



# Unlocking the Scope 3 opportunity

Insights from Asia Pacific businesses



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# Foreword

## The climate crisis is intensifying, but so too is the movement to decarbonize.

The past two decades have seen a concerted push by governments, investors and consumers to hold companies accountable for their carbon footprint with corresponding efforts in the business community to track and report their Scope 1 and Scope 2 emissions.

More recently, there has been increased scrutiny on Scope 3 emissions, the indirect emissions that are produced by a company's supply chain.

Measuring and reporting on Scope 3 emissions is critical to any climate or decarbonization goal as they typically make up 70–90 percent of a company's total carbon footprint.<sup>1</sup> Yet, they can be extremely challenging to accurately measure and report as they lie beyond the company's formal span of control.

In this report, we examine the current equilibrium between strategic and voluntary initiatives at companies in Asia Pacific and compliance efforts in disclosing such emissions. The report assesses the progress and challenges faced by businesses as they strive to meet net zero targets in the coming years.

This report provides an analytical overview of the Scope 3 emissions reporting landscape in the region, providing insights into one of the defining corporate themes of our time, and a look at how companies in Asia Pacific are responding.



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1. Carbon Trust. 'An introductory guide to Scope 3 emissions.' 2023.



# Executive summary

## Measuring and reporting on Scope 3 emissions is challenging for a variety of reasons, chief among which is that they occur outside of an organization's direct control.

Any efforts to measure and disclose requires emissions data from multiple participants in a company's supply chains. The challenge is exacerbated in Asia Pacific owing to the region's famed complexity of supply chains, and the broader issue of a lack of standardization around Scope 3 emissions.

This study aims to showcase the state of Scope 3 emissions reporting and disclosures in Asia Pacific by analyzing publicly available ESG reports from 338 companies listed on six stock exchanges, published between 2022-2023.<sup>2</sup>

Leveraging the data provides a broad-ranging picture of the progress made by corporate Asia Pacific and where more effort is required. The report also aims to support companies newly starting out on their reporting journey by exploring a range of considerations, methods and best practices that are now being observed and noted in the region. Ultimately, the report emphasizes the importance of transparency, accuracy and collaboration in tackling Scope 3 emissions.

2. For more information on the report's methodology, please refer to the Appendix at the end of the report.

## Regional trends in Scope 3 emissions reporting

Climate is a global challenge with regional solutions — across Asia Pacific, there are major and minor differences in terms of pace and intensity, but also commonalities: a clear, growing movement towards integrating ESG into supplier relationship management; increasing regulatory and investor pressure, mixed with rising consumer demand and industry initiatives.



Scope 3 emissions **disclosures are expanding** in Asia Pacific, with 62 percent of companies engaging in some form of reporting on their indirect emissions, though overall supply chain environmental monitoring is still immature.



**Emerging markets:** China and India are experiencing rapid growth in this area, driven by government regulations and investor pressure. However, challenges in data transparency and supply chain complexity remain.



Companies in Asia Pacific generally demonstrate **more focus on upstream emissions** versus downstream emissions, as they typically have more control over their upstream suppliers than their downstream customers or logistics providers, which is why Asia Pacific companies are more likely to invest in supplier-side initiatives than customer-facing ones.



**Southeast Asia:** While still in the early stages, countries like Vietnam and Thailand are witnessing growing awareness of the importance of ESG in supplier relationship management due to global market pressures and trade agreements.



**Leaders:** Japan and South Korea, with their strong focus on resource efficiency and established supplier relationships, are seen as leaders in integrating ESG into supplier relationship management.

# 10 industry best practices for Scope 3 emissions reporting

**01 | Set science-based targets** with intermediate milestones that enable progress tracking towards long-term sustainability goals, while also addressing the challenge of maintaining momentum and accountability in the short- to medium-term. Embed these targets into organizations' risk management frameworks to ensure governance on ESG issues and alignment with overall business strategies.

**02 | Engage in environmental assurance practices** to validate the accuracy and credibility of emissions reporting.

**03 | Link executive incentives to sustainability metrics** to foster a culture of accountability and motivation towards environmental goals. Also consider how environmental and Scope 3 reporting skills can be embedded into the existing workforce and roles.

**04 | Prioritize sustainable product design** including energy efficiency, sustainable packaging and sustainable sourcing.

**05 | Invest in green initiatives** to demonstrate a commitment to sustainability in operational and product offerings while also reflecting a strategic approach to environmental stewardship. Identify areas to adopt the right technology to support emissions data capture, measurement and reporting.

**06 | Monitor environmental supply chains** both upstream and downstream to manage and mitigate carbon footprints beyond immediate operations.

**07 | Conduct consumer engagement** in sustainability to better align products and services with environmental goals.

**08 | Adopt Life Cycle Assessments** methodologies to gain a comprehensive map of a product's environmental footprint.

**09 | Practice strategic supplier engagement** by embedding environmental and social criteria in the onboarding processes and emphasizing the importance of sustainability from the start of the supplier relationship. Encourage and support suppliers to build capacity for better environmental management and reporting.

**10 | Apply environmental certifications and targets** for suppliers to encourage compliance with environmental standards and promote collective action towards sustainability goals.

## Part I

# The rise of Scope 3

In April 2024, the world marked yet another month of unprecedented heat levels, building off a 11-month streak of new temperature records for the respective month of the year.<sup>3</sup> The news sits alongside a string of extreme weather events that have wreaked havoc, such as drought-driven wildfires in the Amazon rainforest and agricultural destruction in the southern parts of the African continent.<sup>4</sup>

These are merely the latest developments in the ongoing climate crisis that is fueling a movement to decarbonize entire industries and sectors in pursuit of the goals set out in the 2015 Paris Agreement to limit the rise in global temperatures to under 1.5°C.

As the impacts of climate change mount, there has been a marked uptick in pressure from governments, investors and consumers to hold companies accountable for their carbon footprint. Emissions reporting is becoming increasingly common with many companies now tracking and reporting the amounts of carbon dioxide (CO<sub>2</sub>) being produced as a direct result of their business activities, also known as Scope 1 and Scope 2 emissions.

## What emissions do companies produce?

### Scope 1:

Emissions coming directly from the company itself.

### Scope 2:

Indirect emissions from purchased electricity, heating and cooling.

### Scope 3:

Indirect emissions occurring upstream and downstream of the company's operations. Includes emissions associated with the production of raw materials, logistics, workforce commuting, waste disposal, the use of sold products, as well as the impact of any investments.



3. Copernicus. 'Copernicus: global temperature record streak continues - April 2024 was the hottest on record.' May 2024.

4. Reuters. 'March marks yet another record in global heat.' 2024.



## Unlocking the Scope 3 opportunity

### Defining Scope 3 emissions

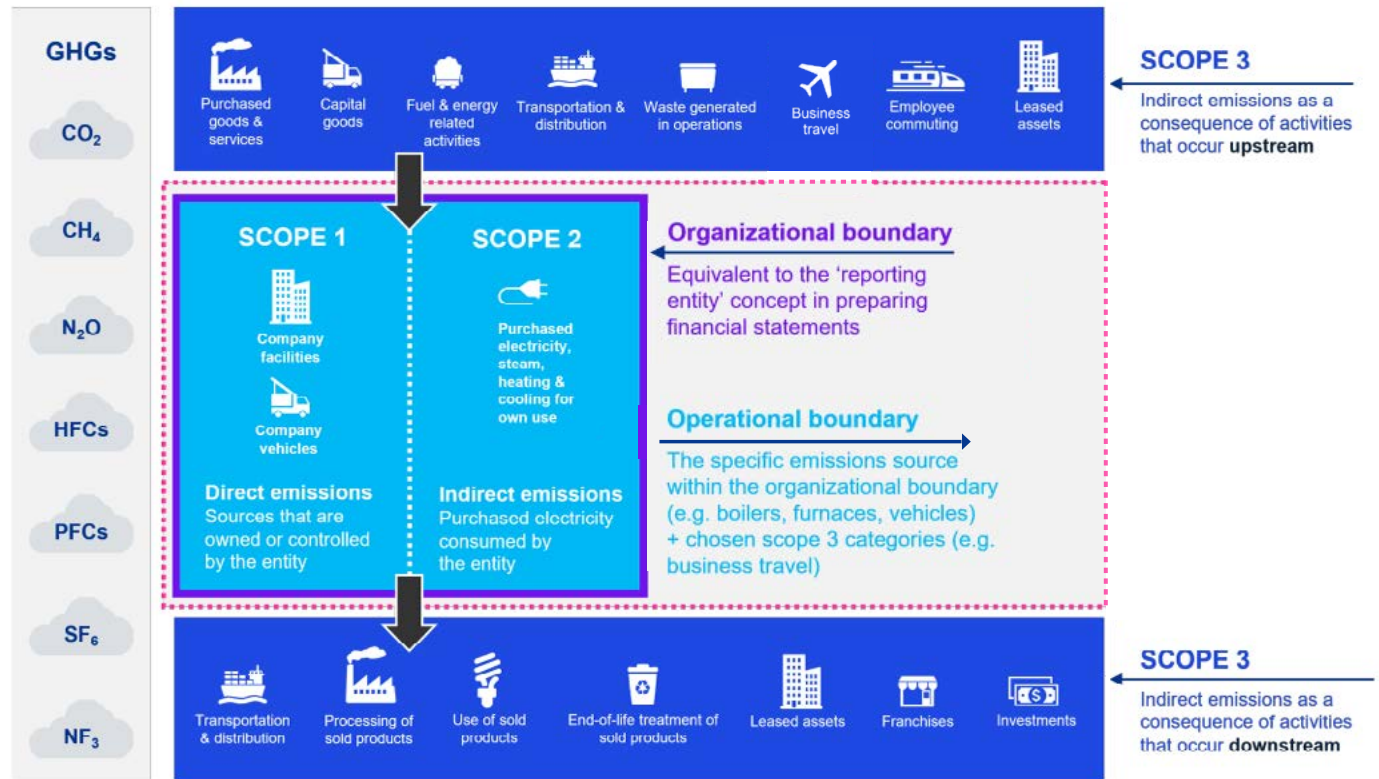
In recent years, there has been increased scrutiny into “Scope 3 emissions”; a term coined by the Greenhouse Gas (GHG) Protocol to refer to indirect emissions that are produced outside the company’s formal span of control.<sup>5</sup> Unlike Scope 1 and Scope 2 emissions, Scope 3 emissions can occur from both upstream and downstream of a company’s operations, spanning 15 different categories (see Figure 1).

Upstream emissions are produced by external parties that source, produce and transport any raw materials and components used.

Downstream emissions are produced from logistics activities, as well as the use and disposal of company products and services. Downstream emissions also cover activities like investing and franchising.



Figure 1: Roadmap of emissions reporting under the Greenhouse Gas Protocol



Source: KPMG GHG emissions reporting handbook March 2024

Not all categories will be relevant to each company, as differences in operating model and industry will impact which ones are the most important. For example, a financial services firm might find that its investments will be a big source of emissions, while franchises will be a key source for a retailer or hotel group.

5. Greenhouse Gas Protocol. ‘Scope 3 Frequently Asked Questions.’ 2022.

## Why does Scope 3 matter?

For organizations in both the public and private sectors, tackling Scope 3 emissions will be critical to achieving any kind of climate goal as they typically make up 70-90 percent of a company's carbon footprint.<sup>6</sup> Without a robust Scope 3 reporting practice, organizations cannot obtain accurate emissions data necessary to fully decarbonize its supply chains.

Let's say, for example, that Organization X's Scope 1 and 2 emissions total 1 million tons of CO<sub>2</sub>. The company sets a 50 percent reduction target, meaning that by 2030, it will reduce its emissions by 500,000 tons. However, as its Scope 3 emissions could well total 20 million tons, achieving the same target would require it to cut 10.5 million tons of CO<sub>2</sub>.

Even if the organization lowered its reduction target to 15 percent, it would still need to slash 3 million tons of CO<sub>2</sub>, an achievement six times greater than the original goal. This scenario demonstrates the power of Scope 3 to amplify the impact of reduction strategies on overall emissions reduction goals and quickly achieve a variety of sustainability business goals.

There are also significant business rewards to be gained from a Scope 3 emissions strategy. Done correctly, accurate reporting can yield valuable insights into a company's supply chain and product performance, and enhance vendor and customer relationships.

It is also becoming mandated by several public exchanges in the Asia Pacific region over the next 1-3 years for MNC's to report their actions in greater detail that they are taking to combat and reduce overall emissions with severe penalties or suspension in trading being threatened or imposed for non-compliance.

Furthermore, more transparent emissions reporting can bolster companies' reputations among their customers and investors, many of whom are increasingly demanding higher sustainability standards.

6. Carbon Trust. 'An introductory guide to Scope 3 emissions.' 2023.

## The challenges around Scope 3

As Scope 3 emissions lie beyond an organization's sphere of influence, they are especially challenging to accurately quantify and measure for several reasons:



Obtaining this data usually requires firms to engage deeply with their stakeholders, a time-consuming and costly process.



Even when data has been obtained, getting good results relies on having consistent and accurate data capture processes and formatting. Building the right internal systems to support this will be a major organizational effort.



Organizations, particularly large ones, do not always have total visibility into their supply chains, especially when it comes to their extended supplier bases.



The accuracy of a reporting company's Scope 3 emissions is also highly dependent on the availability and quality of primary data from suppliers in the value chain.



Companies may face skills constraints to adequately manage a wide breadth and depth of different activity data.



Allocating sufficient resources to validate the accuracy of data reported by suppliers and captured internally may be challenging.

“ It is recommended to seek and engage subject matter expertise if firms are struggling with new mandated requirements by Asia Pacific exchanges at the earliest stage as the actual annual reporting is the final step. Having a data collection system in place that suits the firm's objectives is crucial to ensure accuracy and buy-in from stakeholders and employees. ”

Michael Walsh  
CEO & Executive Director  
PBEC



Part II

# Scope 3 emissions reporting in Asia Pacific

Companies in Asia Pacific are beginning to expand their efforts on Scope 3 reporting. These efforts are emerging largely in response to a growing swell of mandatory and voluntary disclosure standards globally.<sup>7</sup> Both US and European regulators have announced rules requiring companies to disclose emissions. In Asia Pacific, Hong Kong Exchanges and Clearing (HKEX) and Australian Securities Exchange (ASX) are set to phase in Scope 3 reporting standards from 2024 onwards.<sup>8, 9</sup>

In 2023, the International Sustainability Standards Board (ISSB) released IFRS S2, a voluntary GHG reporting standard that is increasingly being adopted by corporations across the world.<sup>10</sup>

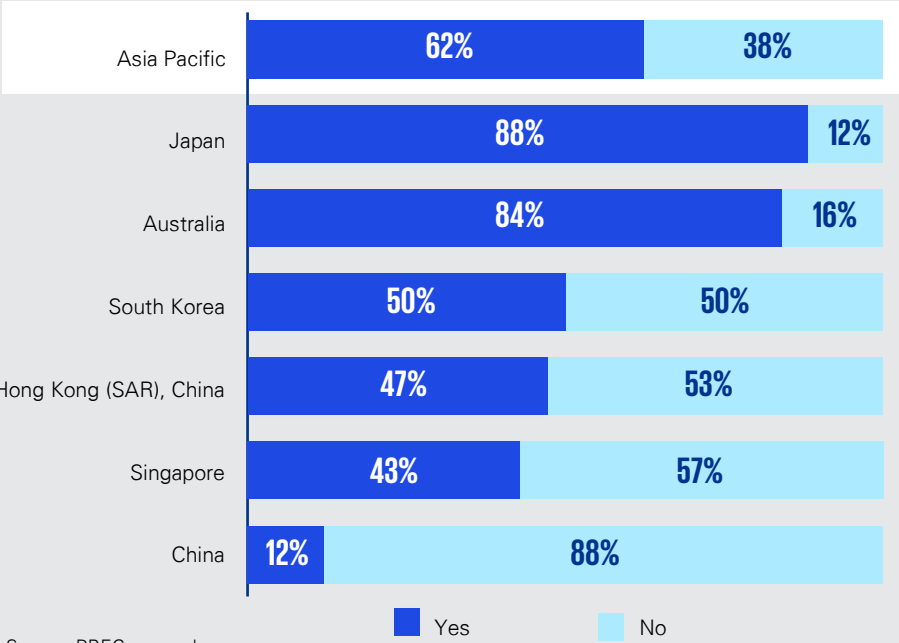
While companies have responded to these regulations, there is still largely an absence of mandated Scope 3 reporting today, though this will change over time as other Asian exchanges such as the Shanghai Stock Exchange (SSE), the Shenzhen Stock Exchange (SZE), the Singapore Exchange (SGX) and the Japan Exchange Group (JPX) begin making IFRS S2 compliance mandatory.

These forthcoming developments make it imperative that companies begin preparing to implement these plans into their longer-term strategies.

## How are Asia Pacific companies performing?

A Pacific Basin Economic Council (PBEC) survey of 338 large companies across Asia Pacific reveals that, despite the practice’s relative nascency, many companies in the region are engaged in some form of Scope 3 emissions reporting.<sup>11</sup> On average, 62 percent of companies in Asia Pacific have disclosed their Scope 3 emissions data, though that still leaves more than a third yet to do so.

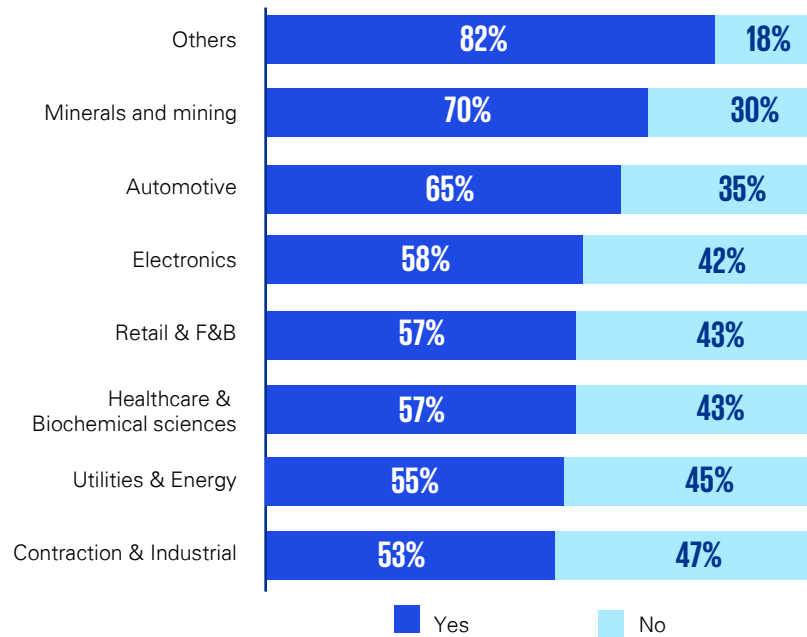
**Figure 2: Most companies in Asia Pacific include mentions of Scope 3 in their ESG reporting**



7. Table 1 (Appendix) provides a high-level overview of the latest requirements from several exchanges across Asia Pacific.  
 8. Reuters. ‘Hong Kong to make climate disclosures mandatory for issuers.’ April 2023.  
 9. Department of the Treasury, Australia. ‘Mandatory climate-related financial disclosures.’ 2024.  
 10. World Resources Institute. ‘What Are Greenhouse Gas Accounting and Corporate Climate Disclosures? 6 Questions, Answered.’ 2024.  
 11. For more information on the survey’s methodology, please refer to the Appendix.

The minerals and mining sector leads the pack with 70 percent reporting Scope 3 emissions in some form, followed by 65 percent of automotive firms. The good news is that more firms across Asia Pacific are reporting on Scope 3 than those that are not.

**Figure 3: The minerals and mining sector leads in terms of Scope 3 mentions**



Source: PBEC research

With increased emissions reporting, there is a need for a concurrent emphasis on assurance to alleviate concerns about the validity of the data underlying the company's emissions reporting, and to bolster transparency and accountability.<sup>12</sup> This can be done by engaging third-party auditors who will verify a company's data against a registry or GHG emissions inventories.

12. The Climate Registry. "Credible Carbon Reporting: The Importance of Verification." 2023.

## Market focus - Japan

Across various reporting categories, Japan repeatedly outperforms its counterparts in its Scope 3 emissions reporting and initiatives, especially reporting their upstream emissions. These results reflect several factors, but primarily Japan's very narrow supply chains and a business culture built atop strong established relationships.

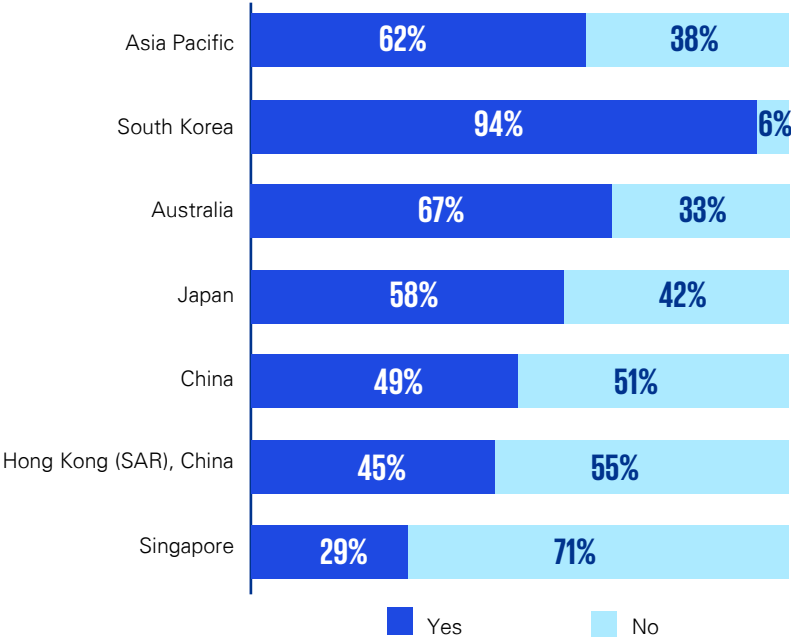
- Due to their long-standing tradition of close collaboration with their suppliers (many of which are based locally), Japanese companies find it easier to collect data and implement emissions reduction strategies throughout their supply chains.
- Japanese manufacturing culture emphasizes quality and efficiency throughout the entire value chain, which naturally extends to minimizing waste and resource consumption, leading to lower Scope 3 emissions.
- Like Australia, Japanese investors are increasingly pressuring companies to prioritize ESG factors, including Scope 3 emissions. This pressure encourages companies to develop robust reporting practices.
- The Japanese government has implemented policies promoting transparency in Scope 3 emissions reporting, such as guidelines from the Ministry of the Environment.



# Unlocking the Scope 3 opportunity

Most Asia Pacific companies are obtaining external assurance on their emissions calculations, reflecting the region's acceptance of the importance of these practices. South Korea is particularly notable with 94 per cent of organisations in the study doing so.

**Figure 4: South Korean firms prioritize external assurance more than firms elsewhere**



Source: PBEC research

However, despite the efforts to report on Scope 3 emissions, only 42 percent of Asia Pacific companies are actively monitoring the environmental impacts of their supply chain. As this practice is crucial to supporting the continuous collection of accurate Scope 3 metrics, the gap between these data points suggests that Asia Pacific's emissions reporting culture is still very nascent.

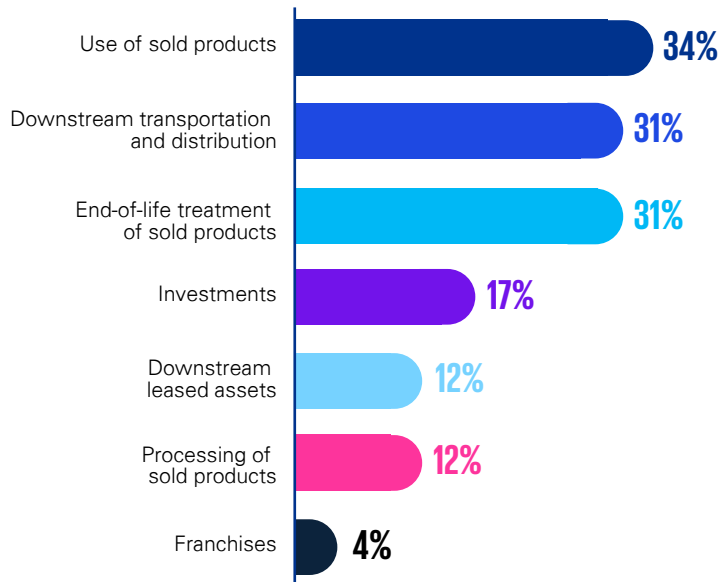


## Upstream vs downstream Scope 3 emissions disclosures

As Scope 3 emissions can occur both upstream and downstream of an organization, we note several differences in how these are disclosed among Asia Pacific companies.

Among Asia Pacific companies, downstream Scope 3 emissions disclosures are largely focused on how sold products are used (34 percent), treated at end-of-life (31 percent) and transported and distributed (31 percent) to customers. It is notable that the categories with low rates of disclosure are correlated with stakeholders that can be further removed from the organization — such as franchisees.

**Figure 5: Downstream Scope 3 emissions disclosures in Asia Pacific**

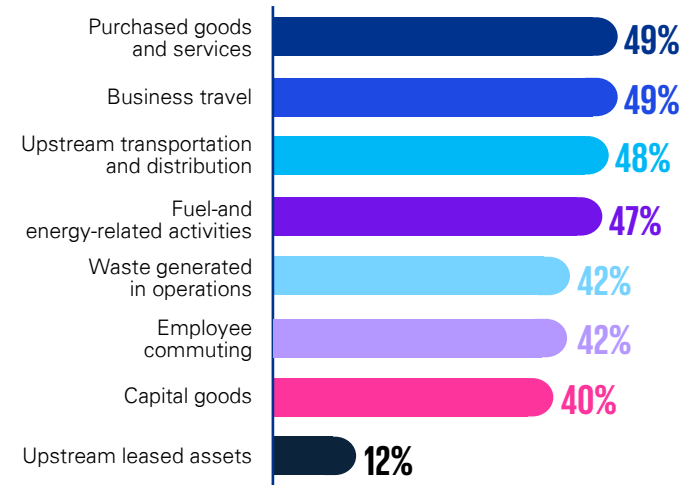


Source: PBEC research

13. Science Based Targets. 'Value Change in the Value Chain: Best Practices in Scope 3 Greenhouse Gas Management.' 2018.

Meanwhile, upstream Scope 3 emissions disclosures are more evenly spread out across various categories. Among the top categories are emissions from purchased goods and services (49 percent), business travel (49 percent), and upstream transport and distribution (48 percent).

**Figure 6: Upstream Scope 3 emissions disclosures in Asia Pacific**



Source: PBEC research

Downstream Scope 3 emissions generally receive markedly less attention than those upstream, reflecting the varying levels of control companies have over these stakeholders, relatively speaking.

In an analysis of science-based targets set by the first 105 companies approved by the Science-based Targets Initiative (SBTi), 90 percent are concerned with upstream Scope 3 emissions, versus the 10 percent that only target consumers.<sup>13</sup>

This is because when it comes to upstream suppliers, a company has relatively more control due to its role as a customer; when it comes to downstream stakeholders, those roles are reversed, leaving companies with limited influence over how their product is used or processed.



Part III

# Key considerations in setting ESG standards

The ESG reporting landscape has grown and become more complex over the past two decades as regulatory and investor scrutiny have intensified. From 2024 onwards, with the introduction of the European Union's Corporate Sustainability Reporting Directive (CSRD), almost 50,000 companies across the world – both inside and outside the bloc – will be subject to some form of mandatory sustainability reporting standard.<sup>14</sup>

While climate change is a global issue, the reality is that many ESG reporting standards are geographically determined, making it challenging to set applicable standards that cut across borders and regulatory jurisdictions. The CSRD and IFRS S2 are examples of progress being made on this front, but there is a significant need for harmonized standards and guidance.

**“ Scope 3 represents the most significant opportunities to influence GHG reduction, including through strategic engagement, stewardship and management of supply chains, financing and investment portfolios. Home to the world's fastest growing economies and faced with adverse climate change, the ASPAC region must rise to the challenges through enhanced data quality, reporting transparency and adopting best practice for Scope 3 reduction. ”**

**Daisy Shen**  
Head of Climate & Sustainability  
KPMG in China

## Market focus - China

Since its re-entry on the world stage in 1978, China prioritized economic growth and industrial development, becoming one of the world's largest contributors of greenhouse gas (GHG) emissions in the process. However, priorities are now shifting.

- China's manufacturing industry has evolved into a complex web of supply chains that often involve numerous subcontractors, making it challenging to gather accurate data on Scope 3 emissions.
- Transparency in corporate governance and environmental reporting is still evolving in China. Companies might be less forthcoming about their Scope 3 emissions, which are likely to go beyond the minimum disclosure requirements emphasized by regulatory mandates or political directives.
- Advances have been made in environmental regulations focused on Scope 1 and Scope 2 emissions, but Scope 3 reporting requirements are still largely absent.

China's environmental regulations have matured – it is likely they will come to converge with international standards in the near-term, especially as growing pressure from domestic and international stakeholders pushes companies to report on Scope 3 emissions. Advances in data collection and analysis technologies could simplify the process of gathering and reporting Scope 3 emissions data for Chinese companies.

14. KPMG International. 'Get ready for the next wave of ESG reporting.' 2023.

## 1 Should targets be “net zero” or “carbon neutral”?

Often used interchangeably, “net zero” and “carbon neutrality” are two different standards with different goals.

- “Carbon neutral” targets are primarily concerned with the amount of carbon that is emitted into and absorbed from the atmosphere
- “Net zero” targets encompass all greenhouse gases, including carbon but also methane, nitrous oxide and others

While carbon neutral targets are more manageable stepping stones for companies, net zero reflects a more strategic and holistic approach with potentially wider-ranging impacts. Setting a net zero target requires a broader assessment of the company’s impact, which could result in stricter emissions reduction goals.

This delicate balance in difficulty versus impact helps explain why Asia Pacific companies, on average, demonstrate a preference for net zero target (51 percent) over carbon neutral (33 percent) ones, though there are some regional differences.

**Figure 7: Net zero targets are more widely adopted than carbon neutrality in Asia Pacific**



Source: PBEC research

15. World Bank. ‘China’s Transition to a Low-Carbon Economy and Climate Resilience Needs Shifts in Resources and Technologies.’ October 2012.

16. PRI Association. ‘Policy briefing: Asset owners, ESG and carbon neutrality in China - Current practices and policy recommendations.’ 2023.

17. International Capital Action Partnership. ‘China National ETS.’ 2024.

18. Teneo. ‘Net Zero in China: Opportunities and Challenges for Multinationals.’ 2022.

19. The SBTi is a collaboration between the CPD Worldwide, the United Nations Global Compact, World Resources Institute (WRI) and the Worldwide Fund for Nature (WWF).

## 2 Science-based targets

While there are several standards that companies may subscribe to, it is critical they fall in line with and can be validated by science. Targets are considered “science-based” if they align with what the latest climate science deems necessary to meet the goals of the Paris Agreement — to limit global warming to well below 2°C above pre-industrial levels and pursue efforts to limit warming to 1.5°C.

The SBTi, a corporate climate action organization, is a key player in this respect.<sup>19</sup> The SBTi regularly updates its standards in line with the latest scientific research and provides an independent validation process that adds a layer of credibility — both these aspects set it apart from broader sustainability standards. The SBTi targets typically require deeper emissions reductions than other voluntary standards.

As such, it is no wonder that only an average of 42 percent of Asia Pacific countries committed to science-based targets, underscoring the challenges of adopting this particularly rigorous approach.





### 3 The relevance of immediate targets

While long-term targets provide a tangible, shared goal for companies to work towards, intermediate targets also have a key role to play. Usually set as part of a roadmap for the years 2025 to 2035, intermediate targets usually aim for up to a 50 percent reduction in carbon emissions.

These targets act as significant, short-term milestones for companies, helping gauge performance and communicate progress to the company's stakeholders. Breaking up the larger task of decarbonizing supply chains may also make it more manageable for internal teams and enhance organizational buy-in.

The study shows that, on average, only 38 percent of Asia Pacific companies have set intermediate decarbonization targets. A greater share of Japanese firms demonstrates a high level of commitment to these shorter-term goals, reflecting the country's conservative corporate culture over longer-term ambitions.

### 4 Integrating climate risk into materiality assessments

As climate issues have grown in importance to a broad range of stakeholders, they are increasingly featured in risk assessment for companies in Asia Pacific.

When it comes to climate risks, there are two aspects to consider:

Physical risks, which are the direct consequences of climate change that a company may face on the ground, such as frequent and extreme weather events, rising sea levels, changes in precipitation levels and so on.

Transitional risks, which arise from the global shift towards a low-carbon economy. Factors such as government policy, technological advancements and shifting consumer preferences could pose new risks and opportunities for companies.

## Physical vs transitional risks

Distinct from one another, it is essential that both physical and transitional risks are taken into consideration.

While addressing physical risks could improve companies' overall resilience to climate events, it is a more reactive approach that disallows companies from proactively addressing the direct causes of global warming.

Tackling transitional risks, on the other hand, may be costly and disruptive to the businesses' ongoing operations, but it offers a more proactive approach that can help them gain an advantageous position in an increasingly sustainability-focused economy.

However, merely identifying climate risk does not create sufficient, tangible impacts. Companies can demonstrate their commitment by going a step further and integrating climate risks into their materiality assessments and reporting on them.

While materiality assessments have traditionally focused on financial and social factors, they are increasingly expanding to include environmental aspects. When climate risks are integrated into materiality assessments, companies can better prioritize their most critical issues in line with their financial significance before integrating them into the company's overall sustainability strategy. This means that climate change and emissions are not considered in isolation but inform strategic decision-making across the organization.

Embedding climate risk into materiality assessments can be significantly more challenging than identifying climate risks, as reflected in PBEC's findings. While 83 percent of companies have undertaken a climate-related risk assessment, only 44 percent have done the same with their materiality assessments.

**Figure 8: Most Asia Pacific companies are undertaking climate risk assessments**



Source: PBEC research

When it comes to whether materiality assessments feature climate metrics, even fewer companies have gone beyond simply identifying risks. Of the surveyed companies, only 30 percent feature carbon and GHG emissions targets, suggesting significant room for improvement.

The study shows that 93 percent of minerals and mining sector companies undertake climate-related risk assessment, followed by the utilities and energy sector (91 percent) and the automotive sector (85 percent). In terms of reporting their materiality assessments too, the minerals and mining sector is presently doing better (56 percent) than other sectors barring construction and industrial (also 56 percent).

## Part IV

# Approaches to measuring Scope 3

The actual practice of measuring Scope 3 emissions represents one of the biggest challenges for companies embarking on their ESG reporting journeys. The method selected by each company may be determined by several factors, such as:



the type and quality of data that is readily available to the company



the industry the company operates in, as certain sectors may have a standardized method or emissions factors that must be considered



the availability of sufficient resources to meet the needs of different methods, weighed against the desired level of accuracy



specific sustainability goals and priorities

20. Primary emissions data refers to emissions data collected from a main source, such as a specific facility. In the context of Scope 3 emissions, primary data is linked to supplier's activity. Secondary data, on the other hand, refers to model-based data gleaned from a variety of third-party sources such as scientific research, national statistics and existing Life Cycle Inventory databases.

Method	Suitability	Factors to consider	Limitations
<b>Spend-based method</b> enables companies to measure their emissions based on the monetary value of goods and services purchased by the organization. To achieve these results, companies multiply their total spending by the emissions intensity of their purchased goods and services.	Companies with readily available financial data but limited information on their supply chain activities. (e.g., Retail, Finance)	Ease of calculation. Limited data requirements.	Accuracy might be compromised due to assumptions about emission factors per dollar spent.
<b>Activity-based method</b> requires companies to measure the number of emissions associated with a specific activity, such as transporting goods or powering a factory. These emissions are calculated by looking at data specifically linked to an activity, such as a vehicle's fuel efficiency or the energy efficiency of an appliance.	Companies with good data on their activities (e.g., transportation volume, material usage) but limited supplier information. (e.g., Manufacturing, Logistics)	More accurate than spend-based method if good activity data exists.	Requires detailed tracking of relevant activities, which can be resource intensive.
<b>Supplier-specific methods</b> calculate emissions by collecting suppliers' activity data and multiplying them by secondary emissions factors. <sup>20</sup>	Companies with significant influence over their supply chain and a strong focus on supply chain sustainability. (e.g., Automotive, Electronics)	Most accurate method that allows for targeted emissions reduction strategies within the supply chain.	Most data-intensive and resource-intensive method, requires strong supplier relationships and cooperation.
A <b>hybrid method</b> calculates emissions through a combination of supplier-specific activity and emissions data and secondary data.	Many companies can benefit from a combination of methods depending on data availability and resources	Flexibility to leverage different methods based on specific emission sources.	Requires careful design and integration of different methods to ensure consistency and avoid double counting.
<b>Product-based method</b> , also known as a <b>Life Cycle Assessment (LCA)</b> is a form of emissions calculation that evaluates the environmental impacts of a product throughout its entire lifecycle. This "cradle-to-grave" analysis relies on data from every stage of the production process, from raw materials extraction to distribution to disposal or recycling.	Many companies can benefit from an LCA depending on data availability and resources.	Can be very accurate if the foundational data is of high quality and wide-ranging.	Generally considered the most difficult method because it requires a full life cycle analysis which is very resource intensive.





As there is no one-size-fits all answer, companies must remain focused on the balance between accuracy, feasibility and resource constraints. Ultimately, they should look to improve data collection and transparency, potentially transitioning to more data-intensive methods like the supplier-specific approach for greater accuracy and impact.

## What methods are Asia Pacific companies using?

Our study shows significant variance in terms of methods selected from country to country. Overall, the LCA method is a regional favorite, closely followed by the activity-based method. At the other end of the spectrum, supplier-specific methods are the most unpopular among Asia Pacific companies.

The popularity of the LCA method is especially notable, reflecting that companies in the region recognize its efficacy despite the complexity involved in conducting such assessments.

## Technology: a true enabler of Scope 3 reporting

While these methods form the foundation of organizations' approach to Scope 3 emissions, leveraging innovative technologies can revolutionize the pace and quality of reporting practices. In their current form, traditional account methods such as manual data collection and surveys still play a critical role in Scope 3 reporting, but they struggle to capture the vast amounts of information and complexity of a company's value chain, leading to inaccuracies and inefficiencies.

Technological solutions could offer a powerful solution by automating data collection and consolidation across the supply chains. This will provide the foundations for organizations to take advantage of cutting-edge analytics to generate granular insights into their carbon footprint, areas for improvement and key suppliers. Consider, for example, how blockchain technology could empower companies to closely track raw materials sourcing and verify their environmental impact.

Technology will also further enhance the impact of Scope 3 measurement methods. Software, for one, could simplify the LCA process for firms by providing comprehensive data management tools and data sets. Meanwhile, cloud-based communications platforms could streamline communications with suppliers, while artificial intelligence accelerates data analytics for more accurate scenario planning.

Both globally and in Asia Pacific, various companies and startup ecosystems have emerged with the goal of supporting companies on their Scope 3 journeys with digital tools that improve supply chain visibility, support carbon measurement and trade flow management.

Part V

# An organization-wide toolkit for tackling Scope 3 emissions

Once a company has set the necessary targets and the corresponding framework to measure, assess and monitor its Scope 3 emissions, the next step towards decarbonization will require changes that can tangibly reduce GHG production within the organization as a whole.

Following are industry best practices that can help companies focus on specific themes.

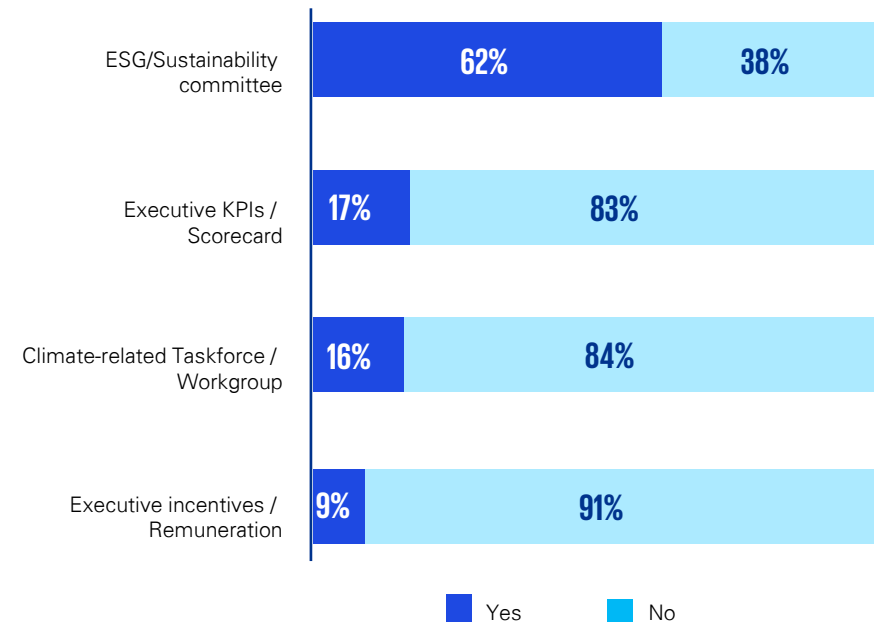
Establishing organizational ESG governance:

- setting up an ESG or Sustainability Committee
- utilizing emissions KPIs or scorecards
- linking sustainability progress to executive incentives
- establishing dedicated climate-related taskforces or working groups

When surveyed on these governance best practices, most Asia Pacific companies report having already established an ESG or Sustainability Council (62 percent) responsible for overseeing climate-related strategies and environmental performance and reporting on them to the board. These bodies are already a staple in many organizations, reflecting the region's relatively mature attitude towards climate issues as a key business risk. However, board-level oversight has yet to materialize in the form of dedicated resources as only 16 percent of companies have established climate-related taskforces or working groups.

As such, it is not surprising that emissions KPIs or scorecards (17 percent) are not widely used in Asia Pacific companies, though they are a valuable tool to continuously monitor companies' performance against their stated goals or targets. The lack of these metrics also make it challenging for companies to begin exploring linking executive pay with ESG performance — only 9 percent of companies report having implemented this practice, mostly in Australia where investor pressure on ESG issues are driving the practice.<sup>21</sup>

Figure 9: Different ESG practices at Asia Pacific companies



Source: PBEC research

21. Sustainability metrics are increasingly being embedded in remuneration frameworks with executive compensation often linked to the achievement of emission reduction targets. This includes short-term incentives (STIs) for CEOs and other senior executives, with a focus on operational emissions reductions.



## Progress through partnerships

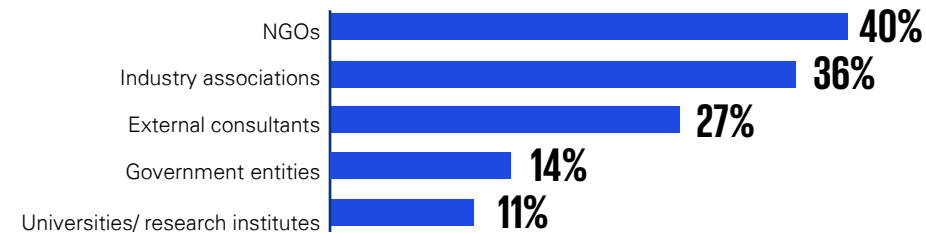
Partnering with other organizations can offer a strategic advantage for companies in their decarbonization efforts, especially where additional expertise is needed. These include:

- non-profits or non-governmental organizations (NGOs)
- industry associations
- universities and research institutes
- government entities
- external consultants

There is a high inclination among Asia Pacific companies to partner with NGOs (40 percent) and industry associations (36 percent) versus government entities (14 percent), and universities and research institutes (11 percent).

The types of partnerships that companies choose to embark on can be illustrative

**Figure 10: Prevalent partnership types: a preference for NGOs, industry associations**



Source: PBEC research

22. A list of major NGOs working in the region can be found in the Appendix (Table 2).

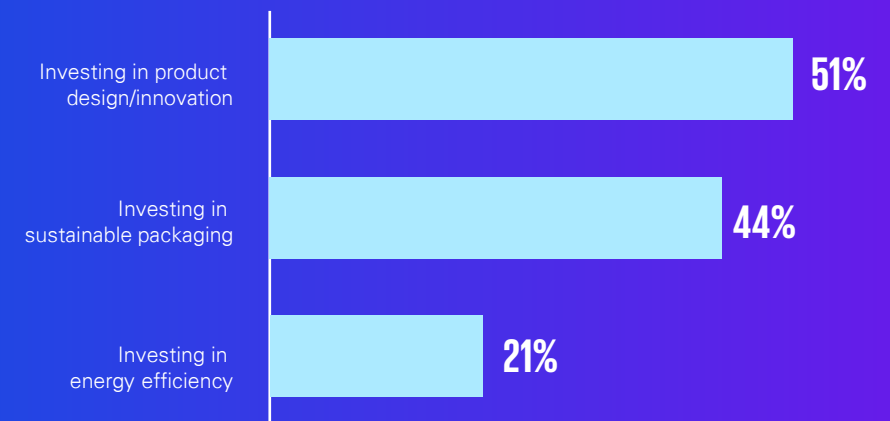
## Revising the production process

Ultimately, to decarbonize, a company will have to address the fundamentals of how their goods and services are made as the purchase of these inputs and the sale of any outputs are the biggest contributors to Scope 3 emissions. These can be addressed by retooling several aspects of businesses' operations:

- product design and innovation
- product energy efficiency
- sustainable sourcing
- sustainable packaging

In Asia Pacific, companies' decarbonization efforts are currently primarily centered on more sustainable product design and innovation (48 percent). Companies have more control over their products' design and innovation processes, and it's reasonable that these efforts will take precedence over their ability to decarbonize via more sustainable materials sourcing (41 percent) and packaging (41 percent), though these latter strategies are becoming more important with Scope 3.

**Figure 11: Prioritizing investment to improve product design and innovation**



Source: PBEC research

Among this regional cohort, Japanese and Korean companies are leaders, reflecting several factors:



**Resource scarcity.** As both countries rely heavily on imports of raw materials and energy sources, minimizing resource use through better design and sourcing practices can create greater cost savings and mitigate the impacts of volatile commodities markets.



**Focus on innovation.** Japan and Korea have strong traditions of technological innovations that are now focused on improving product performance and functionality.



**Government regulation.** Governments in both countries have implemented stringent regulations promoting energy efficiency and resource conservation that incentivize companies to develop eco-friendly products and adopt sustainable sourcing practices.

## Investing in green initiatives

Investments in green initiatives can help highlight the varying degrees of commitment to environmental sustainability within corporate strategies, but also a difference in how firms prioritize their upstream supply chains versus those downstream.

On average, just 22 percent of surveyed companies are investing in downstream green initiatives, versus the 30 percent who are investing in upstream green initiatives. Most companies' Scope 3 emissions will come from the upstream inputs to production, which includes not just raw materials and energy but also worker commutes.

**Figure 12: Asia Pacific companies' green investing priorities**



Source: PBEC research



Part VI

# Talking to the supply chain

While organizations can adopt a multitude of strategies to reduce their overall GHG emissions, tackling Scope 3 emissions depends on their ability to engage with stakeholders across the entire value chain: suppliers, distributors and consumers.

A strong supply chain engagement strategy is foundational to establishing the necessary trust and communication channels that can help companies accurately monitor their Scope 3 emissions and implement tangible change.

The types of engagement that companies need to partake in vary across each subsector, but there are common themes: value chain transparency, incentives, capacity building and effective governance.

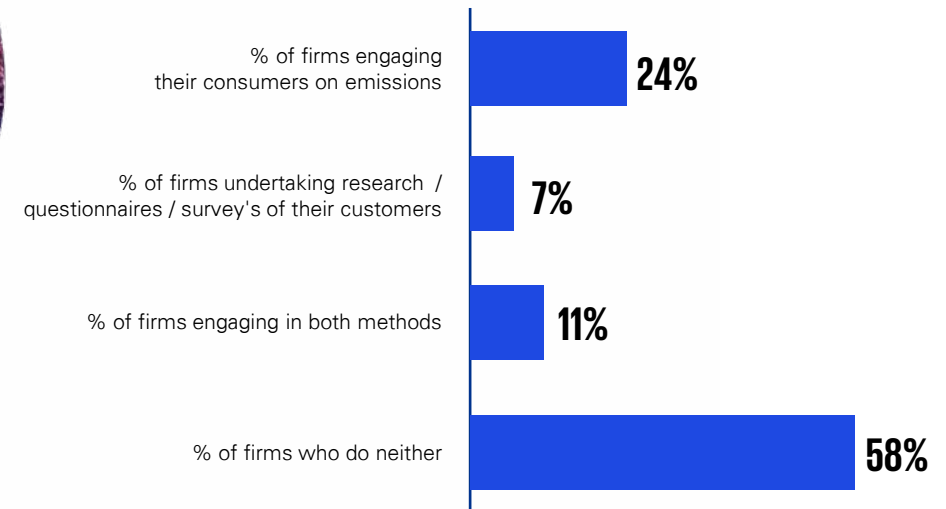
Here, we explore various industry best practices for engaging with supply chain stakeholders.

## Downstream supply chain management

In the downstream portion of a supply chain, companies can reduce emissions by optimizing their logistical networks by bringing production sites closer to their key customers and consumption centers.

In addition, customer engagement is an important lever for reducing downstream Scope 3 emissions, either directly through education and collaboration or indirectly through company policies or marketing. According to our study, on average, Asia Pacific companies prefer to engage directly with customers, for example, via campaigns or reward systems, over consumer research tools such as surveys or questionnaires.

Figure 13: Methods used for downstream supply chain engagement



Source: PBEC research

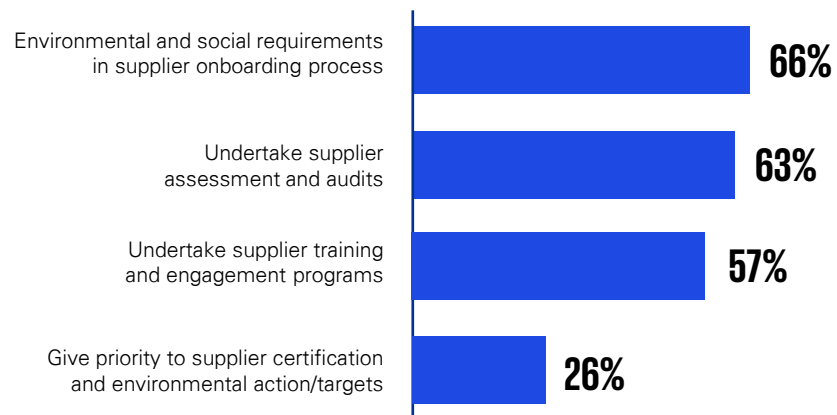
A closer look at the data shows that respondents are more focused on upstream supply chain management methods versus downstream strategies, in part because of their roles as brand manufacturers who rely on middleman retailers rather than direct consumers.

## Upstream supply chain management

In the upstream portions of a supply chain, companies have much broader latitude to effect change given their significant influence over their suppliers.

Larger, public-listed companies have even more influence over their supply chains; in recent years, there have been increasing numbers of multinationals (MNC) pledging to only work with suppliers working within their sustainability standards.<sup>23</sup> Most of these efforts are already impacting MNCs' tier-1 suppliers, where the company has the most influence, but these standards are trickling down lower to all corners of the value chain.

**Figure 14: Methods used for upstream supply chain engagement**



Source: PBEC research

Upstream strategies can encompass a broad spectrum of approaches, but they can be implemented from the beginning of the supplier onboarding process. Among Asia Pacific companies, 66 percent report having integrated environmental and social requirements in their supplier onboarding process, reflecting the maturity of ESG awareness among procurement functions.

23. Harvard Business Review. 'A More Sustainable Supply Chain.' 2020.

Another consideration is that, while a supplier may meet certain environmental or social standards upon onboarding, this status might not last. It is best practice for companies to engage in regular assessments or audits of their suppliers. Among surveyed companies, an average of 63 percent reportedly undertake continuous supplier assessments and audits.

However, few Asia Pacific companies are leveraging these requirements to incentivize their suppliers to do better — only 26 percent give priority to suppliers that can demonstrate their sustainability commitments with certification and environmental action or targets. This suggests companies are still limiting themselves to a punitive approach to supplier engagement, rather than a more collaborative strategy rooted in motivating suppliers to do better.

But some companies do recognize that the shift towards a more sustainable approach can be challenging for many of their suppliers given the relative newness of these concepts and skillsets. Some companies are phasing in their ESG requirements to give their suppliers time to adapt. Training and engagement programs are also effective tools for bringing suppliers onboard and boosting their overall capabilities to meet these higher standards. In Asia Pacific, 57 percent of companies report having invested in training and engaging with their suppliers to enhance their environmental and social performance.

**“ Scope 3 reporting requires ASPAC companies to transform their internal operating models, so they can accurately capture and report on their supply chain emissions. They will also need to create new supply chain strategies and adjust their external business models to reduce their emissions and progress towards a Net Zero target. ”**

**Peter Liddell**  
**Global Operations Centre of Excellence Lead,**  
**Global Sustainable Supply Chain Lead**  
**KPMG**



# Conclusion

As the challenges of the next two decades come into focus, various developments will push companies to consider how they tackle their Scope 3 goals.

Many companies could find they are navigating dual roles as both suppliers and customers. In both cases, they should seek out capabilities to accurately and transparently measure and report their emissions, especially as new and evolving regulatory requirements phase in over the coming years. While daunting, these coming changes offer companies a prime chance to reevaluate their emissions tracking and reporting strategies.

For example, to meet customers' demand for verified carbon footprints, companies should build new data collection and analysis capabilities to assess how changes in materials, suppliers or locations affect a product's emissions.

While challenging, this also poses an opportunity for companies to invest in essential business digitalization that can create benefits beyond sustainability. Greater data capabilities can also yield valuable insights into supply chains

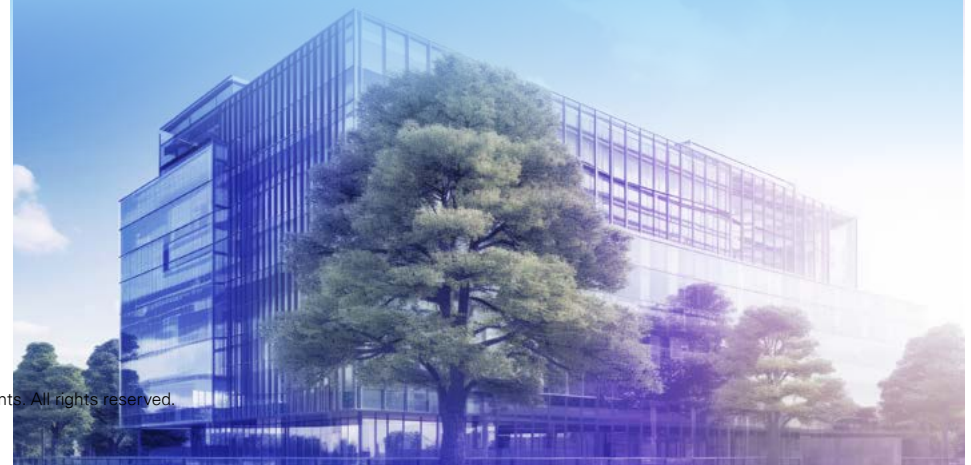
for improved decision-making and strategizing, as well as significant reputational advantages.

By approaching these requirements as a strategic opportunity, organizations can gain operational advantages and ensure readiness for future disclosure mandates. This perspective underpins this report's detailing of best practices in organizational and operational excellence currently adopted by top-performing publicly traded companies in the region.

Over time, more and more organizations reach into their value chains to understand the full GHG impact of their operations and make strategic decisions that can truly impact the trajectory of the world's climate and future. Tackling Scope 3 emissions is a crucial step towards building value that can last.

## Six steps to get started

- 1 Engage the c-suite and board.** Confirm that everyone understands the implications of Scope 3 emissions and how it will affect their area of the business. Some companies have created cross-functional steering committees to better mobilize the business.
- 2 Measure emissions.** Identify high-emission hot spots and work on those decarbonization programs first.
- 3 Model supply chain risk.** Assess how climate change and other disruptions create risks specific to your business. Then prioritize ways to address these vulnerabilities swiftly.
- 4 Find low-carbon opportunities.** For manufacturing companies, these opportunities may be related to product design, sourcing and production. Put these into action to achieve resilient decarbonized value chains.
- 5 Work with your suppliers.** Collaborate with your suppliers to measure and manage Scope 3 emissions. Some key activities here may include helping them establish concrete metrics to reliably measure emissions and helping them determine their potential return on investment for decarbonization.
- 6 Explore potential partnerships.** Consider how external organizations such as regional NGOs, industry associations or educational institutes can deepen efforts to research and innovate solutions.





## Appendix

# Methodology

### Company selection process

In order to decide which companies to involve in the study, we utilized a roster of the top 100 companies based on market capitalization as listed on six major stock exchanges in Asia Pacific. This ensured our analysis included companies with significant influence over their supply chains, that enable them to capture and report on their Scope 3 emissions.

From those 600 companies, those that had the term “manufacturing” in their company description were retained as these companies often benefit from supplier and product-specific emissions capture that fall within the bounds of Scope 3.

We further narrowed the pool of companies by retaining those that had published an ESG report in the years 2022–2023 for easier comparison and categorization. Companies without a clear upstream supply chain — those falling into categories such as consulting, hospitality and service providers — were removed from the selection process.

After applying these criteria, the final count amounted to 338 companies:

- 81 companies from ASEAN Stock Exchange (AX)
- 47 companies from Hong Kong Stock Exchange (HKEX)
- 41 companies from Shanghai Stock Exchange (SSE)/Shenzhen Stock Exchange (SZSE)
- 80 companies from Tokyo Stock Exchange (Nikkei 225)
- 68 companies from Korea Exchange (KRX)
- 21 companies from Singapore Exchange (SGX)

The companies retained can be categorized into eight broad areas of business:

1. Construction and industrial (36)
2. Utilities and energy (33)
3. Minerals & mining (27)
4. Automotive (26)
5. Healthcare and biochemical sciences (56)
6. Retail and F&B (65)
7. Electronics (50)
8. Others (incl. information & media services, transportation and logistics and conglomerate) (45)

For the list of companies identified, data on the availability of ESG reports was collected, including the year of the most recent report and its corresponding link. Additionally, information was collected on the mention of Scope 3 emissions, upstream or downstream activities, disclosure data related to scope emissions, and the earliest year of Scope 3 data being made available, based on the availability of ESG reports. This research, led and put together by Professor Neale O'Connor and the Pacific Basin Economic Council, forms the basis of the analysis captured in this report.

Table 1: Scope 1, 2 and 3 emissions reporting regulations in Asia Pacific

Indicator/ Exchange	Reporting standards	Disclosure requirement of reporting standard	Implementation Date	Applicable to whom	Assurance standards
HKEX	TCFD	Mandatory	No later than 2025	All listed companies	<b>Not mandatory but recommended</b> (although increased take up of assurance by large companies)
	ISSB – IFRS (S1/S2)	IFRS S2 – mandatory 1. Governance of climate-related risks and opportunities 2. Disclosure of material risks 3. Scenario analysis-based climate resilience 4. anticipated financial effects of climate-related risks and opportunities.	January 2024	All listed companies	
	Scope1/2/3	Scope 1&2 mandatory Scope 3 previously voluntary but now mandatory	July 2020 January 2024 – Phased in approach till 2026	All listed companies	
SSE+SZE	TCFD & Notice on Conducting Disclosure of 2021 Annual Reports of Listed Companies on the Shanghai Stock Exchange's STAR Market	TCFD Voluntary, Notice for Science and Technology Innovation Board (STAR) – mandatory	2023	Science and Technology Innovation Board (STAR) market companies on SSE STAR Market 50 Index	Not mandatory
	ISSB – IFRS (S1/S2)	Voluntary	—	All listed companies	
	Scope1/2/3	Voluntary	—	All listed companies	
KRX	TCFD	Voluntary but recommended	N/A	All companies	Not mandatory Korea Institute of Corporate Governance and Sustainability, Korea ESG Research Institute, and Sustainvest have prepared ESG evaluation agency guidance to enhance transparency and reliability in the ESG evaluation market. Dec 2022
	KSSB Standard (inspired by ISSB IFRS)	Based on IFRS S1 & S2 – mandatory	2026	Companies with assets totaling up to KRW 2 trillion	
			2029	KRW 500 billion	
			2030	all KOSPI-listed companies	
Scope1/2/3	Voluntary	N/A	All companies		

Table 1: Scope 1, 2 and 3 emissions reporting regulations in Asia Pacific (cont'd)

Indicator/ Exchange	Reporting standards	Disclosure requirement of reporting standard	Implementation Date	Applicable to whom	Assurance standards
SGX	ISSB	IFRS S2- Mandatory	2025	All listed issuers	<b>Not mandatory.</b> Mandatory external assurance on Scope 1 and 2 GHG reporting – FY2027 for listed issuers.
	TCFD	Climate reporting is mandatory on a “comply or explain” basis for all issuers and then mandatory of certain industries in phases.	2023	All issuers listed on SGX	
			2024	Mandatory for issuers in (a) financial industry; (b) agriculture, food, and forest products industry; and (c) energy industry. For other issuers, climate reporting on a ‘comply or explain’ basis.	
			2025	Mandatory for issuers in (a) financial industry; (b) agriculture, food, and forest products industry; (c) energy industry; (d) materials and buildings industry; and (e) transportation industry. For other issuers, climate reporting on a ‘comply or explain’ basis.	
Scope1/2/3	“Comply or explain” now. But will be mandatory.	2025	All listed issuers		
ASX	TCFD	Voluntary but recommended	2015	All listed companies	<b>Required:</b> Companies to obtain assurance reports from their financial auditor till 2030. From 2030, an audit will be required for all disclosures made in an entity’s sustainability report, including for Scope 1, 2 and 3 GHG emissions.



Table 1: Scope 1, 2 and 3 emissions reporting regulations in Asia Pacific (cont'd)

Indicator/Exchange	Reporting standards	Disclosure requirement of reporting standard	Implementation Date	Applicable to whom	Assurance standards
ASX	AASB based on (ISSB – IFRS (S1/S2))	1.Mandated to report on material climate-related risks and opportunities, metrics, and targets. 2. Any governance or risk management processes, controls and procedures of the entity related to these matters	July 2024	Companies with over 500 employees, revenues over \$500 million or assets over \$1 billion, as well as asset owners with more than \$5 billion in assets	<b>Required:</b> Companies to obtain assurance reports from their financial auditor till 2030. From 2030, an audit will be required for all disclosures made in an entity's sustainability report, including for Scope 1, 2 and 3 GHG emissions.
			2026	Medium-sized companies (250+ employees, \$200 million+ revenue, \$500 million assets)	
			2027	Smaller companies (100+ employees, \$50 million+ revenue, \$25 million+ assets)	
	Scope1/2/3	Mandatory Phased-in approach for Scope 3 reporting allowing companies an extra year from the beginning of their disclosure requirements to report on the quantity of their indirect value chain emissions, as well as on the application of liability for reporting, with "limited immunity" for sustainability reports for years until the end of June 2027.	July 2024	All listed companies as phased above	
JPX/TSE	TCFD	TCFD pillars (Strategy, Metrics and Targets, Governance and Risk Management) required to be used, but TCFD not specifically prescribed.	2023	All listed companies, including foreign companies listed in Japan.	<b>Not mandatory</b>
	SSBJ (Based on ISSB – IFRS (S1/S2))	Mandatory	2025		
	Scope1/2/3	"Comply or explain" basis now. Mandatory later.			

**Table 2: Examples of NGOs working on ESG disclosures in Asia Pacific**

#	Australia	China	Hong Kong SAR	Japan	Singapore	South Korea
1	Carbon Disclosure Project (CDP) (19)	Carbon Disclosure Project (CDP) (5)	Carbon Disclosure Project (CDP) (5)	Carbon Disclosure Project (CDP) Supply Chain Program (13)	Carbon Disclosure Project (CDP) (2)	Carbon Disclosure Project (CDP) (21)
2	Australian Packaging Covenant Organisation (APCO) (9)	China Yangtze Power partners with local communities (1)	Decarbonize Thailand Sandbox (2)	Climate Group RE100 (9)	Malaysian Recycling Alliance (MAREA) (1)	WWF Korea (1)
3	Climate Action 100+ (2)	Conservation International (1)	Call2Recycle and Blue Box (1)	Japan Climate Initiative (JCI) (6)	United Nations Global Impact Network Singapore (1)	EU 4evergreen Alliance (1)
4	WWF ReSource, Circular Economy for Flexible Packaging (CEFLEX) and Delterra (NGO) (1)	Responsible Cobalt Initiative (RCI) (1)	China Environmental Protection Foundation (1)	Better Cotton (BC) (1)	Roundtable on Sustainable Palm Oil (RSPO) (1)	Korea Environmental Preservation Association (1)

Table 3: Heatmap of carbon emissions strategies and disclosures

Best practices	Scope 3 Reporting, governance, measurement and engagement dimensions		Australia	Singapore	China	Hong Kong SAR	South Korea	Japan	
Emissions targets, risk assessment & assurance	Commitment to	Net zero target	77%	71%	10%	30%	53%	50%	
		Carbon neutrality	7%	0%	68%	32%	38%	44%	
		Intermediate target	25%	29%	12%	36%	31%	74%	
		Science Based Targets (SBT Initiative)	53%	43%	24%	30%	34%	53%	
	Climate related risk assessment		89%	95%	61%	85%	74%	91%	
	Materiality assessments		68%	95%	93%	98%	96%	81%	
	Carbon & GHG emission identified		26%	43%	44%	57%	24%	14%	
	Scope 3 emission disclosure data		84%	43%	12%	47%	50%	88%	
External assurance on emission calculations		67%	29%	49%	45%	94%	58%		
Scope 3 Emissions – company best practices	Organizational ESG governance	Sustainability committee	40%	76%	51%	64%	63%	83%	
		Executive incentives	23%	5%	5%	6%	3%	6%	
		Use of emissions kpis	5%	10%	15%	19%	21%	28%	
		Climate related taskforce	7%	19%	10%	32%	15%	20%	
	Strategy - partnership	NGOs, industry assoc, universities & gov	44%	29%	46%	45%	43%	56%	
		Engaging consultants	44%	24%	12%	21%	29%	19%	
	Sustainable product design and innovation	Sustainable product design	43%	24%	51%	47%	62%	60%	
		Product energy efficiency	12%	14%	22%	23%	29%	21%	
		Sustainable sourcing of raw materials	20%	10%	41%	43%	71%	61%	
	Sustainable packaging		28%	14%	46%	53%	51%	55%	
Investment in green initiatives		22%	29%	41%	38%	46%	29%		
Scope 3 emissions disclosures and measurement	Downstream - C9 to C15 categories		27%	9%	11%	14%	17%	27%	
	Upstream - C1 to C8 categories		28%	10%	17%	20%	23%	31%	
	Scope 3 emissions measurement approaches	Spend based	31%	0%	0%	4%	4%	20%	
		Activity based	37%	10%	0%	9%	10%	48%	
		Hybrid method	21%	0%	0%	2%	4%	23%	
		Supplier specific	7%	5%	0%	0%	1%	0%	
LCA product specific		17%	14%	12%	30%	24%	26%		
Supplier engagement best practices	Environment supply chain monitoring and engagement		46%	24%	46%	34%	50%	39%	
	Downstream supply chain management strategies Research, questionnaires, surveys   Consumer engagement		28%	12%	22%	19%	35%	28%	
	Upstream supply chain management strategies Onboarding, certification, assessment, & training & engagement		35%	18%	58%	60%	58%	69%	
10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

The formula for calculating the percentage is to divide the frequency of disclosure by the total number of companies listed on each national stock exchange (n).



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