmental protection standards in the cement industry. The adoption of this technology helps the company reduce the environmental impact of its production activities. In contrast, the lowest level of carbon emission disclosure in East Asia is reported by BBMG from China, with a disclosure level of only 14%, indicating that the company disclosed only one out of the seven disclosure indicators.

A maximum carbon emission disclosure level of 100% is observed in South Asia. The companies attaining this highest level of disclosure are largely based in India, including UltraTech Cement, Shree Cement Ltd., and JK Lakshmi Cement Ltd. UltraTech Cement is the largest producer of grey cement, ready-mix concrete, and white cement in India and one of the largest cement producers in the world. According to information available on the company's website, UltraTech has established an environmental policy based on five key pillars: climate change (carbon emissions), energy transition, water management, circular economy (waste and resource management), and biodiversity management (UltraTech Cement, 2025). In its ESG Factbook, the company reports that it has implemented an internal carbon pricing strategy. This strategy involves setting an internal price of USD 10 per ton of CO₂ to support the integration of climate-related risks into financial planning and investment decisions. Furthermore, in its Sustainability Linked Bonds (SLB) Performance Report published in June 2024, UltraTech Cement states that it has successfully doubled its energy productivity compared with the 2010 baseline, achieving this milestone earlier than its initial target set for 2035 (UltraTech Cement, 2024). The company has also fulfilled its commitment under the EP100 initiative, which aims to significantly improve energy efficiency.

In addition to UltraTech Cement, another major cement producer in India is Shree Cement. The company also demonstrates a high level of transparency in its carbon emission disclosure. In its 2024 Annual Report, Shree Cement identifies climate change as a potential risk associated with cement production. These risks include potential government regulations that may affect operational continuity due to the high level of carbon emissions, as well as increased scrutiny from the investment community regarding climate-related impacts that may influence the company's market capitalization. To address these challenges, Shree Cement has identified several mitigation initiatives, including energy efficiency projects, the use of renewable energy, increased utilization of alternative fuels, and the production of blended cement. The company has also committed to achieving 100% renewable energy by 2050 as part of the RE100 initiative. In addition, Shree Cement targets a reduction of Scope 1 emissions by 12.7% and Scope 2 emissions by 27.1% per ton of cement product by 2030 compared with the 2019 baseline.

Another company with a high level of carbon emission disclosure in India is JK Lakshmi Cement. The company is part of the long-established JK Organization and has developed a climate and sustainability roadmap in response to the fact that cement production is a major contributor to its greenhouse gas emissions. JK Lakshmi Cement focuses on reducing its carbon footprint, with a target of achieving net-zero emissions by 2047. During the year of observation, the company's renewable energy utilization reached 38%, with plans to meet its entire electricity demand from renewable energy sources by 2040. In addition, the company aims to increase its Thermal Substitution Rate (TSR) to 20% by 2030 through the expanded use of alternative fuels and improved emission management. JK Lakshmi Cement has also introduced green cement products designed to be more environmentally friendly.

Despite the relatively large number of companies in the South Asian cement industry, many firms still do not disclose their carbon emissions. These include Confidence Cement PLC and Aramit Cement from Bangladesh, Kakatiya Cement Sugar & Industries and Mangalam Cement Ltd. from India, as well as Attock Cement Pakistan Ltd., Dandot Cement Co. Ltd., Dewan Cement Ltd., and Fecto Cement Ltd. from Pakistan. Importantly, although these companies publish annual reports, they do not provide any information related to carbon emissions.

For example, although Confidence Cement PLC and Aramit Cement in Bangladesh provide clear corporate profiles in their annual reports, no environmental or sustainability reports disclosing carbon emission data are publicly available. Differences in national regulatory frameworks or firm-specific resource constraints may be associated with these varying disclosure levels; however, these explanatory factors were not directly evaluated in this study.

Similarly, in India, Kakatiya Cement Sugar & Industries and Mangalam Cement Ltd. do not provide carbon emission disclosures in their annual reports. A comparable pattern is observed in Pakistan, where several cement companies also omit carbon emission metrics from their corporate disclosures. While institutional governance literature frequently discusses firm size and regulatory enforcement as potential drivers of corporate disclosure, these explanatory factors were not empirically evaluated in the present study. Ideally, cement companies, regardless of their size, should disclose their carbon emissions. The cement industry is recognized as one of the largest contributors to global carbon emissions, and its activities have significant implications for climate change and environmental sustainability. Greater transparency in carbon emission disclosure can help companies better manage their environmental impacts while responding to increasing stakeholder expectations for social and environmental accountability.

According to a study conducted by [Athaya et al. \(2025\)](#), the measurement of carbon emissions can help companies develop mitigation strategies, improve operational efficiency, and comply with environmental regulations. The data presented above illustrate information on greenhouse gas (GHG) emissions and emission reduction efforts in 2024 across several regions in Asia. The assessment is based on three main emission categories: direct emissions (Scope 1), indirect emissions related to energy consumption (Scope 2), and other indirect emissions (Scope 3), as well as several additional emission-related indicators. The results indicate that each region in Asia demonstrates different reporting patterns, reflecting varying levels of engagement and awareness regarding climate change issues.

In Southeast Asia, almost all cement companies report disclosures related to direct emissions and energy-related indirect emissions (91%), indicating a relatively high level of awareness regarding greenhouse gas (GHG) emission reporting in the region. In addition, Southeast Asia records a very high

level of participation in emission reduction efforts, with 100% of companies involved in initiatives aimed at reducing GHG emissions. However, disclosure related to ozone-depleting substances (ODS) remains relatively limited in Southeast Asia. Despite this limitation, more companies in Southeast Asia report ODS-related emissions compared with companies in other regions of Asia.

Meanwhile, West Asia shows a relatively lower level of reporting, particularly for other indirect emissions (Scope 3), with only 33% of companies disclosing such data. Despite the relatively low level of Scope 3 disclosure, the region demonstrates a fairly strong commitment to greenhouse gas (GHG) emission reduction, as 89% of companies report initiatives aimed at reducing carbon emissions. However, disclosures related to ozone-depleting substances (ODS) and nitrogen oxides (NO_x) remain limited in West Asia, indicating potential constraints in reporting practices or a lower level of awareness regarding these issues. East Asia, in contrast, demonstrates relatively solid performance across most indicators. The majority of companies in this region disclose energy-related emissions (Scope 2) and GHG emission intensity, with approximately 80%-90% of companies reporting these data. East Asia also shows significant efforts in emission reduction, as around 90% of companies disclose initiatives related to reducing emissions. Nevertheless, disclosure of ODS emissions remains very limited in East Asia, with only about 10% of companies reporting this information.

In South Asia, a greater disparity is observed in carbon emission disclosure, particularly in relation to direct emissions (Scope 1) and energy-related indirect emissions (Scope 2), with only around 27% of companies disclosing these indicators. Although approximately 67% of companies in the region report initiatives related to GHG emission reduction, disclosure concerning ozone-depleting substances (ODS) and nitrogen oxides (NO_x) remain very limited. Despite having a relatively large number of companies in the research sample, South Asia appears to face greater challenges in achieving transparency and comprehensive emission reporting.

6. Conclusion and Recommendations

Based on the analysis of carbon emission disclosures among cement industry companies in Asia in 2024, the study finds that the average disclosure score across the sampled Asian cement

companies is 50% of the assessed GRI 305 indicators, indicating growing awareness of environmental transparency and accountability. However, several limitations should be noted. This study relies on content analysis of publicly available reports, which may not fully reflect actual carbon performance and may favor firms with more advanced reporting practices. The use of GRI 305 as the sole benchmark may not capture all dimensions of disclosure, particularly those based on alternative frameworks or country-specific regulations. In addition, content analysis involves a degree of subjectivity that may affect the reliability of the results.

The focus on the cement industry in selected Asian countries also limits the generalizability of the findings, and the cross-sectional design does not capture changes over time or evolving regulatory influences. Considering these limitations, future research is encouraged to adopt longitudinal approaches, incorporate multiple disclosure frameworks, and combine content analysis with quantitative emission data, as well as expand the scope to other industries or regions to enhance generalizability.

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