Improving the Integrity of Sustainability Data:
Reviewing Environmental Coverage of Sustainability Data Providers

SGFIN Whitepaper Series #6

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Abstract

Climate change has elevated the importance of sustainability data in corporate and financial decision making. Evaluating corporate sustainability performance, however, is quite complicated due to its multi-dimensional nature. While various entities have proposed sustainability rating frameworks, the ratings assigned by raters tend to exhibit substantial variation, even when they evaluate the same company, in contrast to the relatively consistent evaluations in credit scoring. While these discrepancies can be partially explained by differing (proprietary) methodologies employed by each rater, they could also be due to discrepancies in the sustainability data recorded by each vendor from the sustainability data disclosed by corporations. These discrepancies in input data, further diminish the usefulness of sustainability data and ratings in corporate and investment decisions. This paper brings to light the lack of consistent sustainability data, quantifies the current data gap in the Southeast Asian context, and provides insights to enhance the usefulness of sustainability data for commercial and financial decisions.

About SGFIN

The Sustainable and Green Finance Institute (SGFIN) is a research institute established by National University of Singapore (NUS). SGFIN aims to develop deep research capabilities in sustainable and green finance with a focal point on Asia, and to provide thought leadership and shape sustainability outcomes in policymaking across the financial sector and the economy at large. Supported by exceptional domain experts across NUS, SGFIN equips businesses with critical cross-disciplinary knowledge, training, and toolkits to integrate sustainability dynamics into their business strategies and investment decisions to better quantify the environmental and social impacts of their business developments, operations, products, and services. In essence, SGFIN aims to help companies embed sustainability as a key pillar in their business decisions.

Recommended citation

The cover page features a photo by Joshua Sortino, titled "Worm's Eye-View of Ceiling," published on Unsplash.

Foreword

With global temperature continually reaching new peaks each year, the increasing frequency and severity of climate change impacts have become more pronounced around the world. For financial institutions and market participants integrating the financial repercussions of climate change into their investment analyses, there is an increasing urgency to adopt non-financial metrics that can capture sustainable business practices. Such integration can only be achieved with the availability of accurate and relevant sustainability data, increasing both demand and supply of sustainability data.

On the supply side, corporations have become more accustomed to reporting sustainability metrics in Sustainability and/or Annual Reports. These disclosures are partially spurred by sustainability disclosure requirements mandated by Exchanges around the world. On the demand side, stakeholders – such as financial intermediaries and those beyond the financial sector, e.g., consumers, policymakers, Non-Governmental Organizations (NGOs) - are also pushing for greater transparency in sustainability reporting by companies to facilitate more informed decisions.

Both companies and stakeholders also face challenges in navigating the growing landscape of reporting standards, frameworks and requirements, complicating their understanding of sustainability data and its financial implications. Information intermediaries attempt to address this growing challenge by aggregating multi-dimensional sustainability metrics and providing simplified ratings and scores to facilitate easier interpretation. Despite these efforts, significant inconsistencies remain across different ratings and datasets. This Whitepaper reveals that the inconsistencies could be driven by discrepancies in the initial input data, i.e. the recording of sustainability data indicators disclosed by companies. These discrepancies hinder the usefulness of sustainability data for informed decision-making.

This Whitepaper addresses these challenges, with a focus on the assessment of the reliability of fundamental sustainability data, highlighting and investigating discrepancies between corporate disclosures and vendor data, and providing suggestions for improvements to enhance the value and impact relevance of sustainability data.

Executive Summary

This rising tide of corporate sustainability data has led to a deluge of data that is not easily digestible by investors and stakeholders. The rapidly evolving landscape of reporting frameworks, standards, and requirements for sustainability data, makes it difficult to fully understand the financial implications of this non-financial information. Data providers and platforms (henceforth, information intermediaries) have responded to this growing gap by offering more accessible alternatives, e.g., by consolidating various sustainability metrics into sustainability ratings or scores that are ostensibly straightforward and easy to understand.

Recent research has documented significant inconsistencies among sustainability scores from different sustainability and financial information intermediaries, that are largely attributed in public discourse to the differences in methodologies employed by these information intermediaries. The differences in methodologies seem reasonable in this context since they allow information intermediaries to provide different insights on the manifold dimensionality of corporate sustainability. Indeed, scoring the sustainability performance of a particular company is conceptually more challenging than the by-now highly standardized credit scoring and evaluation mechanisms.

Assessing whether the inconsistencies in sustainability scores documented in existing research reflect genuine disparities in firms' sustainability performance in various dimensions is quite challenging. This challenge arises from the absence of definitive characterizations of the building blocks of each scoring methodology. Most information intermediaries protect their methodologies as proprietary innovations and trade secrets. This analysis is complicated further by the lack of credible and consistent (or even the complete absence of) reporting of sustainability metrics by corporation, making it difficult to discern whether scoring inconsistencies across vendors are due to differences in corporate sustainability performance across its variety of aspects, or merely the result of inconsistencies in handling sustainability data reported by corporations.

This paper provides a direct assessment of the veracity of the fundamental sustainability data that serves as crucial inputs for the calculations of sustainability scores. We examine whether the information intermediaries start with the same initial data inputs in their respective scoring exercise. Discrepancies in such fundamental data can both cause and exacerbate the divergence of sustainability scores, leading to various potential negative consequences, e.g., inaccurate risk assessments and market pricing of corporations leading to inefficient capital allocations. Inefficient allocations related to corporate sustainability are ultimately detrimental to the global objective of alleviating environmental damages in the face of climate change.

For this investigation, we compile a sustainability database from information manually extracted from the Sustainability Reports (and/or Annual Reports) of publicly listed

firms in Southeast Asia, henceforth SGFIN Sustainability Database.[1] This database includes various sustainability indicators manually extracted from corporate reports, primarily focusing on metrics reflecting environmental (E) performance. We observe substantial discrepancies between the data in SGFIN Sustainability Database and the corresponding data as recorded by information intermediaries. We identify and investigate several factors contributing to these data discrepancies, including varied approaches to handling restatements of sustainability metrics, differences in data handling processes, and differing interpretations and definitions for certain indicators.

This analysis underscores the urgent need for consistency, accuracy, and transparency in sustainability data reporting and recording. Improving the integrity and quality of this data will enhance the usefulness of commercially available sustainability ratings as well as internal evaluations of corporate sustainability performance to generate reliable and actionable insights for stakeholders. We hope that our in-depth analysis of these discrepancies and the supplementary database are useful in improving the accuracy and reliability of sustainability data, ultimately leading to better risk assessment, capital allocation, and environmental outcomes.

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[1] The SGFIN Sustainability Database is compiled for several firms publicly listed on Southeast Asia's main stock exchanges: Bursa Malaysia, Malaysia; HNX/HOSE, Vietnam; IDX, Indonesia; PSE, Philippines; SET, Thailand; SGX, Singapore. A limited set of sustainability metrics is available on SGFIN's Sustainability Data Hub (**link:** https://www.sgfin.tech/#/datahub) for public use. Please visit the website for more details.

About the Authors

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1 Corporate Sustainability Data

The relevance of corporate sustainability data has risen significantly over the last decade spurred by global developments in climate change and sustainability. The past decade has seen growing scrutiny on non-financial performance of corporations due to rising importance of sustainability-related risks.

Collecting and recording reliable sustainability data can help companies to understand and manage their impacts and potential risks. The process of measuring and collecting sustainability data is a useful exercise for companies in assessing their performance in areas related to long-term sustainability and ethical practices. By offering measurable insights into environmental, social, and governance factors, sustainability data collection enables companies to implement better risk management strategies and drive sustainable business practices. On a broader scale, corporations can benchmark their performance against peers and identify areas of concern.

Corporations are not the only beneficiaries of reliable sustainability data. Signatory countries of the Paris Agreement also track corporate environmental metrics to ascertain the effectiveness of their climate mitigation strategies. Monitoring sustainability indicators on a national level can reveal previously unacknowledged fault lines.

Additionally, there is a growing demand for corporate sustainability data from investors who seek to be informed about the sustainable (or unsustainable) practices of companies that can be integrated into their investment processes as well as consumers of their products and services.

Key Takeaways:
There is a threefold demand for corporate sustainability data stemming from:
- Corporations recognizing the financial implications (and opportunities) of sustainability-related issues, including global climate change;
- Increased regulatory pressure because of sustainability commitments by nations; and
- Increased pressure from stakeholders, including investors and consumers, for corporations to adopt more sustainable business practices.

1.1   The Rise of Corporate Sustainability Data

The Intergovernmental Panel on Climate Change (IPCC) released its Fifth Assessment Report (AR5) in 2014 and concluded that the Earth's climate was warming because of human activity, mainly via burning of fossil fuels and deforestation (IPCC, 2014). By describing the effects of global warming such as the melting of polar ice, rising sea levels, and higher frequency of extreme weather events, this report highlighted the global action required to mitigate the impacts of climate change.

The economic burden on corporations due to the increasing frequency and severity of extreme weather events associated with climate change has also been significant. In 2023, the World Meteorological Organization (WMO) reported that from 1970 to 2019, the frequency of annual extreme weather events increased fivefold, while the cost per event surged nearly eightfold in the same period (Whitt & Gordon, 2023). Corporations may encounter several sustainability-related risks beyond the physical risks to assets due to extreme weather events. These include operational disruptions from supply chain interruptions and workforce availability issues, which can lead to reduced revenues. Rising insurance premiums for extreme weather events and litigation costs from workplace safety lapses, such as heat-related injuries, also contribute to increased expenses. Furthermore, human capital may be impacted by a higher incidence of chronic health conditions and forced migration due to climate change (Markovitz & Heading, 2024). Additionally, the availability of raw materials can be curtailed, necessitating the procurement of alternative supplies under unfavourable contractual agreements and potentially with worse impacts on the environment.

These potential disruptions and the associated revenue losses or cost increases underscore the growing financial risk and burden that climate change places on corporations. These necessitate the integration of a wide range of corporate sustainability risks into strategic planning and risk management processes to ensure the resilience and long-term sustainability of corporations.

Firms can manage their activities more effectively by measuring and tracking their impacts on the environment. By collecting accurate data, businesses can better understand their environmental footprint, identify areas for improvement, and implement strategies to mitigate negative outcomes. The concurrent management of impacts and risks requires precise data, underscoring the importance of corporate sustainability data.

1.2   Demystifying Corporate Sustainability

Peter Drucker famously said, "What gets measured gets managed." This principle is particularly relevant in the context of corporate sustainability. Businesses impact the environment through their activities, creating a feedback loop where these environmental changes pose sustainability-related risks back to the firms. By collecting and analysing relevant data, businesses can manage this circular relationship more effectively. Understanding current sustainability-related features of corporate activities through meticulous data collection allows for the identification of trends and patterns over time. This enhanced understanding of evolving sustainability practices and sustainability-related risks enables businesses to implement better mitigation strategies, ultimately fostering a sustainable and resilient business model.

The detrimental consequences of climate change towards ecosystems, economies, and societies highlighted in IPCC reports elevate the importance of recognizing sustainability-related risks. Accurate sustainability data is crucial in managing these risks.

Sustainability data is typically categorized into three pillars of corporate sustainability: Environment, Social and Governance, or in short ESG. Environmental data consists of metrics related to environmental impact such as direct and indirect Greenhouse Gas emissions (i.e. Scope 1, Scope 2, Scope 3 emissions); energy consumption data such as electricity purchased; waste management data such as the hazardous and non-hazardous waste produced and the way the waste is disposed or reused; and water management. This paper will focus on data covering the E pillar. Social data includes labor and hiring practices that may show diversity in the labor force via race, age, and gender; community engagement; and human rights violations (Cao & Wirjanto, 2023). Governance data includes linking of executive pay to sustainability metrics; board diversity; corporate bribery (and/or corruption); and whistleblower policies and corporate social responsibility.

1.3   The Growth of Sustainability Data

The growing demand for sustainability data has led to the development of a dynamic market where this data is supplied and consumed by various entities. Investors, regulators, and policymakers seek accurate sustainability metrics to assess corporate impact and make informed decisions. This demand not only drives corporates to provide more sustainability data but also provides the incentives for potential information intermediaries of sustainability data—such as third-party data providers and developers of industry-specific databases—to continuously enhance the scope of their offerings. As corporate sustainability becomes increasingly critical, the market for this data is expanding rapidly.

1.3.1   Supply of Sustainability Data

Corporations disclose sustainability data for several compelling reasons. By providing transparent environmental data, corporations build trust with stakeholders and address growing concerns from the public or investors. Disclosing sustainability data can enhance a company's competitive positioning by underscoring the company's dedication to sustainability and robust governance. Indeed, effective sustainability disclosure can improve stock market performance, facilitate access to capital, and improve opportunities in securing contracts and partnerships.

Collecting sustainability data also enables companies to track and benchmark their performance against industry peers. This comparative analysis helps in assessing their standing relative to competitors and identifying areas for enhancement and potential risks and opportunities. Through a thorough analysis of sustainability metrics, companies can make informed, strategic decisions and proactively address emerging trends. Failing to address these risks could lead to financial losses and damage to their reputation, highlighting the importance of integrating sustainability factors into their risk management frameworks.

As regulatory frameworks around sustainability reporting continue to evolve globally, proactive disclosure ensures compliance with diverse standards and regulations. This approach not only aligns with current regulatory requirements but also positions companies favorably in anticipation of future regulatory developments.

1.3.2   Information Intermediaries of Sustainability Data

Third-party information intermediaries play a pivotal role in the supply of sustainability data by collecting and curating extensive information from corporate disclosures and a variety of other sources, such as government reports, publicly accessible data, and proprietary data. In order to provide additional value, most vendors standardize and package this data into user-friendly formats like sustainability scores or grades, enabling market participants to assess and compare the sustainability performance of companies against their industry and regional peers as well as across different industries and regions.

Beyond mere aggregation, some vendors develop proprietary methodologies to break down complex sustainability factors into more digestible metrics, facilitating easier comparisons across sectors, peers, and regions. A relatively simple approach is to scale sustainability metrics by outputs, revenues, or the number of employees, to capture the intensity, e.g., emission intensity. However, it is crucial to remember that while third-party vendors process and shape this data, the fundamental information mostly originates from the companies' own disclosures via annual financial and/or sustainability reports.

1.3.3 Demand for Sustainability Data

The demand for sustainability data is driven by multiple stakeholders, each with distinct objectives. Supply chain partners downstream seek transparency to ensure sustainable sourcing practices. Asset owners and managers require reliable data to integrate ESG factors into their investment strategies. Retail investors, increasingly aware of the importance of sustainability, also push for clearer, more accessible data to make informed decisions. This collective demand reflects the growing importance of sustainability metrics in ensuring sustainable practices, managing sustainability-related risk, and ultimately improving long-term financial outcomes across industries.

<u>Demand from Supply Chain Partners</u>
Companies play a significant role in the growing demand for sustainability data, particularly through their collection of sustainability metrics for their own public disclosures. Recent research documents that companies are influenced by their peers when determining the extent and nature of their environmental disclosures, as they need to align with industry standards and avoid falling behind in regulatory and public expectations (Ji et al., 2023). The peer effect is a critical factor in this process, as companies often mirror the disclosure practices of their peers to maintain legitimacy and competitiveness within their industry. This motivation extends to downstream supply chain partners who also seek to enhance their appeal to potential clients by aligning with industry expectations and practices in sustainability reporting.

Global companies are striving to enhance their Scope 3 GHG emissions tracking to improve their disclosures and track their progress towards their own emissions targets. They do this by driving sustainability throughout their supply chains and incorporating supplier-specific sustainability data (rather than relying on industry-average figures). They would apply pressure on companies on the supply chains —including private ones—to track, monitor, report, and reduce their respective emissions. This aspired improvement in supply chain transparency is supported by large companies setting science-based targets that guide their active engagements with suppliers, encouraging these smaller companies to provide public sustainability disclosures, and incentivizing responsible business practices by integrating sustainability requirements into business contracts.

Demand from Asset Owners and Managers

Asset owners and managers also play a pivotal role in driving the demand for sustainability data. In the context of climate-related reporting, these institutions face significant challenges gathering sufficient information from investee companies, with about three-quarters of respondents highlighting this issue in a recent survey conducted by the Taskforce for Climate-Related Financial Disclosures (TCFD, 2023). In the survey, asset managers shared that they consider climate-related risks to be material, and they receive requests from clients to report sustainability metrics. Given these considerations, asset managers continue to struggle with the lack of sufficient sustainability data from public companies, with 62% of respondents highlighting this issue in the survey. Asset owners find it even more challenging to obtain information on their private investments that can be used in their own climate-related reporting and investment decisions, with 84% of asset owners in the survey highlighting this issue.

Client demand is a major driver of sustainability adoption among asset managers. Many managers report that clients increasingly request investments aligned with sustainability goals, such as renewable energy or the UN Sustainable Development Goals (Ground, 2022). This client-driven demand is reflected in the increased sophistication of ESG investors, who now prioritize the reporting on specific Sustainable Development Goals (SDGs) and the integration of sustainability metrics into investment strategies (Ground, 2022).

Beyond client demand for information, many institutional investors are also motivated by the potential for improved returns and risk management that sustainability data can offer. Emerging evidence suggests that sustainable investments can provide resilience during economic downturns. For example, during the market volatility of March 2020, many ESG-focused index funds outperformed their traditional counterparts, underscoring the value of integrating sustainability into investment strategies (Cao & Wirjanto, 2023).[2]

This growing demand underscores the critical role that accurate and comprehensive sustainability data plays in the financial ecosystem. Asset owners and managers, by demanding more detailed climate-related information, are not only enhancing their own reporting and investing practices but also pushing for greater transparency and accountability across the entire investment chain.

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[2] The relationship between sustainability performance and financial returns is understandably complex. Some studies suggest that sustainable investment practices offer risk mitigation benefits (Nofsinger et al., 2019) and therefore the potential for enhanced risk-adjusted returns, but others indicate mixed outcomes based on mitigating factors such as data quality and market conditions. With these complexities, the overall evidence leans toward a positive or neutral relationship between sustainability and financial performance, with sustainable investments providing benefits in terms of risk management and long-term viability (Cao & Wirjanto, 2023)

<u>Demand from Retail Investors</u>

Influenced by media coverage and heightened awareness, retail investors are more actively seeking sustainable investment opportunities. They increasingly search for sustainability-related information, driven by a desire to align their investments with their values. This trend is reflected in the rise of mentions of "ESG" on social media platforms, particularly since 2016, indicating a growing public interest (Park et al., 2022). This is evidenced by Google Trends data, which shows a notable uptick in searches for terms like "Environmental, Social, and Governance (ESG)" and "Environment and Climate Change" over the past four years as illustrated in Figure 1 and Figure 2. This growing awareness among the public highlights the expanding recognition of sustainability issues.
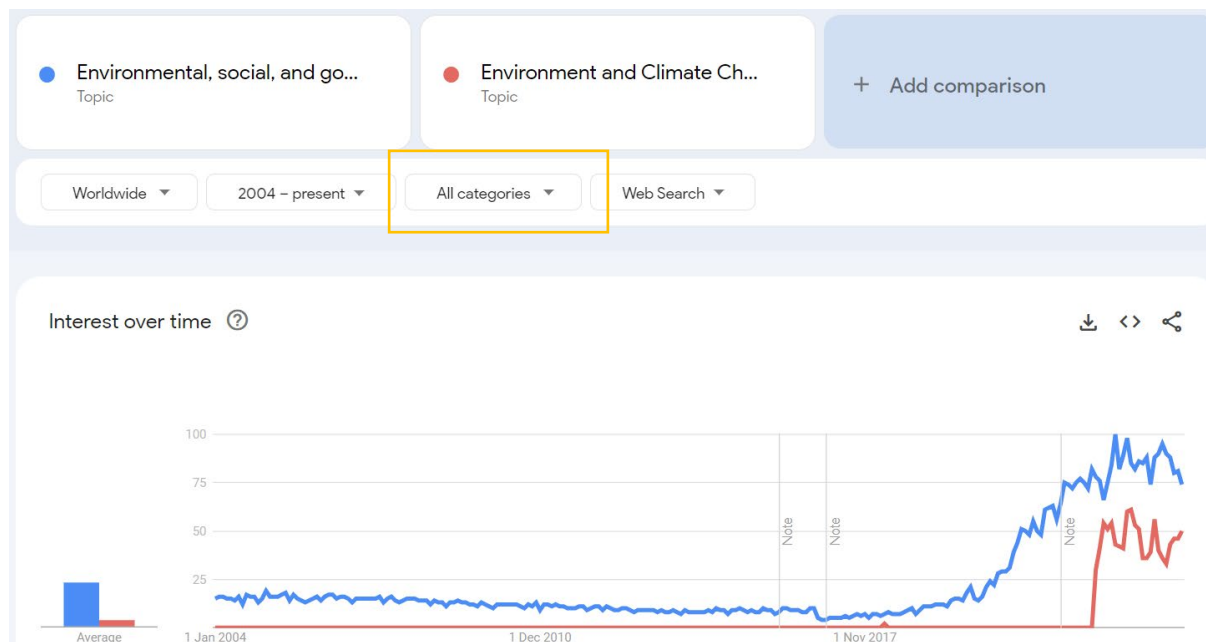
Figure 1: Google Search Trends for Sustainability Terms (2004-present)[3]

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[3] Obtained on 27 August 2024.
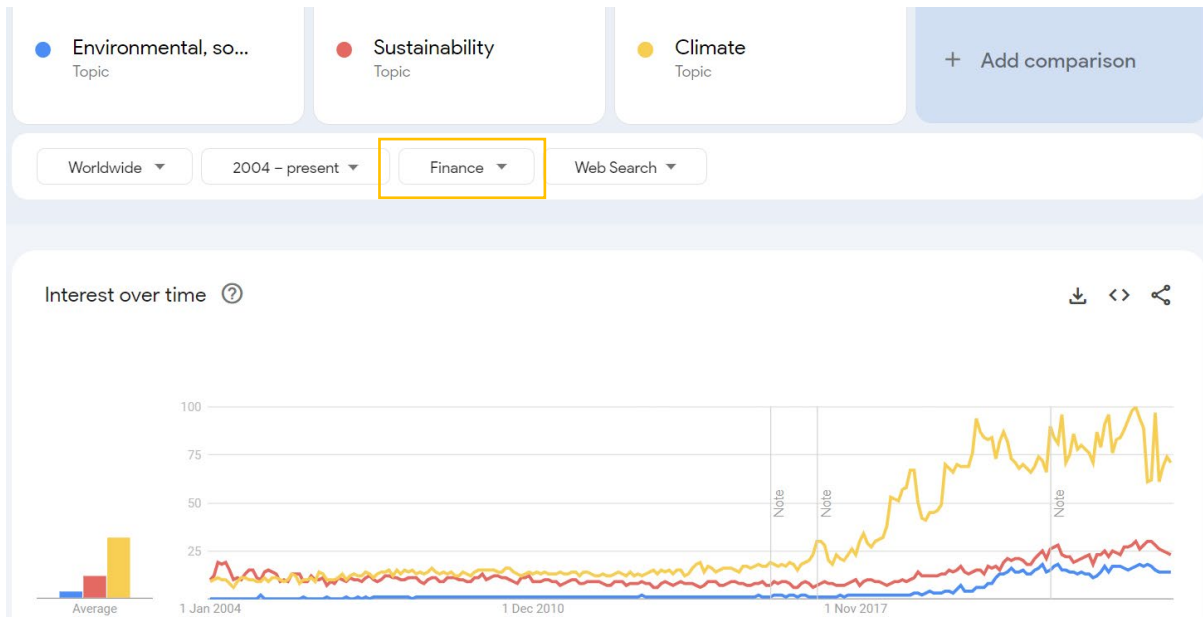
Figure 2: Google Search Trends for Sustainability-Related Terms in the Finance Do-main (2004-present) [4]

Despite the rising demand for sustainability data from investors seeking reliable information to inform their investment strategies, the lack of robust sustainability data remains a significant hurdle. Approximately 40% of investors cited data quality as the greatest barrier to further adoption of sustainability practices (Ground, 2022). This challenge underscores the need for more reliable and comprehensive data sources to support informed investment decisions. Accurate sustainability data is essential for enabling investors to hold companies accountable, manage risks, and align their strategies with long-term sustainability goals (Ground, 2022).

Beyond investors, the broader impact extends to employees, customers, regulators, and NGOs, each utilizing sustainability data for informed decision-making, monitoring, and influencing corporate practices (Kotsantonis & Serafeim, 2019). This underscores the importance of sustainability data in shaping future investment strategies and ensuring corporate accountability, assessing companies not just on financial performance but also on their ability to manage sustainability risks. With the shared goal of capturing a company's performance on sustainability issues being vital for various stakeholders, the demand for accurate sustainability data is set to rise even further in the future.

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[4] Obtained on 27 August 2024.

2 Measurement and Reporting of Corporate Sustainability Data

Corporate sustainability reporting has gained significant momentum over the past decade, driven by the growing importance of sustainability factors in evaluating corporate performance. Companies now measure and disclose sustainability data to provide transparency on how they manage environmental and social risks, which is essential for investors, employees, and the public. While sustainability frameworks, such as Global Reporting Initiative (GRI), TCFD, and International Founding Reference Standards Sustainability Disclosure Standards (IFRS SDS), provide guidelines for reporting, the lack of global standardization complicates efforts to ensure data comparability and reliability.

In Singapore, the Singapore Exchange (SGX) has played a leading role in shaping corporate sustainability practices, with a high adoption rate of sustainability disclosures among listed companies. Despite progress, challenges remain, particularly in climate-related reporting and Scope 3 emissions tracking. Investors increasingly rely on third-party sustainability information intermediaries to assess company performance, though inconsistencies in ratings and scores across different raters raise concerns about data quality and accuracy. The demand for reliable, consistent, and comparable sustainability data continues to grow as investors integrate ESG factors into decision-making processes.

Key Takeaways:
- The absence of global standardization in sustainability reporting limits comparability and undermines effective assessments of corporate sustainability performance.
- Countries in Southeast Asia have distinct sustainability reporting requirements, reflecting their specific regulatory and environmental priorities.
- Direct corporate disclosures, such as sustainability reports, are foundational data sources, providing firsthand information on environmental, social, and governance practices.
- The growing emphasis on climate-related disclosures highlights gaps in the reporting of other important sustainability dimensions, indicating that corporate sustainability metrics may benefit from further refinement.
- Smaller firms, particularly in emerging markets, face significant hurdles in meeting sustainability reporting requirements, highlighting the need for targeted resources and support.
- Third-party information intermediaries play an essential role in enhancing the reliability and standardization of sustainability reporting, addressing the lack of universally mandated standards. However, the variation in data sources and methodologies used by these intermediaries can lead to discrepancies that impact decision-making.

2.1   Frameworks and Standards

In 2015, all United Nations member states adopted the 2030 Agenda for Sustainable Development, which encapsulates the global commitment to resilient and sustainable development with 17 SDGs. These goals aimed to achieve a responsible growth that collectively harmonised economic prosperity, social well-being and the pink health of the environment (United Nations, 2015b). The 2030 Agenda was a crucial initial attempt to codify sustainability metrics and aspirations into a framework or standard.

The year 2015 also marked another important development: the historic accord of Paris Agreement that established a global commitment to limit warming to well below 2 degrees Celsius compared to pre-industrial average temperatures (United Nations, 2015a). The immediate goal of this accord is the peaking of global emissions as soon as possible to pave the way for the world to reduce its emissions. A crucial tenet of the Paris Agreement was the need for enhanced transparency as well as accuracy in reporting climate actions and progress. The reporting requirements at the national level naturally extended to the corporations thereby precipitating the proliferation of frameworks and standards for sustainability reporting by governments as well as regulatory bodies and Non-Profit Organizations (NGOs).

As the importance of managing sustainability-related risks became more apparent, the demand for reliable and comprehensive sustainability data surged, which created a need for frameworks and standards for sustainability reporting.

Frameworks offer a structure for contextualizing information, especially in the absence of well-defined standards. They provide guidance on the direction to take but do not prescribe specific methods. Essentially, a framework consists of principles that shape the thinking about a particular topic without setting concrete reporting obligations (GRI, 2022).

Standards refer to the established levels of quality requirements that reporting entities are expected to meet. These standards specify detailed criteria or metrics on what should be reported for each topic. Typically, corporate reporting standards share common features such as a public interest focus, independence, due process, and public consultation, which provide a solid foundation for the requested information (GRI, 2022). The reporting process generally adheres to established reporting standards to ensure the appropriate presentation and disclosure of information. While sustainability reporting has largely been a voluntary practice, the landscape is evolving fast at both regional and domestic levels. As such, companies should undertake preparations for the impending shift towards mandatory reporting.
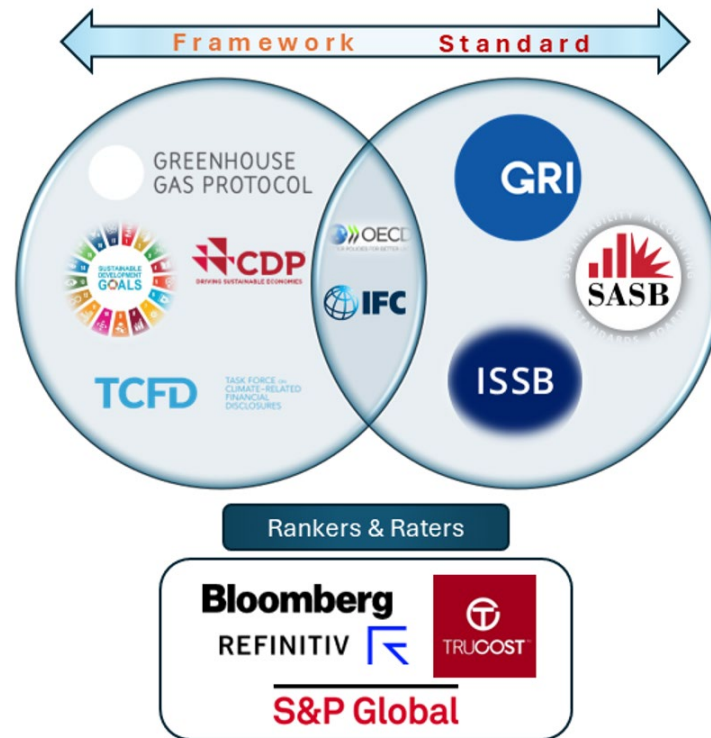
Figure 3: Participants in the Sustainability Data Market

2.1.1 GHG Protocol

The Greenhouse Gas Protocol is a globally recognized framework for quantifying and managing greenhouse gas emissions. It provides a standardized approach for organizations to assess their carbon footprint across three key areas: direct emissions (Scope 1), indirect emissions from purchased energy (Scope 2), and indirect emissions from the value chain (Scope 3) (World Resources Institute, n.d.). By establishing a common methodology, the Protocol facilitates transparent reporting, informed decision-making, and the development of effective emissions reduction strategies. Its applications span corporate reporting, product lifecycle assessment, supply chain management, policy development, and investment analysis (Greenhouse Gas Protocol, n.d.)

2.1.2 Carbon Disclosure Project

CDP (formerly the Carbon Disclosure Project) is a global non-profit organization that offers a platform for companies, cities, states, regions, and public authorities to report and manage their environmental impact, with a focus on areas such as climate change, water security, and forests (CDP, n.d.).Through sector-specific questionnaires that include both general and tailored questions for industries with significant environmental impacts, CDP collects and performs data analyses. The organization then generates scores based on the responses, which are used by investors, policymakers, and other stakeholders to make informed decisions (Hendratama et al., 2024). By promoting transparency, CDP aims to drive environmental improvement and combat climate change.

2.1.3 Taskforce on Climate-related Financial Disclosures

The Task Force on Climate-related Financial Disclosures (TCFD) is a global, industry-led initiative established by the Financial Stability Board (FSB) to develop consistent climate-related financial risk disclosures (TCFD, n.d.). The TCFD's recommendations focus on four core areas: governance, strategy, risk management, and metrics and targets. By providing a framework for organizations to disclose climate-related financial information, the TCFD aims to improve the ability of investors, lenders, and insurers to assess and manage climate-related risks and opportunities (TCFD, n.d.).

2.1.4 Global Reporting Initiative

The GRI standards are among the most widely used for sustainability reporting globally. According to KPMG's 2022 Survey of Sustainability Reporting, 78% of the world's 250 largest companies by revenue (G250) and more than two-thirds of the top 100 companies by revenue across 58 countries (N100) utilize GRI standards in their sustainability disclosures.

Established in 1997, the GRI initially focused on creating an accountability mechanism for responsible environmental conduct principles. Over time, its scope broadened to encompass social, economic, and governance issues. In 2000, GRI introduced its first global sustainability reporting framework. By 2016, GRI had evolved from offering guidelines to setting global standards for sustainability reporting with the GRI Standards (PwC & Centre for Governance and Sustainability NUS Business School, 2023)

2.1.5 Sustainability Accounting Standards Board / International Sustainability Standards Board

The Sustainability Accounting Standards Board (SASB) was established to develop and maintain industry-specific sustainability accounting standards. It focused on identifying financially material sustainability issues. SASB merged with the International Integrated Reporting Council (IIRC) to form the Value Reporting Foundation, which later consolidated with the International Sustainability Standards Board (ISSB). The ISSB, under the IFRS Foundation, aims to create a global baseline for sustainability disclosures, harmonizing various standards for consistent, comparable, and reliable sustainability reporting.

Recently, the IFRS issued its global reporting standardization initiative through its inaugural standards, IFRS S1 and IFRS S2, incorporating and consolidating TCFD recommendations, SASB Standards, Climate Disclosure Standards Board (CDSB) Framework, Integrated Reporting Framework, and World Economic Forum metrics (IFRS Foundation, 2023)

In response to increasing market demands, GRI and the IFRS Foundation are intensifying their collaboration to enhance the interoperability between GRI and ISSB Standards. As GRI remain widely adopted, companies may need to develop strategies for

interoperability and comprehensive reporting to accommodate potential future compliance with additional standards.

2.2 Information Intermediaries: Sustainability Data Platforms

Following the discussion on sustainability standards and frameworks, it is essential to address the role of information intermediaries in sustainability assessments. Some intermediaries act as sustainability rating agencies, evaluating companies' sustainability metrics and aggregating data into accessible scores or ratings based on proprietary methodologies. By consolidating vast amounts of sustainability data, rankers and raters serve as information intermediaries, helping stakeholders interpret complex sustainability metrics and make informed decisions. However, the varying methodologies across these information intermediaries can lead to inconsistencies in ratings, underscoring the need for transparency in their scoring processes to foster reliability and comparability in sustainability assessments. The significance of the data available on the data platforms of these information intermediaries will be further elaborated in Chapter 4.

3 Constructing SGFIN Sustainability Database

The SGFIN Sustainability Database pulls information exclusively from corporate Sustainability and/or Annual Reports, with a focus on six Southeast Asian countries, as the region's susceptibility to worsening climate impacts could incur substantial economic costs. This chapter also examines each country's respective Exchange-driven sustainability reporting requirements, providing a regional view of standardized practices and variances.

Key Takeaways:
- A significant portion of the literature on sustainability data emphasizes the environmental aspect, analysing how it correlates with factors like risk and returns in investment contexts. The SGFIN Sustainability Database focuses on seven key environmental indicators as the starting point for analysis.
- Materiality varies across sectors, influencing which environmental factors companies emphasize in their disclosures. This database uses a standardized set of seven environmental indicators to facilitate consistent analysis across vendors. This approach ensures that even if a specific indicator is not material to a company, the presence or absence of data can be systematically examined across corporate disclosures such as annual and sustainability reports. By standardizing these indicators, it becomes easier to compare data availability and consistency among different vendors, regardless of sector-specific materiality considerations.

The environmental dimensions of a corporation's non-financial risks and opportunities are intricately linked to the natural resources and physical assets vital for its operations. These encompass factors like climate change, carbon management, resource depletion, energy consumption, water consumption, and waste management. Addressing these aspects is crucial for sustainable development, with efficient resource usage emerging as a pivotal strategy. By optimizing material use, minimizing waste, and implementing sustainable energy and water management practices, corporations can aim to reduce their environmental impact and bolster operational resilience and cost-effectiveness, aligning with long-term sustainability goals (International Finance Corporation (IFC), 2021)

For this analysis, materiality is the key criterion in selecting the environmental indicators. Materiality plays a crucial role in sustainability reporting, determining which environmental indicators are most relevant and impactful for stakeholders. This concept ensures that companies concentrate on the most significant environmental impacts and opportunities, rather than distributing their efforts across all possible environmental indicators indiscriminately (Henriksson et al., 2019). This approach aligns with global reporting standards, such as GRI, which emphasizes the importance of identifying material topics that reflect significant economic, environmental, and social impacts, or those that substantially affect stakeholder and influence their decisions.

The seven indicators below were chosen to represent critical intersections between corporate activities and environmental concerns, such as greenhouse gas emissions, energy usage, water consumption, and waste generation. This focus on material aspects ensures that the database provides a relevant and accurate depiction of corporate environmental performance. The seven environmental indicators are:
- Scope 1 Greenhouse Gas Emissions,
- Scope 2 Location-Based Greenhouse Gas Emissions,
- Total Energy Use,
- Total Electricity Use,
- Total Waste,
- Total Water Consumption / Use and,
- Total Water Withdrawal

A detailed description of these indicators can be found in Table A-1 in the Appendix.

The focus on GRI standards in identifying the necessary environmental indicators ensures alignment with global best practices in sustainability reporting. Over the past two decades, the number of companies adhering to GRI standards has increased significantly (Pucker, 2021). This alignment not only facilitates comparisons with data from leading vendors such as Bloomberg, Refinitiv, and TruCost but also ensures that the SGFIN Sustainability Database remains a valuable tool for assessing corporate sustainability performance. The detailed list of corresponding GRI definitions for the chosen indicators is compiled in Table C-1 in the Appendix below.

In constructing the SGFIN Sustainability Database, SGFIN gathered point-in-time data directly from corporate disclosures, i.e., financial or sustainability report, for each specific year. This means that only data for fiscal year 2022 was extracted from FY 2022 annual or sustainability report, ensuring each year's data point is directly sourced from that year's official report. The database offers a clear and accurate depiction of corporate environmental performance, contributing to more informed decision-making and enhanced sustainability practices.

3.1 Direct from The Source: Corporate Sustainability Disclosures

Over the past decade, many companies have adopted sustainability reporting processes. The process pertains to the measurement, disclosure, and communication of information related to a company's performance and impacts in various sustainability aspects. The process and the resulting disclosure provide employees, investors, customers, and the public with information on how the company manages and addresses its sustainability-related issues, including its strategies, policies, plans, and initiatives. The resulting information can be integrated into the company's annual report or presented as a standalone report, alternatively known as sustainability, ESG, or non-financial report. The disclosed information, whether embedded within an annual report or presented separately, typically covers a diverse range of quantitative and qualitative information, not exclusively monetary in nature (Christensen et al., 2021).

Investors are increasingly demanding reliable, consistent, and comparable sustainability disclosure, recognizing its importance in evaluating corporate risks as well as allocating capital. Reliable data is pivotal for the effective operation of a business, spanning various dimensions, including remuneration, financing, supply chain management, and mergers and acquisitions (M&A) (KPMG, 2022) Reliable and consistent sustainability data also aids companies in setting targets and measuring progress, while comparability allows for effective benchmarking across companies.

A sustainability report generally covers environmental, social, and governance pillars, although the coverage of specific elements may vary based on industry, region, and regulatory requirements. Within the environmental pillar, commonly reported components include greenhouse gas (GHG) emissions, energy consumption, waste generation, water consumption, materials, as well as aspects related to biodiversity and land use. Under the social pillar, key aspects cover metrics related to employees, occupational health and safety, training, diversity, local communities, as well as customer health and safety. The governance pillar typically covers board composition, management diversity, ethical behavior, framework alignment, certifications, and assurance (GRI Standards, 2021), (Singapore Exchange, 2023). In addition, the report may include information concerning climate-related risks and opportunities, targets, as well as remuneration policies (IFRS Foundation, 2023).

TCFD reports that companies generally disclose climate-related metrics at a relatively high rate, particularly compared to other recommended disclosures. Large cap companies are more likely to report these metrics than smaller ones, but even smaller firms disclose climate-related metrics more frequently than other categories (TCFD, 2023). These metrics, however, are broadly defined and include aspects such as water, energy, land use, and waste management. The only explicitly recommended environmental metric is GHG emissions, including absolute and intensity values (TCFD, 2021). While climate metrics show strong disclosure rates, other environmental factors may be underreported.

TCFD documents palpable differences in reporting across regions, with companies in Europe showing higher levels of climate-related metric disclosures—78%—compared to just 49% in Asia Pacific and 35% in North America. This disparity captured in the latest status report underscores the varying degrees of progress across global jurisdictions and the urgent need for enhanced corporate reporting practices to meet sustainability reporting standards (TCFD, 2023)

The latest TCFD status report also highlights the diverse levels of progress in Asia Pacific. Singapore, as a leading financial hub in Asia, has made significant strides in this area, with the Singapore Exchange (SGX) playing a pivotal role in setting standards and expectations for corporate sustainability disclosures. This next section will delve into how SGX's initiatives and guidelines have shaped sustainability reporting among companies listed on the exchange, offering insights into Singapore's approach to integrating sustainability considerations into financial reporting.

3.2 The South-East Asian Context

Southeast Asia, home to 680 million people across diverse economies, faces severe climate change impacts, such as extreme weather events and heat waves. The Philippines and Thailand rank among the world's most affected countries, experiencing significant economic losses estimated in billions. In 2021, the International Monetary Fund (IMF) warned that climate change could reduce Southeast Asia's Gross Domestic Product (GDP) by over 11% (Ding & Beh, 2022), highlighting the economic vulnerability of the region. Despite commitments under the Paris Agreement and the establishment of multiple climate adaptation frameworks, mitigation efforts remain insufficient, particularly in high-emission sectors like agriculture and energy.

Rapid industrialization has intensified environmental challenges, including poor air quality, inadequate waste management, and severe water pollution. Seven Association of Southeast Asian Nations (ASEAN) countries are among the top 50 most PM2.5 polluted globally. Waste generation, reaching 150 million tonnes in 2016, is projected to double by 2030, posing significant environmental and economic threats (ASEAN Taxonomy Board, 2024). Moreover, energy demand continues to rise, driven by reli-

ance on fossil fuels, amplifying the region's carbon footprint and underscoring the urgent need for sustainable financing and policy reforms to advance ASEAN's sustainability agenda and economic resilience.

In addition, slash-and-burn agriculture in Indonesia drives deforestation, contributing to transboundary haze that impacts the entire region, incurring economic costs beyond national borders (Ding & Beh, 2022). The rising environmental degradation threatens both economic stability and public health, making it imperative for ASEAN nations to adopt more effective climate actions and sustainable practices to safeguard the region's future.

As sustainability reporting continues to evolve globally, the ASEAN Exchanges have taken significant steps to align regional practices with international standards. In September 2023, these exchanges collaborated to develop a set of 27 core sustainability metrics, known as the "ASEAN Exchanges Common ESG Metrics." These metrics, covering environmental, social, and governance aspects, are designed to provide a consistent and comparable approach to ESG disclosures across Southeast Asia, ensuring alignment with global best practices while addressing the unique regional context (ASEAN Exchanges, 2023). These 27 metrics cover four environmental, 13 social, and 10 governance metrics. The four environmental metrics can be found in Figure 4 below.

Environmental Metrics

No.	Topics	Metrics (Unit)
1	Greenhouse Gas Emission ("GHG")	Absolute emissions: Scope 1 & Scope 2 (tCO2e)
2	Energy Consumption	Total energy consumption (kWh or J)
3	Water Consumption	Total water consumption (m^3)
4	Waste Generation	Total waste generated

Figure 4: Core Environmental Metrics (ASEAN Exchanges, 2023)

This initiative highlights the growing importance of standardized sustainability reporting in the ASEAN region, reflecting the increasing recognition of sustainability factors in financial markets and their impact on long-term value creation. By establishing these metrics, ASEAN Exchanges are facilitating better transparency and accountability in corporate sustainability practices, which is crucial for attracting global investment and driving sustainable development in the region.

The ASEAN Exchanges' development of common ESG metrics sets the stage for a deeper exploration of sustainability reporting practices across the region. With this

framework in place, the focus now shifts to how individual ASEAN countries, including Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam, are implementing these guidelines. Each country's approach reflects its unique regulatory environment and economic priorities, offering insights into the region's overall commitment to sustainable development and the challenges of harmonizing ESG reporting standards across diverse markets.

Indonesia

Publicly listed companies and financial institutions in Indonesia are required to submit annual sustainability reports, including ESG disclosures within their annual reports (ESGpedia, 2024). The disclosure regulations in Indonesia are most aligned with TCFD, IFRS, ISSB and GRI Standards.

Non-public companies involved in natural resource exploitation are required to develop a corporate social and environmental responsibility plan. While there is no mandate for a specific international standard for sustainability reporting, companies are encouraged to adopt frameworks or standards that best suit their needs and effectively communicate with stakeholders, alongside meeting basic reporting requirements (ESGpedia, 2024). The Exchange also offers ESG-focused training through a series of workshops aimed at helping companies align their disclosures with various international standards, such as GRI and TCFD.

Although specific plans are not yet in place, there is an expectation that international standards will be more widely adopted and implemented in the future to further unify reporting practices already independently embraced by listed companies. Additionally, there is potential for broader sustainability disclosure and oversight among non-listed companies, building on existing CSR legislation (ESGpedia, 2024).

Malaysia

Publicly listed companies in Malaysia are required to include a sustainability statement in their annual reports. Capital Markets Malaysia (CMM) established a Simplified ESG Disclosure Guide (SEDG) which provides SMEs within global supply chains a streamlined and standardized approach to ESG disclosures, aligning them with TCFD and GRI Standards. In collaboration with Financial Time Stock Exchange (FTSE), Bursa Malaysia introduced the FTSE4Good Index in 2014 to evaluate the ESG practices and disclosures of publicly listed companies. Under Bursa Malaysia's listing requirements, issuers must include a narrative on how they manage significant economic, environmental, and social (EES) risks and opportunities within their annual reports. Specifically, companies listed on the Main Market are expected to outline their governance structure, the scope of their Sustainability Statement, and their approach to managing material EES risks and opportunities (ESGpedia, 2024).

To support issuers in preparing their Sustainability Statement, Bursa Malaysia provides a Sustainability Reporting Guide along with six toolkits. Additionally, Bursa Malaysia has

introduced an ESG Reporting Platform, a centralized hub for disclosures that comply with the standardized format set by the updated sustainability reporting guidelines, effective from September 26, 2022, (ESGpedia, 2024). While companies previously had the flexibility to choose their reporting framework, Bursa Malaysia will begin enforcing stricter reporting standards through a phased, multi-year approach aimed at enhancing the resilience of listed companies and attracting increased investment.

Philippines

Publicly listed companies in the Philippines are required to submit annual ESG reports in line with GRI standards. Starting in 2023, companies with a public float of 50% or more must adhere to the 2019 Securities and Exchange Commission (SEC) guidelines and submit their ESG reports accordingly. While these guidelines are mandatory for certain companies, other publicly listed companies, as well as medium to large businesses, are encouraged to voluntarily comply. Additionally, the SEC has introduced a Sustainability Report (SuRe) form for listed companies to enhance their disclosures (ESGpedia, 2024).

The SEC Philippines is planning to release updated Sustainability Reporting Guidelines that will incorporate IFRS S1 and S2 standards, aiming to standardize sustainability information reporting across listed companies. Furthermore, the SEC intends to expand sustainability reporting requirements to cover all types of corporations, not just publicly listed companies, though a specific timeline for this broader initiative has yet to be announced (ESGpedia, 2024).

Singapore

Listed companies in Singapore are required to disclose their ESG metrics through the Sustainability Reporting Guide, which aligns with the GRI and TCFD frameworks. Since 2016, the Singapore Exchange (SGX) has mandated that all listed companies report on their sustainability practices in accordance with this guide. Singapore is aligning its reporting standards with international frameworks like the GRI and TCFD, and following public consultations in 2021, SGX is gradually introducing mandatory climate reporting based on TCFD recommendations. As of 31 December 2022, climate reporting is required on a "comply or explain" basis for all SGX-listed issuers, although there are no mandatory requirements for disclosing Scope 3 GHG emissions (ESGpedia, 2024).

Singapore plans to enforce mandatory climate-related reporting for both listed and significant non-listed companies, with some required to start disclosures in line with ISSB IFRS standards as early as 2025 (ESGpedia, 2024). To support these plans, recent reviews highlight progress in sustainability reporting among SGX-listed companies, showcasing near-universal adoption and alignment with reporting standards.

SGX Sustainability Reporting Review 2023

Singapore Exchange Regulation (SGX RegCo) and the Centre for Governance and Sustainability (CGS) at NUS Business School reported in the third annual edition of their sustainability reporting review that over 99% of eligible SGX-listed issuers published sustainability reports in 2023, reflecting a near-universal adoption rate. The widespread adoption reflects the growing importance of sustainability practices in the corporate landscape, as reflected by regulatory requirements and market demand. The Review also highlighted the timely publication of sustainability reports, with 86% of issuers releasing their reports within SGX's stipulated time frame. Delays are typically observed among smaller issuers, e.g., those with a market capitalization below S$300 million, highlighting the potential resource constraints faced by smaller companies and the need for further support to ensure timely and comprehensive reporting across all company types.

The SGX Sustainability Reporting Review for 2023 by SGX RegCo and CGS also documents a notable improvement in the adequacy of sustainability reporting among small and medium cap issuers, who together account for more than 80% of all SGX-listed companies. This progress among smaller issuers reflects the broad advancement in reporting practices and their significant strides in meeting key reporting criteria.

Furthermore, the Sustainability Reporting Review by SGX RegCo and CGS found significant improvements in the quality of these disclosures. Approximately 78% of companies now align their sustainability reporting with GRI standards, indicating a broader commitment to internationally recognized frameworks that enhance the credibility and comparability of reports.

Climate-related disclosures have come under greater scrutiny, with 51% of companies now identifying climate change as a material factor. This shift has been driven by SGX's introduction of mandatory climate-related disclosures, resulting in 50% of companies adopting the TCFD recommendations. However, the integration of climate-related disclosures into SGX's assessment framework has exposed certain challenges, as the average score used by SGX (based on their own methodology and weightage afforded to the presence of different metrics) to evaluate issuers is lower when these climate factors were included. This indicates that many companies are still in the early stages of establishing robust climate reporting practices.

SGX Sustainability Reporting Review 2023

Disclosures on materiality
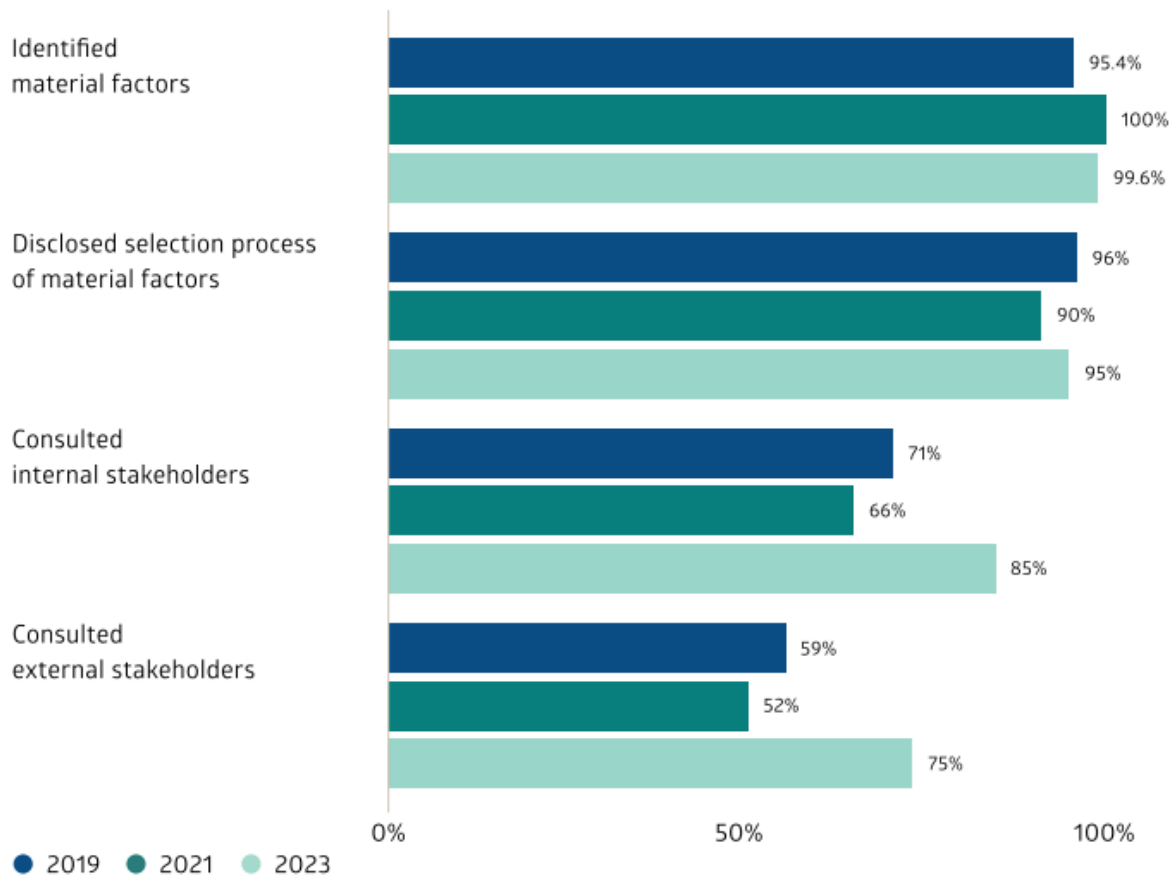
Figure 5: Disclosures on Materiality as Compiled by SGX per Sustainability Reporting Review (Loh & Tang, 2023)

Metrics and targets are essential for tracking progress in managing climate issues. Encouragingly, the SGX Sustainability Reporting Review for 2023 by SGX RegCo and CGS found that 86% of Singapore issuers disclosed data for at least one type of GHG emissions—Scope 1, 2, or 3. The majority focused on Scope 2 emissions, while only 20% reported on Scope 3 emissions, which cover indirect emissions from a company's value chain. Despite the challenges in tracking Scope 3 emissions, early reporting in this area is expected to lead to more accurate and standardized data over time.

Thailand

Thailand has more recently embarked on sustainability reporting initiatives. Currently, sustainability-related disclosures are mandated primarily for listed companies and sustainable and responsible investing (SRI) funds in Thailand. These entities are required to follow the Thai Security Exchange Commission's (SEC) Reporting Guide, which provides detailed instructions for annual reporting through the 56-1 form, known as the "One Report." This guide places a strong emphasis on critical areas like climate change, environmental conservation, carbon footprint reduction, and inequality, with disclosures required on a "comply-or-explain" basis (ESGpedia, 2024).

In line with these efforts, the launch of a sustainable finance framework backed by the International Finance Corporation (IFC) in June 2020 coincided with a push for collaborative sustainable finance among various public and private entities. The Stock Exchange of Thailand (SET) has highlighted the importance of sustainability reporting in building investor trust and has advocated for the endorsement of global frameworks like TCFD and ISSB. This endorsement aims to minimize confusion by avoiding the proliferation of multiple standards and aligning Thailand's reporting practices with international recommendations (ESGpedia, 2024).

Vietnam

Since 2016, Vietnam has required listed companies to report on ESG matters. The latest directive, issued in 2021, mandates that publicly listed companies in Vietnam submit sustainability reports that detail their environmental and social impacts, along with their goals for corporate sustainability. While no specific international standard has been mandated, the 2016 Environmental and Social Disclosure Guide, developed by the State Securities Commission of Vietnam in collaboration with the International Finance Corporation of the World Bank Group, draws from the GRI G4 framework and promotes independent external assurance (ESGpedia, 2024)

The government continues to support sustainable practices by offering programs that raise awareness and assist companies in their green transitions. In 2022, for instance, a workshop was held to guide companies in developing climate-related financial disclosures aligned with the TCFD framework.

As the landscape of sustainability reporting evolves, the emphasis increasingly shifts from merely fulfilling regulatory requirements to a more strategic approach where corporate disclosures serve as a vital tool for assessing long-term value creation and risk management. This transition highlights the growing importance of transparency in corporate sustainability practices, where disclosures offer key insights into how companies manage sustainability risks. It sets the stage for a deeper exploration of the mechanisms and trends shaping these disclosures at both global and regional levels.

4 Discrepancies in Environmental Data Recorded by Information Intermediaries

Discrepancies in environmental data among major information intermediaries of sustainability data —Bloomberg, Refinitiv, and TruCost—highlight critical challenges in assessing corporate sustainability performance. This analysis reveals variations in data consistency between commercially available datasets and the sustainability reports from companies.

These discrepancies necessitate a thorough examination of the methodologies employed by each information intermediary, as these approaches can significantly affect data reliability. The analysis specifically addresses critical environmental indicators, including GHG emissions, energy and electricity consumption, waste, and water usage, highlighting how methodological differences contribute to reporting inconsistencies.

As stakeholders increasingly rely on these intermediaries to provide not only scores and ratings but also fundamental data from corporate disclosures, it is imperative to conduct a critical assessment of these intermediaries and understand their limitations to facilitate informed evaluations of corporate sustainability practices.

Key Takeaways:
- Environmental indicators in the SGFIN Sustainability Database are defined in accordance with GRI standards, facilitating a comparison between data extracted from Sustainability Reports and/or Annual Reports and that provided by information intermediaries such as Bloomberg, Refinitiv (a subsidiary of LSEG, and recently re-branded as LSEG Data & Analytics), and TruCost (a part of S&P Global).
- Comparison between sustainability reports and data from Bloomberg, Refinitiv, and TruCost reveals notable discrepancies, emphasizing the need for closer scrutiny of environmental data accuracy across vendors.
- Differences in the methodologies used by information intermediaries contribute to discrepancies in reported environmental metrics, particularly in critical areas like greenhouse gas emissions and energy consumption.

Unlike the traditional financial reports which largely conform to reporting standards, there are no globally mandatory reporting standards for sustainability reporting (Berg et al., 2022). While standards such as the GRI, IFRS SDS, and the SASB provide guidelines to improve the quality and comparability of sustainability reporting, there remains a lack of global standardization and mandates in sustainability reporting practices.

Investors are increasingly overwhelmed by the multitude of sustainability frameworks and standards they must navigate, which contributes to a significant challenge in effectively managing sustainability data (Ground, 2022). In Singapore, this complexity is evident in the sharp increase in the number of firms that explain their framework choice—from 46% of issuers in 2021 to 79% in 2022 financial year (Loh & Tang, 2023).

Given the challenges and complexities in effectively digesting data disclosed in corporate sustainability reports, industry practitioners often turn to commercial information intermediaries for both sustainability ratings and underlying data for a more streamlined and standardized format for analysis. One of the primary responsibilities of these intermediaries is to ensure the reliability and accuracy of the data available on their platforms. Through their rigorous validation processes, information intermediaries can help companies spot inaccuracies and potential misrepresentations in their sustainability reports.

With their widespread usage, these intermediaries also play a de facto role in "standardizing" corporate sustainability reporting. By imposing a consistent data recording and validation process across all disclosing companies, those intermediaries allow their clients to quickly assess and compare different companies without delving into individual company's disclosure. Data available in each commercial data platform is therefore useful to streamline the evaluation and benchmarking process to facilitate comparability across different companies and industries, allowing stakeholders to make more informed assessments.

As technology evolves, information intermediaries continually innovate their approaches to collecting, analyzing, and presenting sustainability data. The increasing integration of textual analyses, advanced analytics, and artificial intelligence is not only used to identify trends, assess risks, and provide insights but also to impute missing data, contributing to efforts aimed at enhancing data completeness and accuracy (The Board of the International Organization of Securities Commission, 2021).

4.1 Curated Expertise: Leveraging Data from Information Intermediaries

Given the data complexity, investors face significant challenges when integrating sustainability data into their decision-making processes. To overcome these challenges, some investors resort to sustainability ratings, e.g., ESG ratings and scores, provided by information intermediaries. Investors rely on these assessments for several practical reasons. Investors appreciate the straightforward comparability that ratings offer across companies and industries, offering a quick way to categorize high-performing

and low-performing entities in terms of sustainability. This streamlines the decision-making process, so that investors can efficiently implement risk mitigation strategies, identify opportunities, and manage diversified portfolios without extensive analysis (Hendratama et al., 2024). There is also a widely held perception that sustainability data intermediaries employ teams of technical experts who are well-equipped to evaluate sustainability performance with greater depth and accuracy than individual investors. This expertise is crucial for navigating the vast amount of data and organizing it effectively for various applications (Hendratama et al., 2024). As a result, the significant efforts made by corporations in compiling data for sustainability disclosures can be wasted if the data is not accurately recorded or handled by information intermediaries.

The sustainability ratings industry faces various potential shortcomings. The most pressing issue is the lack of consistency among sustainability scores from various intermediaries, even among scores that are supposed to cover similar aspects of sustainability. This inconsistency impacts the investment process, from data interpretation to performance measurement. While data access was once the primary hurdle, discrepancies in sustainability ratings now pose the biggest challenge for global investors, cited by at least half of the investors surveyed in a recent study of investor perception of sustainability data (Ground, 2022). Multiple factors potentially contribute to the inconsistencies in ESG scores, including (1) the reliance on backward-looking data, which may not accurately predict future ESG leaders, (2) the utilisation of different indicators to measure the same attribute (Berg et al., 2022), and (3) the subjective nature of scoring systems presumably reflecting varying perspectives on the importance of different sustainability pillars across sectors and regions (Ground, 2022).

There is extensive literature on the divergence of sustainability ratings across different information intermediaries. A previous SGFIN Whitepaper by Hendratama et al., (2024) explored these inconsistencies and found relatively lower aggregated correlations between various ESG ratings providers. This mirrors the findings of Larcker et al., (2022) who noted the environmental, social, and governance components provided by one data provider showed low correlations with the corresponding components from another provider. Additionally, the study reaffirms the conclusions of Berg et al., (2022) attributing these discrepancies in sustainability scores to methodological differences employed by the ratings agencies. The differences in methodologies partially reflect the manifold dimensionality of sustainability, which renders the scoring of corporate sustainability more difficult than financial-related scoring, such as the by-now highly developed credit scoring systems. Another potential source of differences is the relatively sparse and poor-quality reporting of sustainability data that are necessary inputs into these methodologies. Disentangling the sources of these differences is a difficult task due to the lack of definitive information regarding the building blocks of each scoring methodology, with claims of proprietary innovations and trade secrets put forth by the information intermediaries.

To shed light on the factors contributing to discrepancies in sustainability scores and provide a direct assessment of the veracity of these scores, this paper examines the underlying sustainability data that underpins these sustainability scores to determine whether the information intermediaries share the same initial data inputs in their respective scoring and rating exercises. This paper focuses on evaluating environmental data to isolate the impact of data quality.

Discrepancies in fundamental data can both cause and exacerbate the divergence of sustainability scores, leading to various potential negative consequences, e.g., inaccurate risk assessments and market mispricing of corporations leading to inefficient capital allocations, which is ultimately detrimental to the global objective of alleviating environmental damages and the effects of climate change.

As previously noted, a lack of robust data remains a major obstacle for investors incorporating sustainability into their analyses. Data quality and consistency issues hinder the integration of sustainability factors into investment decision-making. Overcoming these challenges is crucial for effective sustainability implementation (Ground, 2022).

4.2   Information Intermediaries of Sustainability Data

This study uncovered instances where discrepancies between data recorded by information intermediaries and corporate sustainability reports introduce complexities that demand a closer examination. SGFIN conducted a comparison between the information disclosed in company sustainability reports and the data available in data platforms of information intermediaries.

As mentioned previously, SGFIN gathered point-in-time data directly from corporate disclosures for each specific fiscal year. The hand-collected data in the SGFIN Sustainability Database was compared against data from three information intermediaries: Bloomberg, Refinitiv and TruCost. In academic research, Bloomberg, Refinitiv, and TruCost are leading information intermediaries known for their extensive ESG datasets. Researchers frequently rely on these information intermediaries for accessing insights into sustainability issues. As noted by Hendratama, Broadstock, and Sulaeman (2023), these vendors are pivotal in providing the necessary data for rigorous analysis into ESG factors. They are among the most prevalent and widely used ESG information intermediaries in the academic landscape, underscoring their significance and frequent usage in research. We restrict the sample to firm-year observations with data available on both the sustainability report and commercial datasets.

Bloomberg's ESG data platform boasts an extensive coverage of over 16,000 companies across 100+ countries, encompassing approximately 94% of the global market capitalization. With a robust historical dataset spanning 18+ years, users have access to a wealth of information. The platform offers an unparalleled depth of data, featuring 6,400+ ESG data fields and derived metrics. Bloomberg ESG Scores cover 15,000+

companies, and the platform houses over 20 million ESG data points accessible through the Terminal and data licenses (Bloomberg, n.d.)

Refinitiv offers a comprehensive ESG data platform featuring transparent ESG data and scores for more than 15,500 public and private companies globally, with data dating back to FY2002. This extensive dataset surpasses other providers in terms of historical coverage (LSEG Workspace, n.d.)

The platform provides customized analytics, scores, and ranks to meet specific ESG requirements. With over 750 ESG data points and more than 70 ESG analytics, all standardized for easy benchmarking, Refinitiv empowers users to conduct in-depth company analyses.

Point-in-time ESG data, including category and summary scores since 2017, pillar scores since 2021, data points since 2008, and indicators since 2013, are available. Additionally, Refinitiv offers near real-time ESG data derived from news and social media, covering over 100,000 companies and 252 countries and regions.

TruCost, a part of S&P Global, is a prominent provider of environmental data, covering over 15,000 companies worldwide. Renowned for its expertise in carbon and environmental data and risk analysis, TruCost evaluates risks related to climate change, resource limitations, and broader ESG factors. This analysis helps companies and financial institutions understand their exposure to these risks, enhance resilience, and identify sustainable solutions for a global economy (S&P Dow Jones Indices, n.d.).

TruCost gathers extensive corporate environmental data, including metrics on GHG emissions, water use, pollution impacts, and waste disposal. Additionally, it collects information on a company's business activities. The firm's environmentally extended input-output (EEIO) model integrates industry-specific environmental impact data with macroeconomic data on the flow of goods and services between different sectors. This model allows for the estimation of environmental impacts across a company's entire global supply chain. TruCost's model calculates environmental impacts per USD 1 million in revenue for each of the 464 business activities in its system, enabling the anticipation of the most significant impacts based on a company's activities.

4.2.1 Data Download from Information Intermediaries' Platforms

Bloomberg's environmental data was obtained by screening six Southeast Asian countries and selecting companies with available data for the relevant indicators. If a company lacked data in either Bloomberg dataset or its sustainability report, the firm-year observation was excluded from the sample.

Refinitiv's environmental data was obtained by screening six Southeast Asian countries. The sample excluded any estimates, including only observations with environmental performance data provided by the companies. If a company lacked data in either

the Refinitiv dataset or its sustainability report, the firm-year observation was excluded from the sample.

For S&P data, SGFIN utilized the TruCost Environmental Dataset. The TruCost Environmental dataset utilizes three distinct disclosure methods: "Exact," "Derived," and "Estimated" as shown in Table B-1 in the Appendix below. SGFIN subsequently attributed codes starting with "1xx," to any datapoint TruCost disclosed as "Exact" data,or data that was directly sourced from disclosed information. Similarly, SGFIN attributed disclosure codes marked by "3xx" codes to the data TruCost classified as "Derived" data, or data that is derived from partial or incomplete information. Finally, for the data TruCost disclosed as "Estimated", or data where their EEIO model was used to estimate data when disclosures are absent, SGFIN attributed with codes that begin with "2xx". To ensure fair comparison across vendors, data marked with "2xx" codes is excluded from the sample, as it relies on TruCost's proprietary estimates rather than company disclosures.

While S&P offers an alternative dataset known as the ESG Scores dataset, this analysis focused on the TruCost data. The ESG Scores dataset is derived from company-provided information through the Corporate Sustainability Assessment (CSA). Future iterations of this Whitepaper may incorporate the raw, underlying data from the ESG Scores dataset for a more comprehensive comparison.

4.2.2 Consistency Across Information Intermediaries

Before comparing the information intermediaries' outputs to the SGFIN Sustainability Database, it is crucial to establish the baseline consistency level among these vendor datasets themselves. Evaluating accuracy across platforms require consideration of their distinct methodologies, which can impact reported data. This comparison serves as the foundation for assessing how well these intermediaries align with the SGFIN database. To avoid skewed results due to proprietary approaches to estimation, we excluded data estimated by the vendors. For TruCost, for instance, this analysis includes only data we have classified as "1xx" (Exact) or "3xx" (Derived) (See Appendix Table B-1). Our focus is to ensure a fair assessment by comparing data based solely on corporate disclosures.

We conducted this consistency analysis for all indicators. However, TruCost Environmental dataset lacks data on energy consumption, electricity consumption, and water withdrawal, while Refinitiv does not provide water consumption data. As a result, these indicators could only be compared between two datasets.

Table 1 provides an overview of the alignment between GHG Scope 1 data across the three information intermediaries. It highlights similarity levels across thresholds— exact matches, within 1% threshold, and within 5% threshold—giving insight into data consistency among the intermediaries. For example, 70.58% of Bloomberg and Refinitiv data points were exact matches for firm-year values, based on 979 shared data

points where data is available on the platforms of both information intermediaries. The other two panels of Table 1 illustrate data consistency when allowing for deviations of 1% and 5%, reflecting the proportion of common data points within those specified ranges.

Table 1: Consistency of GHG Scope 1 Data Across Information Intermediaries [5]

SCOPE 1											

EXACT MATCH	REFINITV	TRUCOST
BLOOMBERG	70.58% (691/979)	38.26% (313/818)
REFINITV		33.38% (250/749)

<= 1%	REFINITV	TRUCOST
BLOOMBERG	77.53% (759/979)	50.61% (414/818)
REFINITV		44.99% (337/749)

<= 5%	REFINITV	TRUCOST
BLOOMBERG	82.53% (808/979)	59.41% (486/818)
REFINITV		55.27% (414/749)

Table 2 illustrates the consistency in data between the information intermediaries for GHG Scope 2 Location-Based data.

Table 2: Consistency of Scope 2 Data Across Information Intermediaries [6]

SCOPE 2											

EXACT MATCH	REFINITV	TRUCOST
BLOOMBERG	67.62% (685/1013)	46.91% (448/955)
REFINITV		37.37% (330/883)

<= 1%	REFINITV	TRUCOST
BLOOMBERG	73.54% (745/1013)	57.80% (552/955)
REFINITV		48.24% (426/883)

<= 5%	REFINITV	TRUCOST
BLOOMBERG	79.17% (802/1013)	65.34% (624/955)
REFINITV		59.11% (522/883)

Table 3 and Table 4 below show the consistency of energy consumption and electricity consumption values between Bloomberg and Refinitiv because TruCost does not provide data for energy consumption and electricity consumption under its TruCost Environmental Dataset. Bloomberg and Refinitiv both have higher consistency in the data for electricity consumption compared to the data for energy consumption.

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[5] The three tables illustrate the consistency of Scope 1 data across vendors, highlighting Exact Matches, data within 1% threshold, and data within 5% threshold, respectively

[6] The three tables illustrate the consistency of Scope 2 data across vendors, highlighting Exact Matches, data within 1% threshold, and data within 5% threshold, respectively

Table 3: Consistency of Energy Consumption Data Across Information Intermediaries[7]

ENERGY CONSUMPTION											

EXACT MATCH				**<= 1%**				**<= 5%**		
	REFINITV	**TRUCOST**			**REFINITV**	**TRUCOST**			**REFINITV**	**TRUCOST**
BLOOMBERG	47.12% (433/919)	NIL		**BLOOMBERG**	59.74% (549/919)	NIL		**BLOOMBERG**	68.88% (633/919)	NIL
REFINITV		NIL		**REFINITV**		NIL		**REFINITV**		NIL

Table 4: Consistency of Electricity Consumption Data Across Information Intermediaries [8]

ELECTRICITY CONSUMPTION											

EXACT MATCH				**<= 1%**				**<= 5%**		
	REFINITV	**TRUCOST**			**REFINITV**	**TRUCOST**			**REFINITV**	**TRUCOST**
BLOOMBERG	58.99% (538/912)	NIL		**BLOOMBERG**	68.53% (625/912)	NIL		**BLOOMBERG**	75.66% (690/912)	NIL
REFINITV		NIL		**REFINITV**		NIL		**REFINITV**		NIL

Table 5 shows the consistency of water consumption data between Bloomberg and TruCost because Refinitiv does not provide data for water consumption. The water consumption data is rather inconsistent between Bloomberg and TruCost. Indeed, water consumption exhibits the lowest consistency among all indicators compared across the information intermediaries.

Similar to the water consumption in Table 5, Table 6 shows the consistency of water withdrawal data between Bloomberg and Refinitiv because TruCost does not provide data for water withdrawal.

---

[7] The three tables illustrate the consistency of energy consumption data across vendors, highlighting Exact Matches, data within 1% threshold, and data within 5% threshold, respectively

[8] The three tables illustrate the consistency of electricity consumption data across vendors, highlighting Exact Matches, data within 1% threshold, and data within 5% threshold, respectively

Table 5: Consistency of Water Consumption Data Across Information Intermediaries [9]

WATER CONSUMPTION											

EXACT MATCH				<= 1%				<= 5%		
	REFINITV	**TRUCOST**			**REFINITV**	**TRUCOST**			**REFINITV**	**TRUCOST**
BLOOMBERG	NIL	32.53% (203/624)		**BLOOMBERG**	NIL	37.82% (236/624)		**BLOOMBERG**	NIL	45.83% (286/624)
REFINITV		NIL		**REFINITV**		NIL		**REFINITV**		NIL

Table 6: Consistency of Water Withdrawal Data Across Information Intermediaries [10]

WATER WITHDRAWAL											

EXACT MATCH				<= 1%				<= 5%		
	REFINITV	**TRUCOST**			**REFINITV**	**TRUCOST**			**REFINITV**	**TRUCOST**
BLOOMBERG	61.63% (575/933)	NIL		**BLOOMBERG**	69.99% (653/933)	NIL		**BLOOMBERG**	75.56% (705/933)	NIL
REFINITV		NIL		**REFINITV**		NIL		**REFINITV**		NIL

Finally, Table 7 details the similarity of data for total waste between the three information intermediaries.

Table 7: Consistency of Total Waste Data Across Information Intermediaries [11]

TOTAL WASTE											

EXACT MATCH				<= 1%				<= 5%		
	REFINITV	**TRUCOST**			**REFINITV**	**TRUCOST**			**REFINITV**	**TRUCOST**
BLOOMBERG	56.07% (439/783)	45.79% (337/736)		**BLOOMBERG**	67.18% (526/783)	56.39% (415/736)		**BLOOMBERG**	73.82% (578/783)	66.30% (488/736)
REFINITV		43.99% (278/632)		**REFINITV**		55.85% (353/632)		**REFINITV**		64.72% (409/632)

---

[9] The three tables illustrate the consistency of water consumption data across vendors, highlighting Exact Matches, data within 1% threshold, and data within 5% threshold, respectively

[10] The three tables illustrate the consistency of water withdrawal data across vendors, highlighting Exact Matches, data within 1% threshold, and data within 5% threshold, respectively

[11] The three tables illustrate the consistency of total waste data across vendors, highlighting Exact Matches, data within 1% threshold, and data within 5% threshold, respectively

Table 8: (In-)Consistency of Environmental Data Across Information Intermediaries [Greater than 5% Threshold]

> 5%		

SCOPE 1

	REFINITV	TRUCOST
BLOOMBERG	17.47% (171/979)	40.59% (332/818)
REFINITV		44.73% (335/749)

SCOPE 2

	REFINITV	TRUCOST
BLOOMBERG	20.83% (211/1013)	34.66% (331/955)
REFINITV		40.88% (361/883)

ENERGY CONSUMPTION

	REFINITV	TRUCOST
BLOOMBERG	31.12% (286/919)	NIL
REFINITV		NIL

ELECTRICITY CONSUMPTION

	REFINITV	TRUCOST
BLOOMBERG	24.34% (222/912)	NIL
REFINITV		NIL

WATER CONSUMPTION

	REFINITV	TRUCOST
BLOOMBERG	NIL	54.17% (338/624)
REFINITV		NIL

WATER WITHDRAWAL

	REFINITV	TRUCOST
BLOOMBERG	24.44% (228/933)	NIL
REFINITV		NIL

TOTAL WASTE

	REFINITV	TRUCOST
BLOOMBERG	26.18% (205/783)	33.70% (248/736)
REFINITV		35.28% (223/632)

Table 8 summarizes the extent of data discrepancies exceeding the 5% threshold between different information intermediaries. It reveals significant variation, with most comparisons showing that over 20% of firm-year data points exhibit discrepancies greater than 5%. The only exception is the Scope 1 data comparison between Bloomberg and Refinitiv, which has a lower rate of high discrepancies, at 17%. This emphasizes the challenges in maintaining data consistency across vendors.

Hence, after establishing that there are notable discrepancies among the information intermediaries, we now turn our attention to comparing the data from these intermediaries against the SGFIN Sustainability Database. This will allow us to evaluate whether

similar levels of discrepancies persist when benchmarked against the SGFIN data, which was compiled directly from corporate disclosures.

4.3 Environmental Data Discrepancies

The summary of our findings is depicted in Figure 6. Among the three information intermediaries, TruCost had the highest rate of "Exact Matches" at 58%. However, TruCost achieved this across four sustainability indicators. Another caveat is that TruCost also covers fewer firms in our sample of Southeast Asian publicly listed firms.
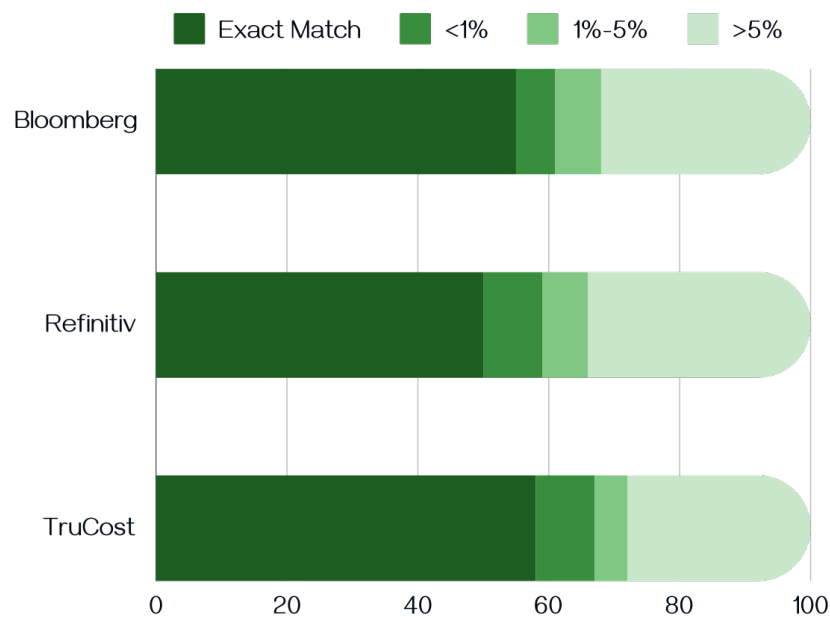
Figure 6: Discrepancies of Sustainability Indicators (versus Corporate Disclosures) [12]

To better understand the findings, we should consider some relevant contexts. As mentioned earlier, TruCost does not provide energy consumption, electricity consumption and water withdrawal data for comparison, which means only four indicators can be used to analyse its discrepancies against the SGFIN Sustainability database. Similarly, Refinitiv does not provide water consumption data. In the next few sub-sections, we explore the discrepancies in environmental indicators.

4.3.1 GHG Emissions Discrepancies

Figure 7 shows that when comparing GHG Scope 1 emissions data, Bloomberg achieved a 60% "Exact Match" rate. Refinitiv and TruCost both followed closely with 55% and 52% "Exact Match" rates, respectively. When a +/- 1% tolerance is applied,

---

[12] The total number of observations across the seven sustainability indicators we consider between SGFIN, and the respective information intermediaries are: 7,865 datapoints for Bloomberg [7 indicators], 5,403 datapoints for Refinitiv [6], and 3,835 datapoints for TruCost [4]. Bloomberg consistently provides a broader range of data points across various sustainability indicators compared to the other two information intermediaries.

the consistency increases to 68%, 63%, and 64% for Bloomberg, Refinitiv, and TruCost respectively. Indeed, the increase in tolerance to +/- 5% also yields corresponding increases in consistency to 74%, 69%, and 71% for Bloomberg, Refinitiv, and TruCost respectively Nevertheless, as highlighted in Footnote 13, Bloomberg's coverage is the most comprehensive relative to the other two information intermediaries.
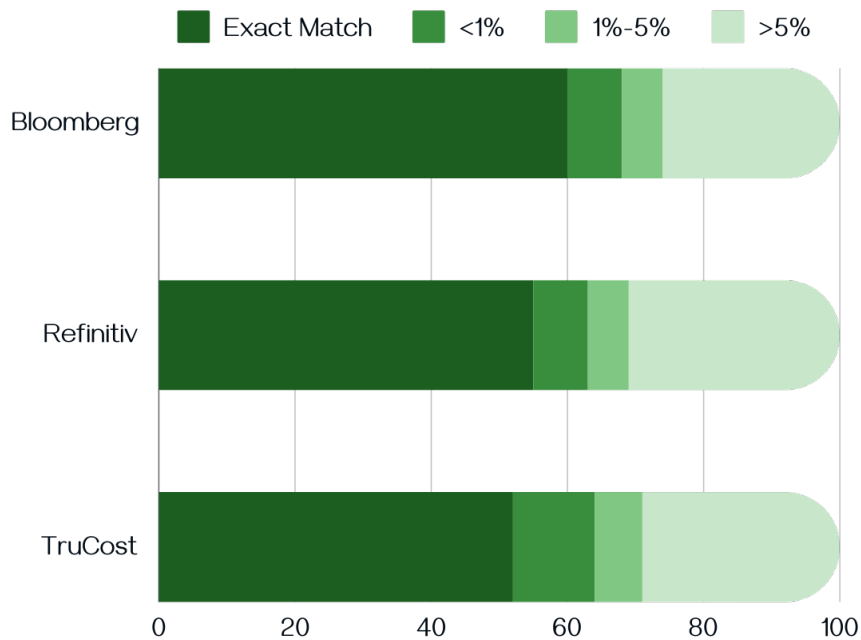
Figure 7: GHG Scope 1 Discrepancies Across Information Intermediaries [13]

A comparative analysis of GHG Scope 2 emissions data in Figure 8 indicates varied performance among the information intermediaries. Bloomberg, Refinitiv, and TruCost recorded "Exact Match" rates of 62%, 51%, and 64%, respectively. Unlike GHG Scope 1 data where Bloomberg had the highest match rate, TruCost performed the best in Scope 2 Location-Based data. Moreover, TruCost outperformed the other information intermediaries the +/- 1% and +/- 5% thresholds, achieving 80% consistency at +/- 5% tolerance compared to Bloomberg's 73%.

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[13] The total number of GHG Scope 1 observations between SGFIN and the respective information intermediaries are: 1,234 datapoints for Bloomberg, 1,021 datapoints for Refinitiv, and 971 datapoints for TruCost.
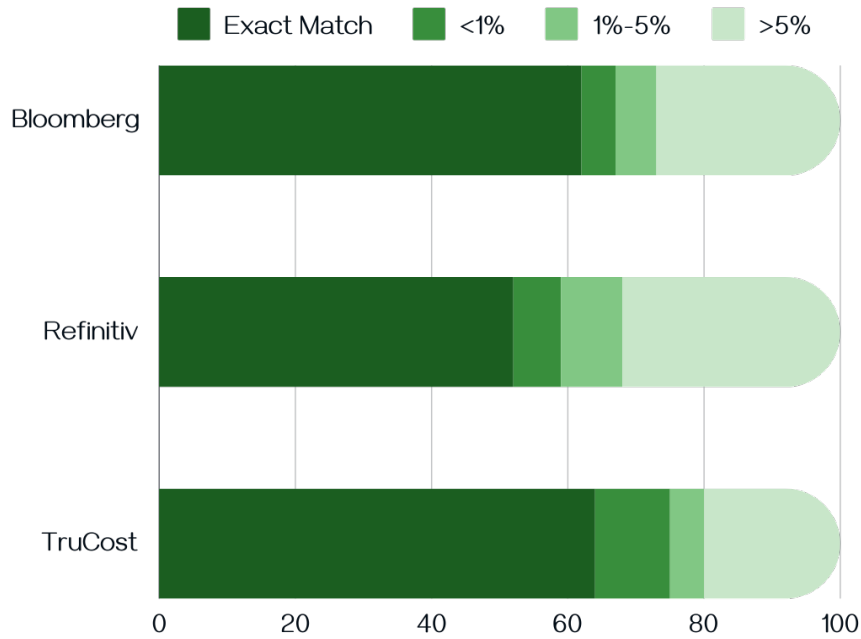
Figure 8: GHG Scope 2 Discrepancies Across Information Intermediaries [14]

4.3.2 Total Energy and Electricity Consumption Discrepancies

TruCost does not provide data for energy and electricity consumption. As such, the comparison is performed only with Bloomberg and Refinitiv. The results in Figure 9 show that Bloomberg has a 53% "Exact Match" rate against the point-in-time corporate reports data collected by SGFIN, whereas Refinitiv has a 45% "Exact Match" rate.

---

[14] The total number of GHG Scope 2 observations between SGFIN and the respective information intermediaries are: 1,280 datapoints for Bloomberg, 1,093 datapoints for Refinitiv, and 1,121 datapoints for TruCost.
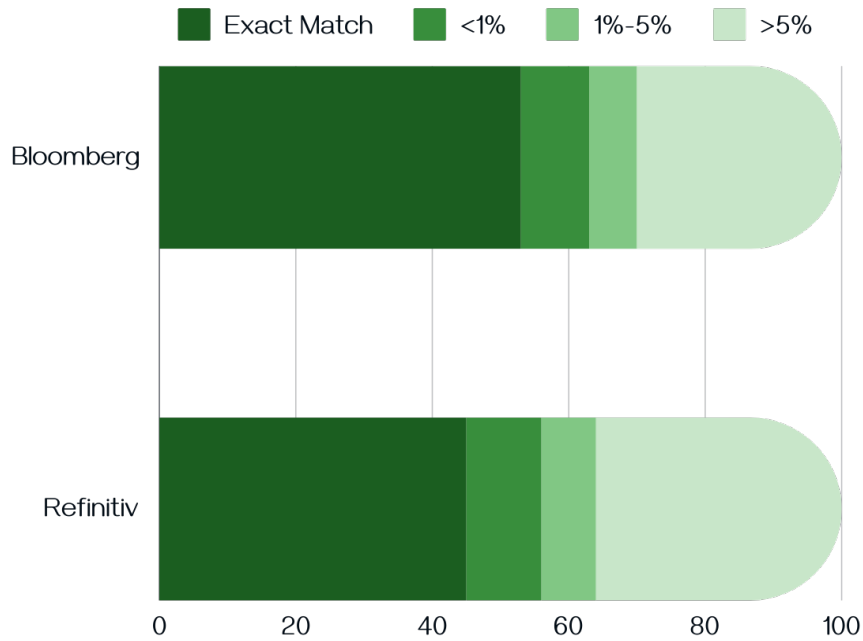
Figure 9: Total Energy Consumption Discrepancies Across Information Intermediaries[15]

Interestingly, these consistency rates are not mirrored in the data for electricity consumption, where both information intermediaries show higher consistency rates. Figure 10 reports that Bloomberg has a 61% "Exact Match" rate while Refinitiv has a 52% "Exact Match" rate. Both information intermediaries have about 10% higher consistency for Electricity Consumption data than for their respective Total Energy Consumption Data.

The GRI definition of Energy Consumption is given by the following formula:

Total Energy Consumption within the Organization =
Non-Renewable Fuel Consumed
+ Renewable Fuel Consumed
+ Electricity, Heating, Cooling and Steam Purchased for Consumption
+ Self-generated Electricity, Heating, Cooling, and Steam which are not Consumed
– Electricity, Heating, Cooling, and Steam Sold.

This indicates that there is potential for improvement in companies' disclosures of total energy consumption, especially when additional variables increase data collection complexity. SGFIN collected data for the components in the above formula where information was available. However, in cases where the companies' calculated value (based on the formula) did not align with the disclosed "Total Energy Consumption"

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[15] The total number of energy consumption observations between SGFIN and the respective information intermediaries are: 1,178 datapoints for Bloomberg, and 874 datapoints for Refinitiv.

values, we used their "Total Energy Consumption" value as the representative figure of the company's energy consumption. Instances where information intermediaries might have used the calculated values instead could have contributed to the lower consistency between the SGFIN Sustainability Database and the data provided by the vendors for this indicator.
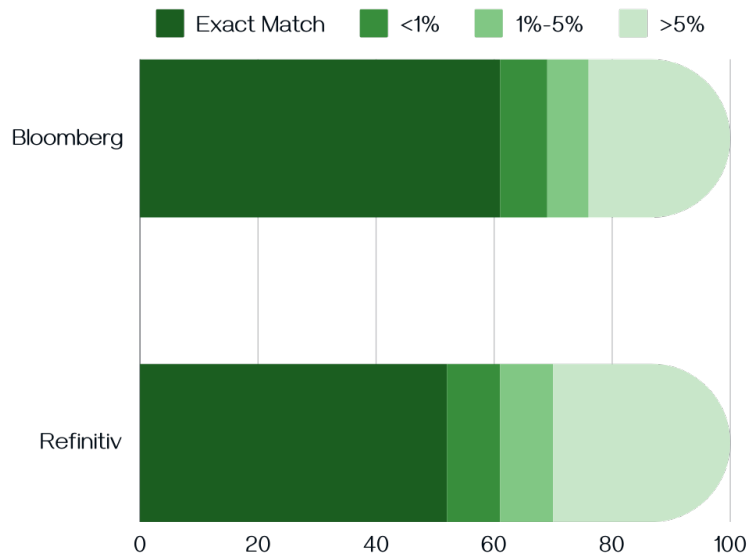
Figure 10: Total Electricity Consumption Discrepancies Across Information Intermediaries [16]

4.3.3 Total Waste Discrepancies

As for Total Waste, Figure 11 shows that when comparing total waste data, Bloomberg has a 50% "Exact Match" rate while Refinitiv and TruCost have 46% and 52% "Exact Match" rates respectively, with the point-in-time corporate report data.

---

[16] The total number of electricity consumption observations between SGFIN and the respective information intermediaries are: 1,253 datapoints for Bloomberg, and 935 datapoints for Refinitiv.

Exact Match   <1%   1%-5%   >5%
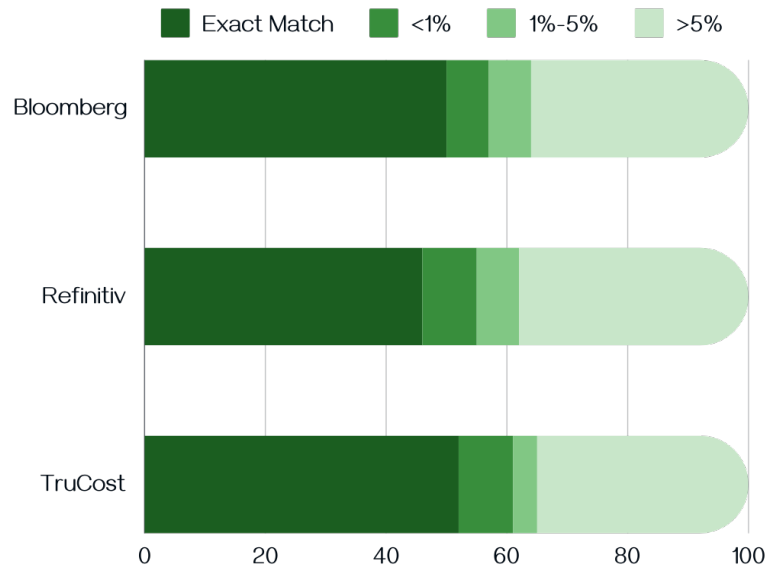
Figure 11: Total Waste Discrepancies Across Information Intermediaries [17]

4.3.4 Water Consumption and Water Withdrawal Discrepancies

Refinitiv does not provide data for water consumption. As such, the comparison can only be made with Bloomberg and Trucost. The results in Figure 12 show that Bloomberg has a 42% "Exact Match" rate against the point-in-time corporate report data collected by SGFIN, whereas TruCost has a 64% "Exact Match" rate.

---

[17] The total number of waste generation observations between SGFIN and the respective information intermediaries are: 1,122 datapoints for Bloomberg, 870 datapoints for Refinitiv, and 908 datapoints for TruCost.
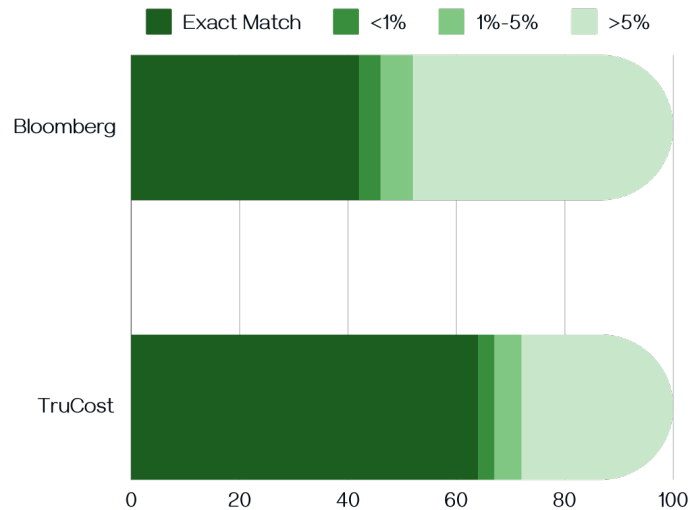
Figure 12: Water Consumption/Use Discrepancies Across Information Intermediaries[18]

Since Trucost does not provide data for water withdrawal, the comparison can only be made with Bloomberg and Refinitiv. The results in Figure 13 show that Bloomberg has a 54% "Exact Match" rate whereas Refinitiv has a 52% "Exact Match" rate with SGFIN's point-in-time corporate report data.
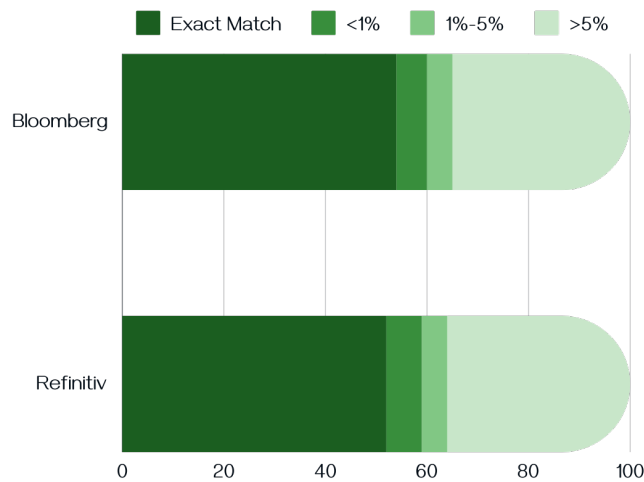
Figure 13: Water Withdrawal Discrepancies across vendors [19]

4.3.5 Overview of High Discrepancies Between Information Intermediaries

Looking across the Figures in this Chapter so far, the "light green" portions highlight the large discrepancies across indicators for each information intermediary, which is

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[18] The total number of water consumption observations between SGFIN and the respective information intermediaries are: 1,053 datapoints for Bloomberg, and 825 datapoints for TruCost.

[19] The total number of water withdrawal observations between SGFIN and the respective information intermediaries are: 745 datapoints for Bloomberg, and 610 datapoints for Refinitiv.

essential for assessing overall data alignment. These "light green" portions reflect the proportion of data by information intermediaries that differ from the data appearing in corporate reports by greater than 5%. These high-discrepancy portions are summarised in Figure 14. For example, Bloomberg shows the largest discrepancy for the water use indicator, suggesting potential reporting inconsistencies. Identifying such areas of divergence helps guide further investigation into why these discrepancies occur. This summary of data discrepancies sets the stage for the following chapter, where the potential reasons behind these discrepancies will be investigated in detail.
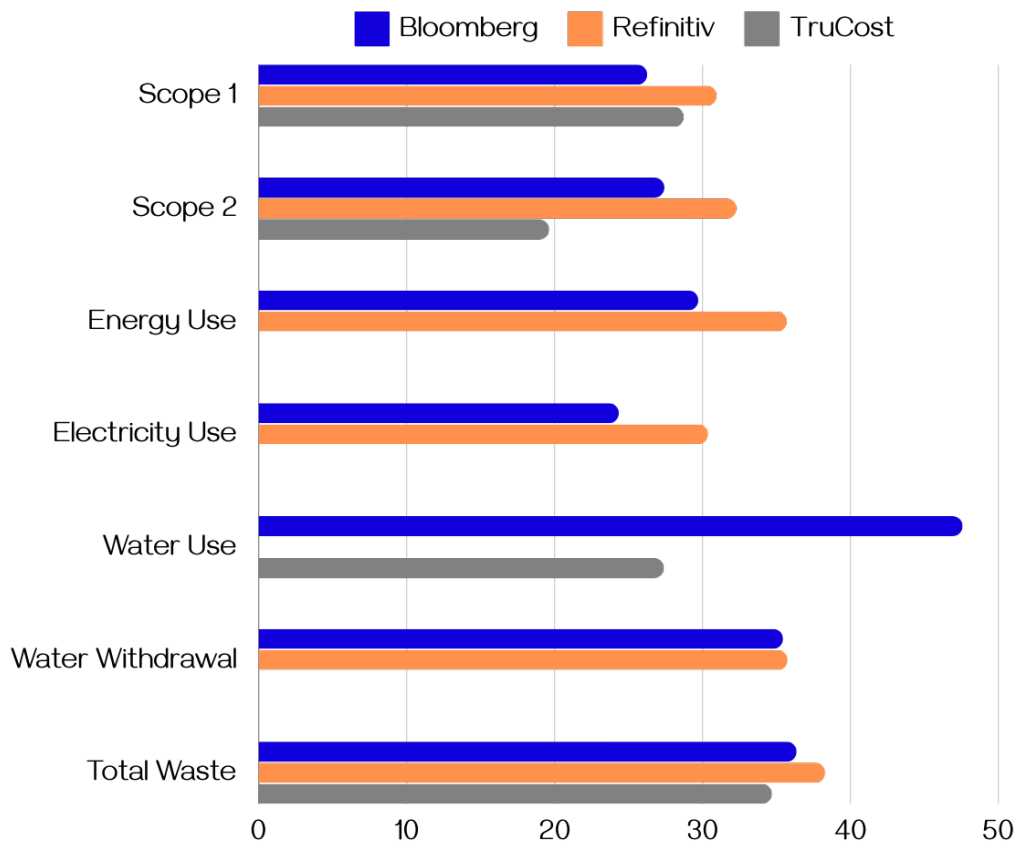
Figure 14: Summary of Significant Data Discrepancies (> 5%) across Information Intermediaries

5 Investigating Reasons for Data Discrepancies

An exploration of the methodologies employed in managing sustainability data reveals a spectrum of practices that contribute to inconsistencies in reported metrics. This section addresses the implications of differing approaches to restatements and the recognition of data misalignments, which may adversely impact data integrity.

Additionally, it highlights the importance of precise definitions of sustainability indicators, as misunderstandings can amplify reporting discrepancies. A thorough understanding of these methodological differences is essential for stakeholders seeking to navigate the complexities of sustainability data and derive meaningful insights from the information provided.

Key Takeaways:
- Original sustainability data is retained by some information intermediaries, while others incorporate data restatements, leading to potential discrepancies.
- Variations in the definitions of sustainability indicators lead to significant inconsistencies across datasets, illustrating the challenges posed by a lack of standardization within the industry.
- There were instances of calculation errors and conversion errors found in Bloomberg and Refinitiv databases.
- TruCost's use of "Estimated" and "Derived" indicators made it challenging to determine the source of discrepancies or even identify the original data source. The investigation into discrepancies between the SGFIN Sustainability Database and the corresponding TruCost data did not conclusively identify errors.
- Our findings highlight the necessity for enhanced transparency and clarity in data reporting, emphasizing the need for continuous dialogue among companies, information intermediaries, investors, and stakeholders.
- Investors and stakeholders must carefully examine the methodologies and definitions employed by information intermediaries, as a comprehensive understanding of these aspects is crucial for informed evaluations of corporate sustainability practices.

Even for seemingly straightforward indicators like GHG Scope 1 emissions, there is a notable amount of data discrepancies. This raises the question of what might be driving these differences. This chapter explores some of the possible reasons for these discrepancies, such as the varying ways in which information intermediaries handle restatements or potential inconsistencies that result from manual data collection, validation processes, and even human error. By investigating these potential causes, we aim to shed light on the roots of these inconsistencies.

5.1   Restatements by Companies

SGFIN retains the data as originally presented in the Sustainability or Annual Reports of the corresponding fiscal year, regardless of any later adjustments in subsequent reports, which include changes in data collection methodologies as well as corrections of previous errors. For instance, if a company's FY2022 report restates its FY2021 GHG Scope 1 emissions, SGFIN does not adopt the restated figure for FY2021. This approach contrasts with that of some information intermediaries, who incorporate such restatements into their data, leading to discrepancies in the reported values relative to the point-in-time data in corporate reports that SGFIN compiles in its SGFIN Sustainability Database.

The focus on point-in-time data is crucial for various analyses in the financial sector. In particular, stock market participants would only have access to the point-in-time data in their interim valuation, since the restated figures would only be available in subsequent periods. In examining the stock market valuation effects of GHG emissions, analysts should focus on linking the stock market reactions following the release of corporate sustainability reports with the disclosed levels of GHG emissions in the corresponding report. Analysing restated data may be subject to look-ahead bias, diminishing the relevance of the analysis for future investment decisions and asset allocations. Furthermore, if there are systematic patterns in corporate restatement behaviour (e.g., consistent understatement of unfavourable environmental metrics such as carbon emissions), studies based on restated data may be subject to potential biases.[20] Please refer to Appendix E for further information on information intermediaries' methodologies with respect to corporate restatements.

The next two case studies provide clear examples of the varied approaches to handling restatements by different information intermediaries. These examples detail how discrepancies can arise from distinct methodologies concerning data restatements and adjustments, particularly when dealing with incomplete or revised disclosures. By examining these cases, it would become evident how differences in approaches can impact data consistency and the comparability of environmental metrics among commercial information intermediaries.

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[20] Indeed, we think it would be crucial to examine stock price reactions in response to restatements, which will be a subject of our future research.

CASE STUDY 1: RESTATEMENTS FOR CAPITALAND INTEGRATED COMMERCIAL TRUST GHG SCOPE 1 EMISSIONS by BLOOMBERG and REFINITV; 2022 AND 2021

In its 2021 Annual Report, Capitaland Integrated Commercial Trust (CICT) reported Scope 1 GHG emissions as 321 tCO2e, shown in the top box of Figure 15. This value was later restated to 42 tCO2e in the 2022 Sustainability Report due to "adjustments of consumption data," as seen in the bottom box. SGFIN retained the original 2021 value, whereas Bloomberg and Refinitiv updated their databases with the restated figure from the 2022 report, as indicated in the middle boxes, highlighting their approach to incorporating restatements in their datasets.

Figure 15: Comparisons of Restatement Approaches by Bloomberg and Refinitiv; Capitaland Integrated Commercial Trust

While Bloomberg and Refinitiv update their datapoints based on restated values, the TruCost values from FY2021 and earlier are significantly different from the disclosed values, as shown below in Figure 16. Only the FY2022 value, disclosed in the 2022 Sus-

tainability Report, matched the GHG Scope 1 values in the TruCost database. However, this may be because the disclosure source for the TruCost data is not "Exact" but "Derived".

companyid	companyname	fiscalyear	gvkey	isin	tickersymbo	exchangesymbol	trucost_GHG Scope 1
9875963	CAPITALAND INTEGRATED COMMERCIAL TRUST	2019	255118	SG1M51904654	C38U	SGX	9738.0324
9875963	CAPITALAND INTEGRATED COMMERCIAL TRUST	2020	255118	SG1M51904654	C38U	SGX	8956.903
9875963	CAPITALAND INTEGRATED COMMERCIAL TRUST	2021	255118	SG1M51904654	C38U	SGX	15375.398
9875963	CAPITALAND INTEGRATED COMMERCIAL TRUST	2022	255118	SG1M51904654	C38U	SGX	30

Figure 16: TruCost, Capitaland Integrated Commercial Trust Scope [21]

A review of the 2021 and 2022 Sustainability Reports reveals changes in the operating properties considered for carbon emissions in each year as seen in Figure 17 below. This adjustment likely explains why 2021's Scope 1 emissions were restated from 321 tCO_2e in the 2021 report to 42 tCO_2e in the 2022 report.

> 1 2019 to 2021 energy consumption, carbon emissions, water consumption and waste have been restated due to adjustments of consumption data.
>
> *Source: Capitaland Integrated Commercial Trust Sustainability Report 2022; Page 72*
>
> 4 Operating properties for **2021** include Retail: BM, BJ, B+, BPP, CQ, FN, IMM, J8, LO, PS, RCS, TM, TAO and WG; and **Office**: AST2, CT, CG, SBR, RCT, OGS (1 January - 30 November 2021), 21CQ (1 October - 31 December 2021) and CS (December 2021).
>
> *Source: Capitaland Integrated Commercial Trust Sustainability Report 2022; Page 28*
>
> 3 Operating properties for **2021** include Retail: Bedok Mall, Bugis Junction, Bugis+, Bukit Panjang Plaza, Clarke Quay, Funan, IMM Building, JCube, Junction 8, Lot 1 Shoppers' Mall, Plaza Singapura, Raffles City Singapore, Tampines Mall, The Atrium@Orchard and Westgate; and Office: Asia Square Tower 2, Capital Tower, CapitaGreen, Six Battery Road, Raffles City Tower (office), One George Street, 21 Collyer Quay (1 October - 31 December 2021) and CapitaSpring (December 2021). Consumption for German operating properties was reported separately.
>
> *Source: Capitaland Integrated Commercial Trust Annual Report 2021; Page 133*

Figure 17: Change in Operating Properties for FY 2021

CASE STUDY 2: BRITISH AMERICAN TOBACCO (MALAYSIA) BERHAD

In its 2019 Annual Report, British American Tobacco (Malaysia) Berhad reported water consumption at 1,275 m³, and the 2020 figure was 1,161 m³, as shown in the top two boxes of Figure 18. These values are reflected in the SGFIN Sustainability Database. However, in 2022, the company restated these figures to 2,088 m³ for 2019 and 1,571 m³ for 2020, which are the values captured by Bloomberg, as shown in the third box.

---

[21] Data obtained from TruCost on 25 July 2024.

| 303-5 | Water Consumption | Commerical:
Total: 1275 cubic metres |

Source: British American Tobacco Malaysia Annual Report 2019, Page 147

Water consumption in 2020 decreased by 9 percent compared with 2019. This in all site offices and warehouses.

	2019	2020
Energy (GJ)	33,295	23,789
Water (m³)	1,275	1,161

Source: British American Tobacco (Malaysia) Berhad Annual Report 2020, Page 51

| Name | H2O↑
Consump:2... | H2O
Consump:20... | H2O
Consump:20... | H2O
Consump:20... |
|---|---|---|---|---|
| british | <Enter Filter> | | | |
| Refined Universe (1) | 1.00k | 969.00 | 1.57k | 2.09k |
| 31) BRITISH AMERICAN TOBACCO... | 1.00k | 969.00 | 1.57k | 2.09k |

Source: Bloomberg, British American Tobacco Malaysia Berhad, screencaps taken on 7 August 2024

WATER CONSUMPTION FOR THREE YEARS (m³)

2,088 — 2019
1,571 — 2020
969 — 2021

Source: British American Tobacco Malaysia Annual Report 2021, Page 43
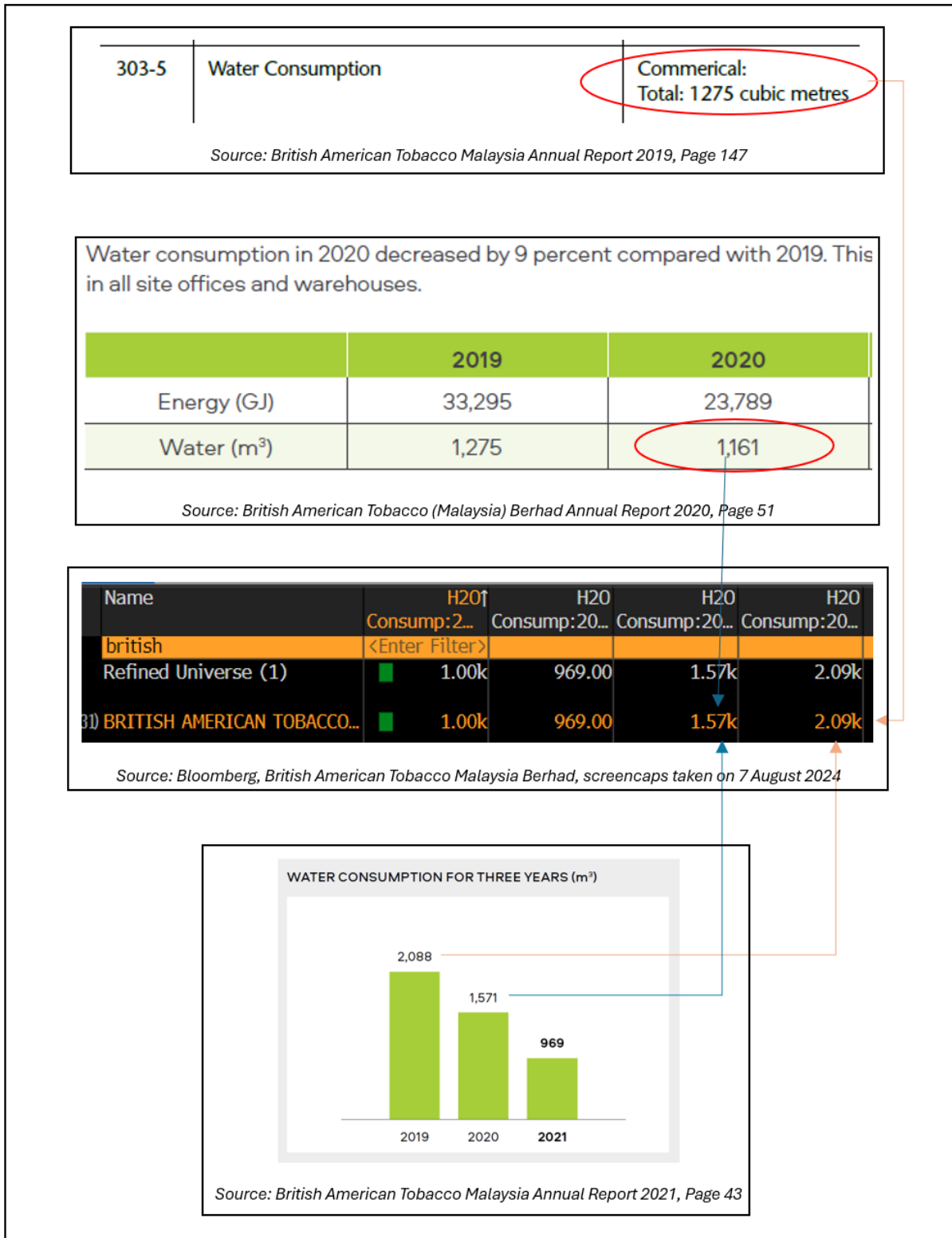
Figure 18: Restatement of British American Tobacco (Malaysia) Berhad's Water Consumption Data over The Years

It is crucial to note here that the company provided no explanation for the restatements in its 2022 Annual Report, with the GRI Standards Index provided at the end of

its 2022 Annual Report indicating no restatements. Indeed, under Disclosure 102-48: "Restatements of information", British American Tobacco (Malaysia) Berhad made the following statement: "There is no restatement of information from previous report" as seen in Figure 19 below. In this scenario, using restated data without any reason seems difficult to justify.

102-47	List of material topics	Refer to How We Assess Materiality on page 34
102-48	Restatements of information	There is no restatement of information from previous report
102-49	Changes in reporting	No significant changes from previous reporting periods in the

Figure 19: (Mis-)Declaration of Restatement Information in British American Tobacco (Malaysia) Berhad's Annual Report 2021

The TruCost value for this company's water consumption in 2019[22] significantly diverges from the values disclosed by the corporation in its 2019 report or captured by Bloomberg (i.e., the restated value). The difficulty in identifying the source of TruCost's values highlights the distinct nature of the restatement issues in Bloomberg versus the lack of transparency in TruCost.

companyid	companyname	fiscalyear	gvkey	isin	tickersymbo	exchangesymbol	trucost_total water use
874830	BRITISH AMERICAN TOBACCO (MALAYSIA) BERHAD	2019	100945	MYL4162OO003	BAT	KLSE	26951.416
874830	BRITISH AMERICAN TOBACCO (MALAYSIA) BERHAD	2020	100945	MYL4162OO003	BAT	KLSE	1571
874830	BRITISH AMERICAN TOBACCO (MALAYSIA) BERHAD	2021	100945	MYL4162OO003	BAT	KLSE	969
874830	BRITISH AMERICAN TOBACCO (MALAYSIA) BERHAD	2022	100945	MYL4162OO003	BAT	KLSE	856.679

Figure 20: TruCost, British American Tobacco (Malaysia) Berhad [23]

5.2   Data Handling

Human errors, such as inaccuracies in conversions or calculations, can contribute to discrepancies between data points across databases. A simple mistake during unit conversion or incorrect data entry during aggregation can lead to significant inconsistencies. These errors may arise from manual handling resulting in notable differences between vendor datasets and SGFIN's data. Bloomberg and Refinitiv have acknowledged such issues, with Refinitiv providing details on improving its quality checks. Compiling TruCost's data also required verification to clarify the use of "Exact," "Derived," and "Estimated" data and properly aggregate indicators like "Total Waste" – which turned out to be a sum of three variables as seen in Table D-3 in the Appendix

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[22] The TruCost indicator used for comparison with SGFIN Sustainability Database water use data is "Absolute: Water Direct and Purchased." This is composed of three sub-indicators: "Absolute: Water Direct Cooling" [999 - Missing], "Absolute: Water Direct Process" [317 - Derived from Previous Year], and "Absolute: Water Purchased" [317 - Derived from Previous Year]. TruCost data with "2xx" disclosure codes refer to data that was estimated and were excluded from the analysis. Although British American Tobacco's water use was not estimated, the 2019 TruCost water use figure could not be verified when referring to their Sustainability Reports.

[23] Data obtained from TruCost on 25 July 2024.

below. This section will present an example of manual error, specifically examined in Case Study 3.

CASE STUDY 3: BRITISH AMERICAN TOBACCO MALAYSIA

British American Tobacco Malaysia disclosed in the text of its 2023 Annual Report that its total water withdrawn was 1,117m^3 in 2023 (the first circle in Figure 21). The figure that was displayed in a graph in its annual report, however, was 1.17 (thousand) m^3 as highlighted in the third circle in Figure 21. The latter value is displayed on Bloomberg Portal when searching specifically for the water withdrawal figures of BAT Malaysia. In fact, the value is rounded up to 1.2 (thousand) m^3 as seen in Figure 22.
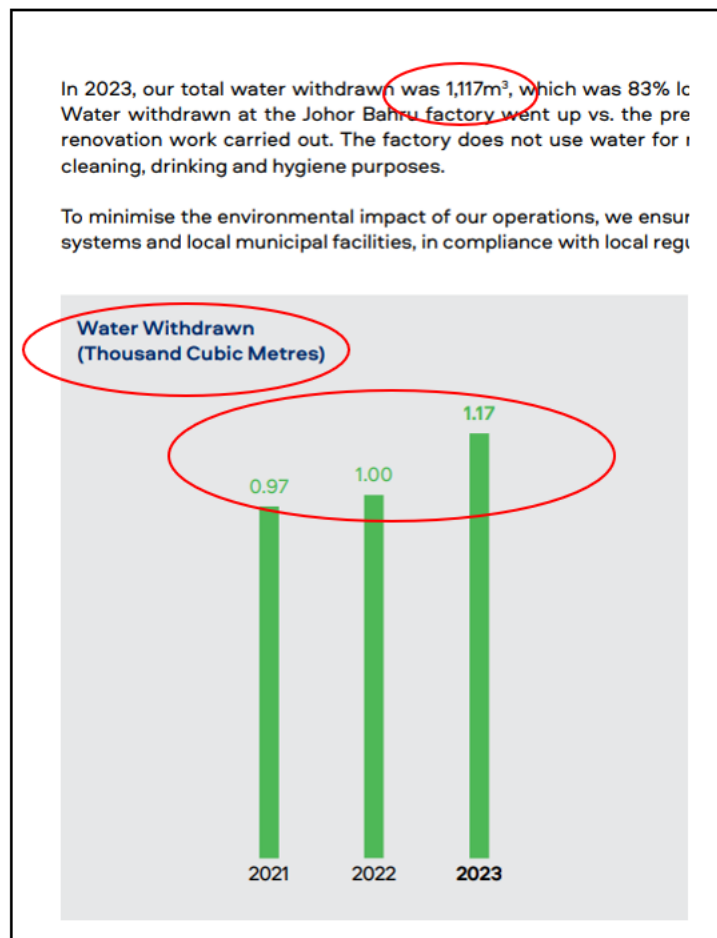
Figure 21: Water Withdrawal Data from British American Tobacco Malaysia Annual Report 2023 [24]

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[24] Referenced from British American Tobacco Malaysia Annual Report 2023, p. 59.

Figure 22: Bloomberg Portal, British American Tobacco Malaysia Berhad [25]

On Refinitiv Workspace, one would be able to find the exact water withdrawal figure that was disclosed by British American Tobacco Malaysia in their 2023 Annual Report as seen in Figure 23.

Figure 23: Refinitiv Workspace, British American Tobacco Malaysia Berhad [26]

This case study highlights how underlying data can differ between commercial information intermediaries. Variations in data handling—such as differing rounding conventions, units of measurement, or interpretations of reported figures—can lead to discrepancies in sustainability metrics. These differences point to the importance of understanding each vendor's approach and methodology to ensure accurate comparisons and informed decision-making based on the data provided.

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[25] Obtained from the Bloomberg Portal, accessed on 7 August 2024

[26] Obtained from Refinitiv Portal, accessed on 2 September 2024

5.3 Differing Definitions of Indicators

In Section 4.3.2, there was lower alignment between the energy consumption data from Bloomberg and Refinitiv compared to the data compiled in the SGFIN Sustainability Database, particularly when contrasted with electricity consumption data (Refer to Figure 9 and Figure 10). This discrepancy may be attributed to the greater complexity in calculating energy consumption data which involves multiple variables[27].

Figure 12 in Section 4.3.4 illustrates relatively low data alignment between water consumption metrics from commercial databases compared to the SGFIN Sustainability Database. Interestingly, Figure 13 shows a much larger alignment between the water withdrawal metrics from information intermediaries and those compiled in the SGFIN Sustainability Database. When comparing against Bloomberg —since Refinitiv lacks water consumption data and TruCost lacks water withdrawal data— a noticeable gap persists, with Bloomberg showing a 42% "Exact Match" for water consumption versus 54% for water withdrawal.

However, the discrepancy between water consumption and water withdrawal does not seem to be due to the complexity in calculating water usage as the formula for calculating water consumption is relatively simple[28]. SGFIN applied the definitions for all the indicators compiled in Table A-1 in the Appendix for its data gathering. Primarily using the definitions as stated by GRI, SGFIN identified that the definitions themselves may not be fully understood, thereby resulting in the discrepancies we have compiled in Chapter 4.

This is exemplified by the previous example of British American Tobacco (Malaysia) Berhad, where Bloomberg reported a value for water consumption/use as seen in Figure 22 (highlighted by the green box) despite non-disclosure by the company in the 2023 Annual Report (see Figure 24).

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[27] The GRI definition of Energy Consumption is given by the following formula:
Total Energy Consumption within the Organization **=** Non-Renewable Fuel Consumed **+** Renewable Fuel Consumed **+** Electricity, heating cooling and steam purchased for consumption **+** Self-generated electricity, heating, cooling, and steam which are not consumed **–** Electricity, heating, cooling, and steam sold.

[28] The GRI definition of water consumption is Water consumption **=** Total Water Withdrawal **-** Total Water Discharge.

GRI Standard	Disclosure	Remarks/Page Number
ENVIRONMENTAL (continued)		
303: Water and Effluents 2018		
3-3	Management of Material Topics	Pages 58 to 59
303-1	Interactions with water as a shared resource	Pages 58 to 59
303-2	Management of water discharge-related impacts	Pages 58 to 59
303-3	Water withdrawal	Page 59
303-4	Water discharge	Not reported
303-5	Water consumption	Not reported

Figure 24: GRI 303-5 (Water Consumption) Disclosure by British American Tobacco (Malaysia) Berhad in Annual Report 2023 [29]

In essence, companies might be using the terms "water consumption" and "water withdrawal" interchangeably in their reports, or commercial information intermediaries may be substituting data from one indicator to represent the other. This is exemplified in Case Study 4 below.

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[29] See British American Tobacco (Malaysia) Berhad Annual Report 2023, p. 217

CASE STUDY 4: ALLIANZ MALAYSIA BHD; 2022

Allianz Malaysia Berhad has reported only water consumption values without specifi-cally addressing water withdrawal in its 2022 Annual Report (See Figure 25).

Item	Unit	2019	2020	2021	2022
Environmental Management System ("EMS") coverage					
Share of employees in scope of our EMS	%	100	100	100	100
Greenhouse gas emissions ("GHG") in own operations*					
Scope 1 – Direct GHG emissions	tCO₂e	925.10	651.50	384.03	777.19
Scope 2 – Indirect GHG emissions (market-based)	tCO₂e	2,981.03	0	0	0
Scope 3 – Other indirect GHG emissions	tCO₂e	1,947.68	789.92	470.73	942.57
Total GHG emissions	tCO₂e	5,853.81	1,441.42	854.76	1,719.76
Total GHG emissions per employee	tCO₂e/employee	3.13	0.76	0.43	0.83
Overall GHG reduction per employee since 2019	%		75.7	86.3	73.5
Energy consumption					
Total energy consumption	MJ	16,386,780	14,461,713	10,803,630	12,851,123
Energy consumption per employee	MJ/employee	8,748.9	7,647.7	5,486.9	6,166.6
Energy reduction per employee since 2019	%		12.6	37.3	29.5
Business travel					
Total travel	km	12,181,200	4,630,327	2,276,652	6,172,271
Travel per employee	km/employee	6,503.6	2,448.6	1,156.2	2,961.7
Travel reduction per employee since 2019	%		62.4	82.2	54.5
Water consumption					
Total water consumption	m³	42,000	45,470	37,054	50,163
Water consumption per employee	m³/employee	22.42	24.05	18.82	24.07
Water consumption reduction per employee since 2019	%		-7.3	16.1	-7.4

Figure 25: Water Consumption Disclosure by Allianz Malaysia Berhad in Annual Report 2022 [30]

Refinitiv, which tracks water withdrawal but does not track water consumption data, reported the disclosed total water consumption figure as water withdrawal (See Figure 26).

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[30] See Allianz Malaysia Berhad Annual Report 2022, p. 74
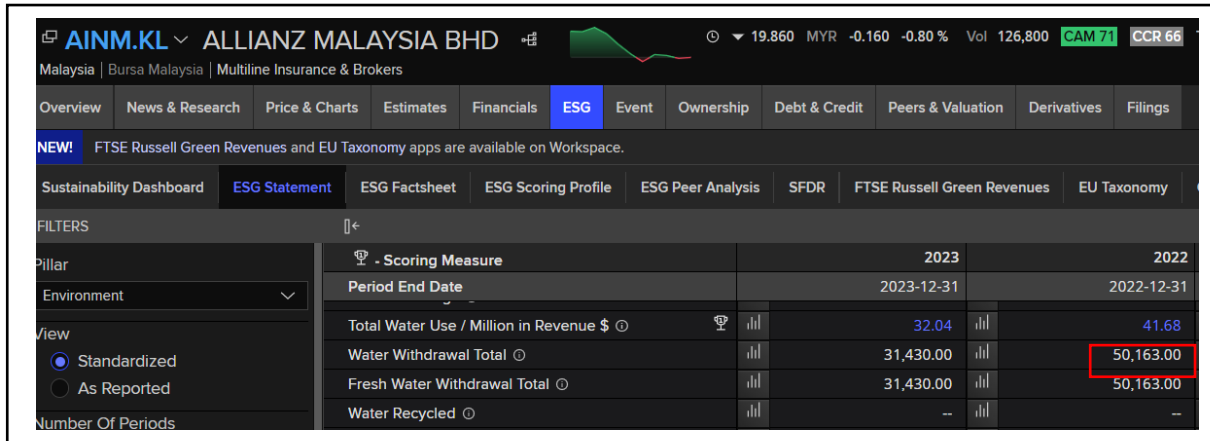
Figure 26: Refinitiv, Allianz Malaysia Berhad Water Withdrawal [31]

In contrast, Bloomberg used the water consumption value from the 2022 Annual Report for both water consumption and water withdrawal metrics, highlighting a potential overlap in how these data points are represented by different information intermediaries (See Figure 27).

Figure 27: Bloomberg Portal, Allianz Malaysia Berhad Water Withdrawal [32]

TruCost does not record water withdrawal data but records water consumption values from 2020 onwards. According to email communications, TruCost recognizes that "water withdrawal" and "water use" are often used interchangeably, leading them to consolidate these terms under a single water-related indicator for their current data tracking approach (see Figure 28).

Figure 28: TruCost, Allianz Malaysia Berhad Total Water Use [33]

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[31] Obtained from Refinitiv Portal, accessed on 6 August 2024

[32] Obtained from the Bloomberg Portal, accessed on 4 September 2024

[33] Data obtained from TruCost on 25 July 2024

6 Implications of Inaccurate Sustainability Data Recording

Inaccurate sustainability data has far-reaching implications for investment practices and market efficiency. With increasing interest in sustainability-driven investments, the reliability of the underlying data is critical. Inconsistencies in sustainability metrics can lead to misguided risk assessments, which may affect portfolio allocations and overall strategic objectives. These discrepancies can also distort perceptions of corporate sustainability, potentially eroding stakeholder trust and exposing firms to reputational and regulatory risks.

The implications of inaccurate sustainability data extend to broader market dynamics, potentially leading to mispricing that can impact company valuations and asset allocation. Investment portfolios that depend on sustainability metrics may face the risk of suboptimal asset allocations, influencing their performance. Central banks and regulatory bodies tasked with managing climate-related financial risks face challenges when relying on inconsistent sustainability data, which may compromise policy effectiveness and risk management.

Key Takeaways:
- Accurate sustainability data is essential for informed investment decisions, enabling proper risk assessments, efficient capital allocation, and market stability.
- Inaccurate data can distort market pricing, lead to misvaluations, and result in suboptimal portfolio allocations, affecting both corporate strategies and investment performance.
- Confidence in sustainability initiatives depends on data reliability. Inaccurate information can erode confidence among investors, regulators, and other key stakeholders, undermining efforts to achieve sustainable economy.

The rapid proliferation of sustainability data has facilitated a rapid growth in sustainability-driven investment practices but also came with several potential crucial considerations, particularly when the integrity and accuracy of this data may be compromised. Inaccurate reporting and recording of sustainability data can lead to misguided decisions by investors, regulators, and corporations. In particular, it can distort market signals, resulting in inefficient capital allocation and hindering progress toward genuine sustainability goals. These inaccuracies can undermine trust among relevant stakeholders, expose companies to reputational risks and legal challenges, and complicate efforts to enhance regulatory and reporting requirements.

6.1   Inaccurate Risk Assessment and Suboptimal Portfolio Allocations

Inaccurate data from sustainability information intermediaries can result in profound implications, particularly in the evaluation of a company's sustainability performance. When these inaccuracies occur, they can distort the perceived risk profiles of companies, leading to mis-estimation of crucial risks faced by these companies such as those associated with climate change.

For instance, if a company's carbon emissions are underreported (or under-recorded), analysts and investors may fail to account for potential regulatory penalties, reputational damage, or future carbon pricing impacts. This can skew the estimation of risk for not only the company but also portfolios that invest in the company, leading to suboptimal asset allocation for investors and excessive allocation of financial resources towards the company or the sector. Poor data can obscure the environmental, social, and governance risks associated with different sectors or geographic regions. For instance, if the data underrepresents the environmental risks in a particular sector, portfolios may become overly concentrated in that sector, increasing their exposure to unforeseen risks.

Portfolio rebalancing decisions are typically based on the relative expected performance and risk profiles of the assets in the portfolio. Inaccurate sustainability data can lead to incorrect assessments of these factors, resulting in rebalancing actions that do not align with the portfolio's strategic objectives. This could mean maintaining or increasing exposure to assets with hidden climate-related risks or missing opportunities to invest in companies that have made genuine progress towards more sustainable business practices.

The implications of inaccurate data extend to the assessment of climate risks. The Bank of International Settlements highlights the need for new insights and tools to address the complexities of climate risk. Inaccurate data can lead to an underestimation of these risks, particularly those associated with extreme weather events. To effectively manage climate risk, investors must combine sophisticated climate models, understand the geographic diversification of portfolio companies, and develop cost functions that link climate impacts to specific business operations (Bertolotti, 2020).

In summary, the consistency of sustainability data provided by vendors is critical for investors to make informed decisions. Inaccuracies can lead to misinformed assessments of a company's sustainability performance, ultimately affecting investment outcomes and portfolio allocations. As the integration of sustainability data into investment strategies continues to grow, ensuring the reliability and consistency of this data becomes increasingly important for the future of money management.

6.2 Market Mispricing

Given its impact on risk assessment, inconsistent sustainability data can distort market pricing mechanisms, leading to overvaluation or undervaluation of companies. This would affect market efficiency and the allocation of resources within the economy.

For active portfolios that integrate specialized sustainability data in order to gain an investment edge, the lack of accurate sustainability data would blunt their investment edge, particularly in evaluating smaller firms with less robust sustainability data collection and verification methods (Bertolotti, 2020).

Inconsistencies in sustainability data can also complicate the management of passive investment portfolios, e.g., index funds. For these portfolios, the distorted pricing would lead to suboptimal portfolio weights, e.g., overweighting of securities with under-recorded sustainability-related risks, which would dent the risk-return trade-off considerations in constructing risk-efficient portfolios.

This issue is exacerbated further for portfolios that are built directly on specialized sustainability data, e.g., sustainability-linked index funds, as the inconsistencies of sustainability data would directly lead to inaccurate allocations in these portfolios, which will pose significant challenges in risk management, oversight, and reputation (Bertolotti, 2020)

6.3 Portfolio Sustainability Performance Measurements

With investors paying closer attention to sustainability performance of their investment portfolios, even for those that are not directly linked to sustainability considerations, they are indirect users of sustainability data. Inconsistencies in sustainability data can lead to incorrect sustainability performance assessments and result in either financially inefficient portfolio allocations or those that do not meet the sustainability requirements of their investors, which may lead to future erosions of the reputations of portfolio managers.

6.4 Capital Structure and Corporate Finance Implications

The cost of capital for a company is shaped by its capital structure, which is made up of debt, equity, and retained earnings. Key theories on optimal capital structure include the trade-off theory, pecking order theory, and asymmetric information theory.

The trade-off theory suggests that the ideal capital structure balances the benefits and costs of borrowing. The cost of capital is essential in determining the value of assets, including companies. Sustainable companies with lower sustainability-related risks are expected to benefit from reduced capital costs, positively affecting overall company value. Recent research advances in this topic indicate that companies with higher sustainability ratings tend to have lower equity beta, consistent with lower cost of equity (Ernst & Woithe, 2024).

Moreover, companies with higher sustainability performance may also benefit from a higher availability of debt capital. A primary benefit of debt is the tax shield it provides, as interest payments are tax-deductible. The ease of access to debt and the lower cost of equity capital essentially reduces the average cost of capital for companies with higher perceived sustainability performance. Indeed, companies with higher sustainability ratings face a lower cost of debt compared to those with average sustainability ratings (Ernst & Woithe, 2024). Inconsistent sustainability data would lead to several negative implications: (1) excess or insufficient allocation of resources to companies and, (2) suboptimal capital structure, leading to lenders being exposed to excessive default risk. The suboptimal capital structure can negatively impact a company's financial stability and enterprise value, making it a crucial consideration for investors and financial institutions.

In summary, inconsistencies in sustainability data could lead investors and financial institutions to make poorly informed decisions, ultimately undermining the long-term financial health and enterprise value of the companies involved. Inaccurate data from vendors not only distorts the perceived risk profile of companies but also leads to misaligned investment strategies that fail to account for the actual sustainability performance of a company, exposing both the company and its investors to unforeseen financial risks.

6.5 Environmental Harms

Central banks and monetary authorities have a crucial role in addressing climate-related financial risks, especially as the effects of climate change become more pronounced. Positioned at the core of the financial system, they have the potential to influence the broader economy and mitigate systemic risks. However, their effectiveness in this role heavily relies on the accuracy and reliability of the data they use. This is where sustainability data provided by information intermediaries may play a substantial role. Inconsistent sustainability data can significantly hinder central banks' efforts, leading to consequences that extend beyond financial stability to influence global climate initiatives, such as the Nationally Determined Contributions (NDCs) committed to by countries.

Financial authorities may increasingly find themselves in the position of acting as the last line of defence against climate-related financial crises. These crises, often unpredictable and potentially catastrophic, require timely and informed intervention. For

central banks to effectively mitigate such risks, they must be able to assess and monitor climate-related exposures within the financial system accurately (Bolton et al., 2020) However, if the sustainability data they rely on is flawed - such as inconsistent recording of corporate environmental metrics, indicators and/or impacts - this can lead to misinformed decision-making. When central banks are unable to accurately gauge the climate-related and other environmental risks faced by financial institutions and their customers, their interventions may be either too late or misdirected, potentially exacerbating financial instability rather than containing it.

One of the tools central banks uses to prepare for climate-related financial risks is scenario-based analyses (Bolton et al., 2020). This approach involves developing various plausible scenarios to understand the potential impact of different climate outcomes on the financial system. The effectiveness of scenario-based analysis is deeply entwined with the quality of the data that underpins the promulgated scenarios. Developing scenarios based on inaccurate sustainability data may fail to capture the true scope of climate-related and other environmental risks. For instance, inconsistent recording of a company's greenhouse gas emissions or water usage can lead to scenarios that underestimate the physical and transition risks faced by these companies. This underestimation could result in central banks failing to foresee the full financial impact of such risks, leading to policy responses that are insufficient to mitigate the systemic threats posed by climate change and other environmental crises (Bolton et al., 2020).

The implications of inconsistent sustainability data extend beyond the financial sector. With NDCs representing each country's commitment to reducing national emissions and adapting to climate impacts, the consistency of corporate sustainability data is essential for tracking progress toward these country-level commitments and for informing the policies necessary to achieve them. When data provided by vendors is inconsistent, it can obscure the true environmental impact of corporate activities, making it challenging for countries to assess their respective progress accurately. This could create a false sense of security regarding the effectiveness of current policies, potentially leading to insufficient mitigation efforts. Additionally, governments' ability to support NDCs through monetary and fiscal policies may be compromised if they rely on flawed sustainability data. For example, policies formulated using flawed sustainability data might be ineffective in promoting green financing initiatives, incentivizing sustainable practices, and eliciting the necessary changes in corporate behaviour, ultimately hindering progress toward NDC targets, and undermining global efforts to combat climate change.

7 The Ways Forward

To better leverage sustainability data in corporate and investment decision-making, a few core strategies can enhance the reliability and utility of these data. First, it is essential that information intermediaries concentrate on providing high-quality and transparent sustainability metrics, which would allow for a more accurate assessment of corporate performance. Meanwhile, companies should play an active role in their data collection and disclosure processes, emphasizing transparency of their sustainable business practices. Lastly, adopting adaptable scoring frameworks would enable users to tailor their assessments to specific needs, maximizing the overall effectiveness of sustainability information.

Key Takeaways:

- Information intermediaries should focus on making material sustainability metrics and indicators available reliably on their platforms, to provide investors with a clearer and more consistent understanding of corporate sustainability performance.
- Companies must take a proactive role in collecting and reporting their sustainability data, ensuring transparency and accuracy, thereby building greater trust and reducing information asymmetry between themselves and investors.
- Creating adaptable and robust scoring systems will enable end-users to customize sustainability assessments based on their specific objectives, thereby enhancing the overall utility of sustainability data.

As sustainability reporting becomes more essential for investors, regulators, and businesses, the integrity and transparency of sustainability data have never been more critical. This chapter provides recommendations and insights to improve the collection, reporting, recording, and eventual use of sustainability metrics. From focusing on indicators that are material to corporate operations and sustainability to developing more adaptable yet transparent rating methodologies, this section underscores the need for more meaningful data, external assurances and audits, and corporate ownership of sustainability reporting and its recording by information intermediaries. Each recommendation aims to ensure more reliable, actionable sustainability data across industries for stakeholders.

7.1 Prioritize Reporting Material Sustainability Metrics

The process of collecting and organizing sustainability data, which is then marketed to the investor community, involves information intermediaries injecting their views on corporate sustainability to the data provided on the platforms. This practice introduces a layer of subjectivity that can result in discrepancies between the sustainability (e.g., ESG) ratings assigned to the same company by different vendors (Hendratama et al., 2024). Such discrepancies raise potentially valid concerns about the integrity of these ratings, particularly when investors rely on them to make portfolio adjustments. A better approach would be to focus on providing the intrinsic indicators that form the basis of these ratings. While these indicators may require contextualization before being used for decision making, they offer a more transparent and consistent measure of specific company performance metrics, such as CO_2 emissions or board diversity (Bertolotti, 2020). Pushing for a higher integrity collection, reporting, and validation of sustainability data would facilitate the development of more efficient and transparent evaluation methodologies of corporate sustainability.

7.2 Ensure Access to Clear, Reliable Data with External Assurance

The increasing demand for sustainability data should be met with educational initiatives and complemented with efforts to ensure integrity and transparency in data reporting. Allowing public access to transparent sustainability data helps end-users better understand and utilize sustainability metrics. Standardized reporting frameworks are crucial in this effort, offering consistency, transparency, and clarity. By integrating global standards, like those from ISSB/IFRS, and adopting relevant taxonomies, commercial entities can streamline their sustainability data reporting, making it easier for investors, regulators, and companies to use the data for informed decision-making.

The ASEAN Taxonomy plays a critical role for member states in setting sustainability disclosure rules and managing risks. The Taxonomy also provides a reference for financial market participants, promoting consistent sustainability disclosures at portfolio and product levels (ASEAN Taxonomy Board, 2024). It helps companies demonstrate their environmental credentials while preventing greenwashing. Despite these advancements, many challenges remain, such as data collection and standardization.

Moreover, different nations and private entities may lack the willingness to share data due to concerns over confidentiality and reputational risks (ASEAN Taxonomy Board, 2024).

Nevertheless, there is a growing recognition among stakeholders that alignment between national taxonomies and the ASEAN Taxonomy is essential. Harmonized taxonomies will help avoid fragmented regulatory landscapes, promoting collaboration over competition. However, balancing national priorities and global sustainability standards is a complex task, requiring interoperable frameworks that respect national contexts while pursuing common goals (Green Finance Industry Taskforce, 2023).

To ensure that sustainability data is not only available but also actionable, it is crucial that this data is transparent, reliable, and independently verified, enhancing trust for end-users such as investors, regulators, and companies. External assurance is essential in maintaining data integrity, helping end-users understand the credibility of reported metrics and guiding informed decisions. Standardized frameworks (e.g., ISSB/IFRS) and taxonomies (such as the ASEAN Taxonomy) further support this goal, providing consistent definitions and requirements. As the ASEAN Taxonomy advances, it offers a harmonized approach to sustainability reporting and risk management, though challenges remain with data-sharing and alignment among member states. Addressing these challenges through data education and assurance is critical to supporting the evolving landscape of sustainability reporting.

7.3   Greater Responsibility by Corporations for Their Sustainability Data

Corporations must shift away from treating sustainability reporting as a mere compliance exercise and instead view it as a tool to enhance how they can make material environmental and social impacts, while maintaining commercial viability and profitability. Measurement and reporting often become goals in themselves, with businesses focusing on producing data rather than driving substantial improvements. This can be compared to counting calories while still eating poorly and not focusing on macronutrients in their diet —the focus should be on the content and quality of the data (Pucker, 2021).

To reduce information asymmetry and facilitate better access to financial resources, firms need to take ownership of their sustainability metrics, collecting accurate and relevant data that financial intermediaries can trust. Doing so provides a clearer picture of the risks and performance of the company. With better data ownership, firms can ensure that their sustainability goals, such as net-zero emissions, are viewed as genuinely achievable and not just distant targets. Many firms have been criticized for setting such long-term goals at a comfortable pace, seemingly neglecting the urgency required to address global challenges. True responsibility requires that companies act with the urgency demanded by climate change, making their reporting part of a larger effort to align their operations with sustainable outcomes.

7.4 Develop Transparent and Adaptable Scoring Methodologies

Unlike credit rating, sustainability rating needs to cater to different objectives and preferences among distinct end-users, e.g., investors, consumers, regulators, and so on. This necessitates a transparent and adaptable mechanism that will allow end-users to understand and integrate their own objectives and preferences in their scoring/rating of corporate sustainability. The mechanism should be parsimonious and transparent for end-users but maintain sufficient adaptability to cater to end-users with differing objectives and risk-return considerations. Each end-user should be able to adapt the ratings for their own needs, so that they can determine the appropriate investment decisions that account for sustainability or formulate regulations and policies that balance sustainability and growth.

Epilogue

While taxonomies and regulations help establish sustainability criteria, they have limitations. The various standards and frameworks, as highlighted in Chapter 2, often differ, and exchanges implement select aspects to regulate listed companies. Taxonomies can streamline indicators, but a standardized framework across Southeast Asian countries would enable uniform comparison. It is understandable that firms, especially those just beginning their sustainability journey, might feel overwhelmed by the extensive information, frameworks, and standards they need to follow. However, it is encouraging to see non-governmental organizations working together to harmonize these requirements, making sustainability reporting more streamlined and accessible. This collaboration enhances the reliability of data and the accuracy of corporate disclosures. This guiding principle is central to SGFIN's ongoing project, which aims to harmonize standards and frameworks to provide a more straightforward solution for sustainability reporting. SGFIN is working on a proposal for such a framework, narrowing down the number of indicators from the IFRS S2 framework into a more concise and unified set of indicators for the region's exchanges to adopt. It is the hope that this framework can guide end-users effectively by providing reliable and accurate data thereby enhancing their ability to make informed decisions

Moving forward, SGFIN aims to expand the scope of the SGFIN Sustainability Database by first adding more recent data for SEA countries, ensuring its continued relevance. Additionally, SGFIN plans to include more countries to enhance research opportunities and generate deeper insights. SGFIN intends to extend the database to include India and Korea, alongside expanding the years covered. Meanwhile, interested parties can access the current SGFIN database featuring point-in-time data for seven environmental indicators, spanning 2019 to 2022 for six Southeast Asian countries, through this link: (https://www.sgfin.tech/#/datahub). SGFIN plans to periodically update the database, adding more indicators beyond the seven covered in this paper.

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Appendix A: SGFIN Indicators

Table A-1: Description of SGFIN Indicators

S/N	SGFIN Indicators	Description of SGFIN Indicators
1	GHG Scope 1 Emissions (tCO$_2$e)	The amount of direct Scope 1 Greenhouse Gas (GHG) Emissions by the specific company by sources that are owned or controlled by the company. These may include gases such as carbon dioxide (CO2) and other gases under the GHG Protocol for the emissions classification by type and Global Warming Potentials (GWP).
2	GHG Scope 2 Location-Based Emissions(tCO$_2$e)	The amount of indirect Scope 2 Greenhouse Gas Emissions of the company specific to the location-based method. This means that emissions are calculated using a location-based methodology which incorporates grid emissions factors of the relevant region. Indirect emissions consist of emissions due to activities of the company but occurring at entities not owned or controlled by the company. These emissions usually include consumption of purchased electricity, heat or steam.
3	Total Energy Use (GJ)	The total energy consumed by the company which includes both direct energy consumption and indirect energy consumption. More than often, energy consumed as electricity is the energy consumption. Energy Units: Gigajoules (GJ). For the purposes of verification, any energy disclosures presented in units of Watt-hours are multiplied by 3.6 and the respective order of magnitude to convert to Gigajoules.
4	Total Electricity Use (GJ)	The amount of electricity used or purchased by a company. It is assumed that no electricity is produced by the company if there are no explicit statements of leveraging on renewable technology (such as solar panels) or if the company is not an energy/utilities company. Energy Units: Gigajoules (GJ). For the purposes of verification, any energy disclosures presented in units of Watt-hours are multiplied by 3.6 and the respective order of magnitude to convert to Gigajoules.
5	Total Waste (Metric Tonnes)	The total waste is a sum of the total hazardous and non-hazardous waste. The waste values compiled are only for solid wastes unless liquid wastes are disclosed in units of grams or tonnes. Waste Units: There are instances of companies reporting in ton which will then be converted to metric tonnes via multiplication of 0.907. This does not apply to Indonesian companies. Their disclosures in "ton" are taken as metric tonnes.
6	Total Water Use (m³)	Total Water Use/Consumption is the difference between the Total Water Withdrawal and Total Water Discharge. It refers to the total amount of water used for the company's activities and operations. If a company reports the same values under headers such as "Water Use/Withdrawal", the numbers will be added to both indicators in the SGFIN Sustainability Database. Often, under the GRI scoping table at the end of a Sustainability/Annual Report, the company claims that Water Withdrawal (GRI 303-3) and Water Consumption (GRI 303-1) has been reported but specific values are only provided for one indicator. In these instances, SGFIN shall ignore the catch-all motherhood statements and only take the values reported for the specific indicator
7	Total Water Withdrawal (m³)	Total Water Withdrawal refers to the total volume of water withdrawn from any water source. If a company reports the same values under headers such as "Water Use/Withdrawal", the numbers will be added to both indicators in the SGFIN Sustainability Database. Often, under the GRI scoping table at the end of a Sustainability/Annual Report, the company claims that Water Withdrawal (GRI 303-3) and Water Consumption (GRI 303-1) has been reported but specific values are only provided for one indicator. In these instances, SGFIN shall ignore the catch-all motherhood statements and only take the values reported for the specific indicator.

Appendix B: Mapping of TruCost's Disclosure Methods

Table B-1: TruCost Disclosure Method Codes

Disclosure Method	Disclosure Group	Code
Exact Value from personal communication	Exact	101
Exact Value from Environmental/CSR	Exact	102
Exact Value from CDP	Exact	103
Exact Value from Annual Report/10K/Financial Accounts Disclosure	Exact	104
Estimated data	Estimate	201
Estimate used instead of disclosure - data is normalised and no aggregating factor is available	Estimate	202
Estimate used instead of disclosure - data does not cover global operations	Estimate	203
Estimate scaled according to company-specific data	Estimate	204
Estimate based on partial data disclosure in personal communication	Estimate	205
Estimate based on partial data disclosure in Environmental/CSR	Estimate	206
Estimate based on partial data disclosure in CDP	Estimate	207
Estimate based on partial data disclosure in Annual Report/10-K/Financial Accounts	Estimate	208
Value summed up from data provided in personal communication	Derive	301
Value summed up from data provided in Environmental/CSR	Derive	302
Value summed up from data provided in CDP	Derive	303
Value summed up from data provided in Annual Report/Financial Accounts Disclosure	Derive	304
Value split from data provided in personal communication	Derive	305
Value split from data provided in Environmental/CSR	Derive	306
Value split from data provided in CDP	Derive	307
Value split from data provided in Annual Report/Financial Accounts Disclosure	Derive	308
Value derived from fuel use provided in personal communication	Derive	309
Value derived from fuel use provided in Environmental/CSR	Derive	310
Value derived from fuel use provided in CDP	Derive	311
Value derived from fuel use provided in Annual Report/Financial Accounts Disclosure	Derive	312
Value derived from data provided in personal communication	Derive	313
Value derived from data provided in Environmental/CSR	Derive	314
Value derived from data provided in CDP	Derive	315
Value derived from data provided in Annual Report/Financial Accounts Disclosure	Derive	316
Derived from previous year	Derive	317
Data approximated from chart/graph in Environmental Report/CSR Report/Website	Derive	318
Data approximated from chart/graph in Annual Report/10-K/Financial Accounts	Derive	319

Source: Compiled by Author

Appendix C: Mapping of GRI Disclosures

Table C-1: Mapping of GRI Disclosures to Environmental Indicators in SGFIN Sustainability Database

Environmental Indicators	GRI Topic Disclosure	Description from GRI Standards
Scope 1 GHG Emissions	Disclosure 305-1: Direct (Scope 1) GHG Emissions	Gross direct (Scope 1) GHG emissions in metric tons of CO_2 equivalent.
Scope 2 GHG Emissions	Disclosure 305-2: Energy indirect (Scope 2) GHG Emissions	Gross location-based energy indirect (Scope 2) GHG emissions in metric tons of CO_2 equivalent.
Total Energy Consumption	Disclosure 302-1: Energy Consumption within the organization	Total energy consumption within the organization, in joules or multiples.
		Total Energy Consumption within the Organization = Non-Renewable Fuel Consumed + Renewable Fuel Consumed + Electricity, heating cooling and steam purchased for consumption + Self-generated electricity, heating, cooling, and steam which are not consumed – Electricity, heating, cooling, and steam sold
Electricity Consumption	Subset of Disclosure 302-1	In joules, watt-hours or multiples, the total: i. electricity consumption "For some organizations, electricity is the only significant form of energy they consume."
Total Waste	Disclosure 306-3: Waste Generated	Total weight of waste generated in metric tons, and a breakdown of this total by composition of the waste.
Total Water Withdrawal	Disclosure 303-3: Water Withdrawal	Total water withdrawal from all areas in megaliters, and a breakdown of this total by the following sources, if applicable: i. Surface water; ii. Groundwater; iii. Seawater; iv. Produced water; v. Third-party water.
Total Water Consumption	Disclosure 303-5: Water Consumption	The reporting organization shall report the following information: a. Total water consumption from all areas in megaliters.
		Water consumption = Total Water Withdrawal - Total Water Discharge

Source: Compiled by Author from multiple GRI Topic Disclosures

Appendix D: Corresponding Indicators from Information Intermediaries

Table D-1: Corresponding Bloomberg Indicators

S/N	SGFIN Indicators	Bloomberg Indicators	Description of Bloomberg Indicators	Identifier Code
1	GHG Scope 1 Emissions (tCO$_2$e)	GHG Scope 1	Amount of scope 1 greenhouse gas (GHG) emissions of the company, in thousands of metric tonnes of carbon dioxide equivalent (CO2e). Greenhouse gas emissions are defined as those gases which contribute to the trapping of heat in the Earth's atmosphere, including carbon dioxide (CO2), methane, nitrous oxide, and others. Emissions reported as CO2 only will NOT be captured in this field. Examples of scope 1 emissions include emissions from combustion in owned or controlled boilers, furnaces, vehicles, and emissions from production in owned or controlled process equipment. Emissions reported as CO2 only will NOT be captured in this field.	ES076
2	GHG Scope 2 Location-Based Emissions(tCO$_2$e)	GHG Scope 2 Location-Based	Amount of scope 2 greenhouse gas (GHG) emissions of the company in thousands of metric tonnes of carbon dioxide equivalent (CO2e), using the location-based accounting method. Greenhouse gas emissions are defined as those gases which contribute to the trapping of heat in the Earth's atmosphere, including carbon dioxide (CO2), methane, nitrous oxide, and others. Emissions reported as CO2 only will NOT be captured in this field. Scope 2 emissions are those emitted as a consequence of the activities of the reporting entity, but that occur at sources owned or controlled by another entity. The principle sources of scope 2 emissions are emissions from purchased electricity, steam and/or heating/cooling. The location-based method for scope 2 GHG reflects the average emissions intensity of grids on which energy consumption occurs, using mostly grid-average emission factors. Note that when a company does not specify which scope 2 accounting method is used, the location-based method is assumed.	ES077
3	Total Energy Use (GJ)	Total Energy Consumption	Total Energy Consumption in thousands of megawatt hours (MWh). This includes energy directly consumed through combustion in owned or controlled boilers, furnaces, vehicles, or through chemical production in owned or controlled process equipment. It also includes energy consumed as electricity.	ES014
4	Total Electricity Use (GJ)	Electricity Used	Total amount of electricity used by the company. In thousands of megawatt hours (MWh). Field part of Environmental, Social or Governance (ESG) group of fields.	ES080
5	Total Waste (Metric Tonnes)	Total Waste	Total amount of waste the company discards, both hazardous and non-hazardous, in thousands of metric tonnes. This field excludes waste given in units of volume.	ES020
6	Total Water Use (m³)	Total Water Use	Total amount of water used to support a company's operational processes, in thousands of cubic meters. The sum of all water withdraws for process water and cooling water and all water retained by company facilities through recycling. Field is part of the Environmental, Social and Governance (ESG) group of fields.	ES016
7	Total Water Withdrawal (m³)	Total Water Withdrawal	Amount of water diverted for use by the organization from all sources, including but not limited to surface, ground, saltwater, and municipal, in thousands of cubic meters. Includes cooling water.	ES269

Source: Bloomberg Portal

Table D-2: Corresponding Refinitiv Indicators

S/N	SGFIN Indicators	Refinitiv Indicators	Description of Refinitiv Indicators	Identifier Code
1	GHG Scope 1 Emissions (tCO₂e)	CO₂ Equivalent Emissions Direct, Scope 1	Direct of CO2 and CO2 equivalents emission in tonnes. Direct emissions from sources that are owned or controlled by the company (Scope 1 emissions). Following Gases are relevant: Carbon Dioxide (CO2), Methane (CH4), Nitrous Oxide (N2O), Hydrofluorocarbons (HFCS), Perfluorinated Compound (PFCS), Sulfur Hexafluoride (SF6), Nitrogen Tri fluoride (NF3). We follow green house gas (GHG) Protocol for all emission classifications by type.	TR.CO2Indirect Scope1
2	GHG Scope 2 Location-Based Emissions(tCO₂e)	CO₂ Equivalent Emissions Indirect, Scope 2	Indirect of CO2 and CO2 equivalents emission in tonnes. Indirect emissions from consumption of purchased electricity,heat or steam which occur at the facility which electricity, heat or steam is generated (Scope 2 emissions). Following Gases are relevant: Carbon Dioxide (CO2), Methane (CH4), Nitrous Oxide (N2O), Hydrofluorocarbons (HFCS), Perfluorinated Compound (PFCS), Sulfur Hexafluoride (SF6), Nitrogen Tri fluoride (NF3). We follow green house gas (GHG) Protocol for all emission classifications by type.	TR.CO2Direct Scope2
3	Total Energy Use (GJ)	Total Energy Consumption	Total direct and indirect energy consumption in gigajoules. The total amount of energy thathas been consumed within the boundaries of the company's operations. Total Energy Use = Total Direct Energy Consumption + Indirect Energy Consumption. Purchased Energy and Produced Energy are included in Total Energy Use. For utilities, transmission/grid loss as part of its business activities is considered as total energy consumed and data not to consider electricity produced to answer energy use (utility company produce to sell). For utilities, raw materials such as coal, gas or nuclear used in the production of energy are not considered under 'total energy use'.	TR.EnergyUseTotal
4	Total Electricity Use (GJ)	Electricity Purchased	Electricity Purchased in gigajoules. Amount of electricity that has been purchased by the company. If there is no evidence that electricity is produced by the company, we consider the reported electricity figure as purchased. If the company provides electricity use and electricity produced, the difference would be electricity purchased. If the company reports purchased electricity as indirect energy, then we consider the reported figure as electricity purchased.	TR.ElectricityPurchased
5	Total Waste (Metric Tonnes)	Waste Total	Total amount of waste produced in tonnes. Total waste = Non-Hazardous waste + hazardous waste. Only solid waste is taken into consideration, exceptionally if liquid waste reported in 'ton' then we do the summation to derive total including liquid waste. For sector like mining, oil & gas, waste generation like tailings, waste rock, coal and fly ash, etc are also considered.	TR.WasteTotal
6	Total Water Use (m³)	Nil	Nil	Nil
7	Total Water Withdrawal (m³)	Water Withdrawal Total	Total Water Withdrawal in cubic meters. The total volume of water withdrawn from any water source that was either withdrawn directly by the reporting organization or through intermediaries such as water utilities. Different sources of water like well, town/utility/municipal water, river water, surface water etc. are considered.	TR.WaterWithdrawalTotal

Source: Refinitiv Workspace

Table D-3: Corresponding TruCost Indicators

S/N	SGFIN Indicators	TruCost Indicators	Description of TruCost Indicators	Identifier Code
1	GHG Scope 1 Emissions (tCO₂e)	Absolute: GHG Scope 1	Greenhouse gas (GHG) emissions from sources that are owned or controlled by the company (categorised by the greenhouse gas protocol)	319413
2	GHG Scope 2 Location-Based Emissions(tCO₂e)	Absolute: GHG Scope 2 Location-based	Greenhouse gas (GHG) emissions from the consumption of purchased electricity, heat, or steam by the company (categorized by the greenhouse gas protocol). Emissions are calculated using a location-based methodology i.e. using grid emission factors for each region.	319414
3	Total Energy Use (GJ)	Nil	Nil	Nil
4	Total Electricity Use (GJ)	Nil	Nil	Nil
5	Total Waste (Metric Tonnes) *	Absolute: Waste Landfill	Quantity of waste that is generated by the company and disposed to landfill	319550
		Absolute: Waste Incineration	Quantity of waste that is generated by the company and incinerated	319547
		Absolute: Waste Recycled	Quantity of waste that is generated by the company and recycled	319552
6	Total Water Use (m³)	Absolute: Water Direct and Purchased	Volume of water from natural sources and purchased from utility companies that is directly consumed by the company	319564
7	Total Water Withdrawal (m³)	Nil	Nil	Nil

* The Total Waste data for TruCost is the sum of the three indicators shown

Source: TruCost Database

Appendix E: Restatement Methodologies of Information Intermediaries

Bloomberg replaces the data with the restated value when more recent information becomes available, as described in the e-mail correspondence with SGFIN (see Figure 29 below).

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There are however, other discrepancies which we found:

    1. To be a result of Company's restatement of their ESG data, where we
    have captured and overwritten based on the latest available information.
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Figure 29: E-mail Correspondence from Bloomberg on Restatements of Sustainability Data [34]

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[34] Information obtained from Bloomberg via email correspondence on February 5, 2024, regarding restatements of sustainability data.

Refinitiv, meanwhile, replaces the data with the restated value under certain conditions. These conditions are shown below in Figure 30.

Below are the points when to do restatements:

Restatement Scenarios	Restatement required Yes/No
Methodological changes or corrections between periods	Yes
Prior FY data is missing or not reported by the company, but in the current FY report has Prior FY data	Yes
Prior FY data reported as Segmental, but in the current FY report as Global for prior FY	Yes
Prior FY data reported as Global, but in the current FY report as Segmental for prior FY	No
Prior FY data changed/restated due to merger, discontinuing operations, acquisitions or disposal of assets or segments etc.	No
Due to rounding of differences b/w year (Refer above rounding of difference points)	No

Figure 30: E-mail Correspondence from Refinitiv on The Restatement of Sustainability Data [35]

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[35] Information obtained from Refinitiv via email correspondence on May 10, 2024, regarding restatements of sustainability data.

In the TruCost Environmental dataset, TruCost does not incorporate restated values. Furthermore, it addresses data gaps by utilising its own EEIO model to fill these data gaps when disclosures are unavailable.

Figure 31 further elaborates on this approach, highlighting how TruCost approaches issues with data completeness without solely relying on corporate restatements.

4. **How often is the data updated?** Trucost produces annual company assessments to align reported environmental data with annual company financial reporting. Trucost's research process is continuous, so revisions may occur at any point in the year as companies disclose information and further complete our quality checks, engagement, and data verification steps. Company data restatements are not typically taken into account in the data, apart from cases in which there is an error correction provided in the disclosures. However, it is common for a company's data disclosure to have valuable information pertaining to previous financial years (time-series performance) that can allow Trucost to refine its assessment or take a disclosed value for a prior year instead of previously estimated values.

Figure 31: Frequently Asked Questions (FAQ) on S&P Global's website[36] Regarding Yes

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[36] The FAQ for TruCost can be retrieved here: https://www.spglobal.com/spdji/en/documents/additional-material/faq-trucost.pdf