

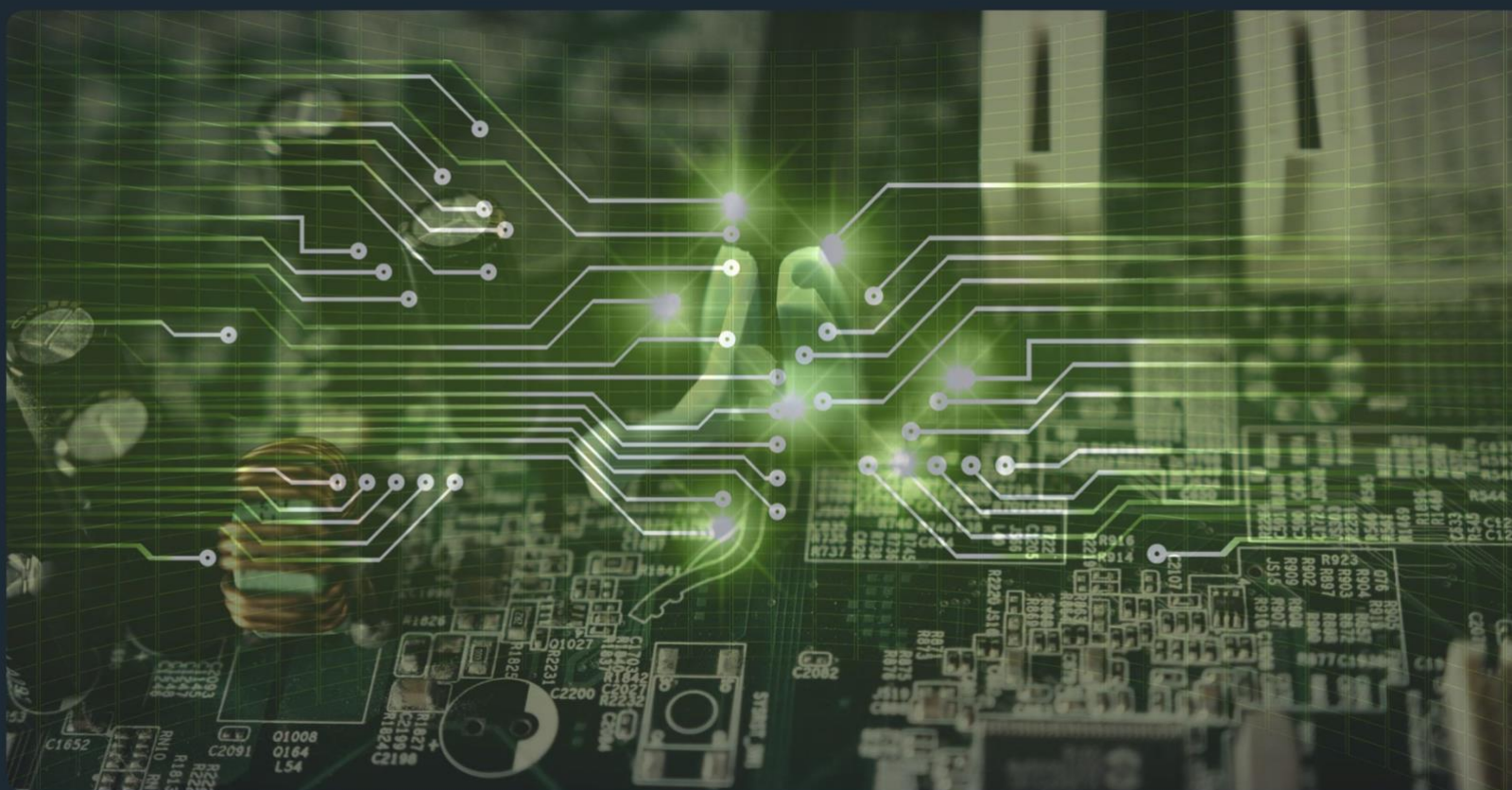


Institute for Energy Economics
and Financial Analysis

Navigating supply chain carbon risks in South Korea

Expanding global carbon regulations amplify costs and vulnerabilities
for the semiconductor and AI industries

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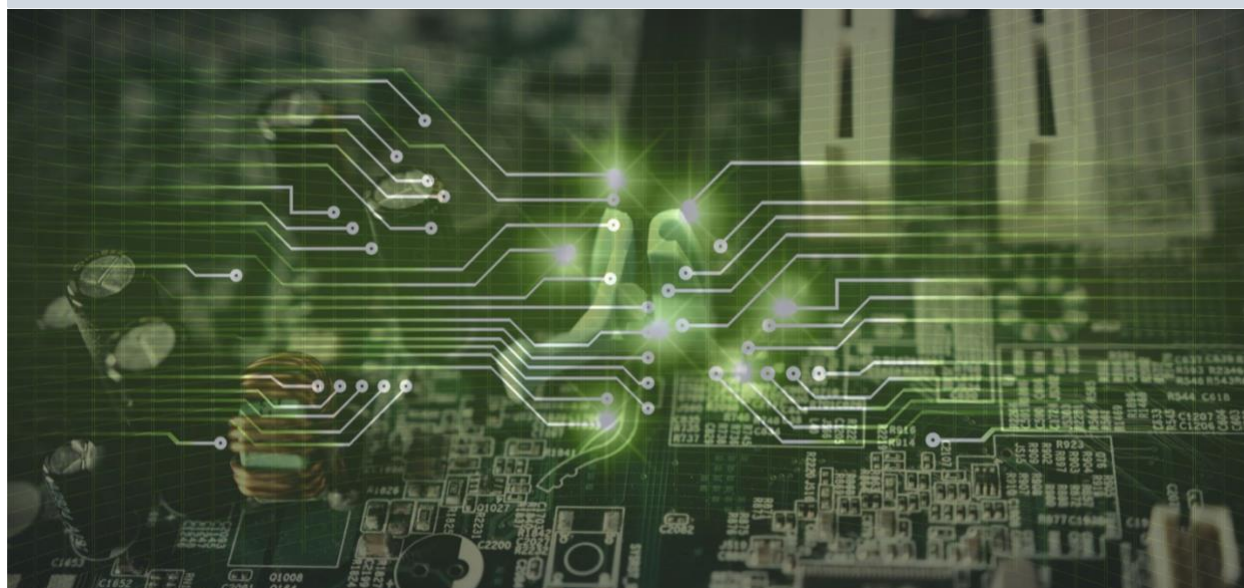
Key findings

Expanding global carbon regulations and stricter reporting requirements for indirect greenhouse gas (GHG) emissions (Scope 2 and 3) could significantly increase supply chain carbon risks for South Korean companies, including investment aversion, higher carbon cost exposure, and counterparty and reputational risks.

Samsung Device Solutions emitted approximately 41 million tonnes of carbon dioxide equivalent (MtCO₂e) in 2024, with a carbon intensity of 539 tCO₂e/USD million — far higher than Apple (37 tCO₂e/USD million) and Amazon Web Services (107 tCO₂e/USD million), reflecting inadequate clean energy use and upstream supply chain GHG management.

If the European Union's Carbon Border Adjustment Mechanism (CBAM) expands to include semiconductors and full supply chain emissions, South Korean chip exporters could face USD588 million in CBAM certificate costs between 2026 and 2034, potentially prompting importers to switch from high-emission producers to low-carbon suppliers.

Rising supply chain carbon costs in liquefied natural gas (LNG)-powered semiconductor clusters and Artificial Intelligence (AI) data centers could increase counterparty risks and production expenses, as South Korea's renewable energy shortage limits global data center investment and heightens carbon cost exposure.



Executive summary

South Korean companies are facing increasing carbon risks along their supply chains as global carbon regulations continue to strengthen. These directives include the International Financial Reporting Standards Sustainability Standards (IFRS S2), the European Union's (EU) Carbon Border Adjustment Mechanism (CBAM), as well as voluntary carbon management initiatives across the global tech industry.

A growing number of Asian markets, such as Singapore and Hong Kong, have mandated IFRS S2, requiring companies to disclose climate-related risks and opportunities, including Scope 1 and 2 greenhouse gas (GHG) emissions from the 2024–2025 reporting cycle, and are in the process of adding Scope 3 from 2026.

Scope 1 emissions are associated with direct inputs to a production process and are under the control of a manufacturing company. Scope 2 emissions arise indirectly from purchased energy and inputs needed to produce a product, and Scope 3 emissions represent the embedded carbon from Scope 1 and 2 activities that were required to manufacture finished goods. The inclusion of indirect GHG emissions, such as Scope 2 and 3, could substantially increase supply chain carbon risks, including:

- (1) Investment aversion
- (2) Higher carbon cost exposure
- (3) Counterparty and reputational risks

According to analysis by the Institute for Energy Economics and Financial Analysis (IEEFA), South Korea's leading chip maker, Samsung Device Solutions, recorded Scope 1–3 emissions of approximately 41 million metric tonnes¹ of carbon dioxide equivalent (MtCO₂e) in 2024 — the highest among seven major global tech companies — resulting in a carbon intensity of around 539 tCO₂e per USD million of revenue. Another South Korean chip manufacturer, SK Hynix, had a carbon intensity of around 246 tCO₂e/USD million.

These emission levels compare unfavorably to those of the global Big Tech companies purchasing these chips. For example, Apple has a carbon intensity of 37 tCO₂e/USD million of revenue, while Amazon Web Services (AWS) has an intensity of 107 tCO₂e/USD million.² These lower emissions reflect their global strategies of maximizing clean energy sales and minimizing GHG intensity, particularly in upstream supply chain purchases.

¹ Scope 2 GHG emissions were location-based. Samsung. [2025 Sustainability Report](#). 27 June 2025. Page 77 and 79.

² AWS. [2024 Amazon Sustainability Report](#). July 2025. Carbon intensity was calculated based on Scope 1–3 GHG emissions and revenues.

Financial investors are increasingly excluding carbon-intensive companies from their portfolios, which could limit access to financing for high-carbon emitters, raising the cost of capital and reducing corporate valuations as forms of carbon penalties.

The inclusion of indirect emissions in financial reporting could increase companies' carbon costs through various regulations, including carbon taxes, emissions trading system (ETS) compliance, and CBAM directives. Assuming Scope 2 and 3 are included in the South Korean ETS, Samsung Device Solutions (DS) would face carbon costs of around USD26 million under the current 10% paid allocation system, according to IEEFA's analysis. If the free ETS allowance is abolished and companies are required to pay 100% of their credit allocation in the future, the ETS costs based on the entire Scope 1–3 emissions would increase tenfold to USD264 million.

Expanding carbon emission disclosures could also increase counterparty and reputational risks. Both downstream customers and upstream suppliers may hesitate to conduct business with companies that report high GHG emissions due to stricter Scope 1–3 reporting requirements, which would impact their carbon accounting for entire supply chains. Companies with high emissions are at risk of being excluded from global supply chains, as several large, multinational tech companies, such as Apple and Taiwan Semiconductor Manufacturing Company (TSMC), have endorsed initiatives to reduce carbon emissions in their supply chains.

The CBAM increases carbon risks along the supply chain since there is (1) a significant difference between the EU ETS and South Korea's ETS, (2) more countries could potentially adopt the CBAM, and (3) the system could be expanded to cover more goods. Any of these factors could undermine South Korea's export competitiveness by raising CBAM financial exposure and potentially lead to supplier substitutions.

Although currently exempt, if the EU CBAM scope expands to cover the semiconductor sector and indirect emissions, such as Scope 2 and 3, South Korean chip exporters could face substantial disadvantages in global trade. If semiconductors are included in the EU CBAM scope and the embedded emission factor (EEF) used for the CBAM certificates encompasses the entire supply chain (Scope 1–3), IEEFA estimates that South Korean chip importers in the EU could face approximately USD588 million (KRW847 billion) in CBAM certificate expenses between 2026 and 2034. The sharp increase in CBAM costs may prompt European importers to switch their chip suppliers from high-emission-intensive producers to low-carbon providers to limit financial exposure.

Given that South Korea's economy is highly dependent on international trade, which accounts for approximately 70% of its Gross Domestic Product (GDP), intensifying supply chain carbon risks will significantly impact national economic viability. Rising supply chain carbon costs in liquefied natural gas (LNG)-powered semiconductor clusters and fossil fuel-based Artificial Intelligence (AI) data centers could increase counterparty risks and raise production expenses.

Against this backdrop, the South Korean government is promoting RE100 industrial complexes (industrial parks that run on 100% renewable energy) and developing an 'Energy Highway' to expand

renewable energy use across industries and streamline grid integration. The ‘Special Act on the Creation and Support of RE100 Industrial Complexes and Energy New Cities’ is expected to be enacted in 2025. The Energy Highway plan includes constructing a high-voltage direct current (HVDC) transmission infrastructure to connect areas with high renewable energy to consumers.

The tightening of global carbon regulations from 2026 in an increasingly uncertain economic landscape exacerbates carbon risks in South Korea’s supply chains. Higher tariffs imposed by the United States (US) following tariff negotiations, as well as the failure to attract global data centers amid a chronic shortage of renewable energy compared with peers, continue to hinder South Korea’s industrial competitiveness. Data center investments are concentrated in countries that can offer abundant, low-cost renewable energy. South Korea risks missing out on attracting such investments due to the lack of cheap, readily available clean energy.

IEEFA recommends the following measures for South Korea to address supply chain carbon risks and strengthen the competitiveness of its tech industry, including the semiconductor sector and AI data centers:

Key recommendations

Establish a public-private supply chain carbon risk management system to integrate national-level trade and industry policies with company-level financial strategies.

Enhance renewable energy access by addressing the chronic shortage of renewable energy supplies and expediting grid expansion and modernization.

Remove renewable energy bottlenecks in Power Purchase Agreements (PPAs) and the Renewable Portfolio Standard (RPS) to promote renewable energy procurement.

Devise financial support through government-backed funds, tax rebates, and low-interest loans for small and medium companies to address supply chain carbon risks.

Develop a domestic ETS market to buffer the impact of various carbon pricing policies, including the EU CBAM.

Strengthen international supply chain decarbonization initiatives to recognize up-to-date carbon accounting rules and regulations.

1. Introduction

As global carbon regulations continue to strengthen, South Korean companies are facing increasing carbon risks along the supply chain.³ A rising number of Asian markets, such as Singapore and Hong Kong, have mandated International Financial Reporting Standards Sustainability Standards (IFRS S2)⁴, requiring companies to disclose climate-related risks and opportunities, including Scope 1 and 2 greenhouse gas (GHG) emissions from 2025, and adding Scope 3 from 2026.^{5, 6} In the European Union (EU), from 2027 onwards, companies importing more than 50 tonnes⁷ of steel, cement, aluminum, fertilizer, hydrogen, and power are mandated to buy Carbon Border Adjustment Mechanism (CBAM) certificates to offset emission differences between an export country with a higher carbon dioxide (CO₂) emission intensity than that of the EU.⁸

Counterparty pressures in global supply chain decarbonization efforts are escalating. Several global tech companies have endorsed supply chain carbon emission reduction initiatives, such as Apple's Supplier Clean Energy Programme and Taiwan Semiconductor Manufacturing Company's (TSMC) Collective Procurement Programme.⁹ These are part of a low-carbon supply chain management strategy to reduce upstream Scope 3 emissions.

Given that the power consumption in the supply chain (Scope 3) is a larger source of carbon emissions than a company's own operations (Scope 1 and 2)¹⁰, particularly in the tech industry, carbon risks within the supply chain are likely to be prioritized. As higher-rated environmental, social, and governance (ESG) companies place greater emphasis on reducing indirect emissions (including Scope 2 and 3¹¹), a growing number of global tech companies are projected to target GHG reduction across their entire global supply chains. Consequently, they would want suppliers from markets that can supply clean energy or products with low embedded carbon.

Driven by global trends, many companies have pledged to transition their operations to 100% renewable energy sources. Company coalitions such as the Climate Group's RE100 bring together

³ Institute for Energy Economics and Financial Analysis (IEEFA). [South Korea's economy risks missing out on global transition to renewables](#). August 2024.

⁴ IFRS. [IFRS S2 Climate-related Disclosures](#). 2023.

⁵ Scope 1 emissions are direct GHG emissions from company operations, such as chemical releases from manufacturing processes or burning fossil fuels for heat. Scope 2 emissions are indirectly attributable to company operations, such as purchasing electricity from a high-carbon intensity utility grid. Scope 3 emissions are associated with purchases from supply chains of high-carbon intensity products or the use of such products. Currently, South Korean manufacturers have high Scope 2 emissions from purchased electricity, which causes their customers to incur high Scope 3 emissions.

⁶ All listed companies are mandated to report Scope 1 and 2 GHG emissions from the financial year (FY) 2025 in Singapore, and from 01 January 2025 in Hong Kong. Scope 3 GHG emission disclosures are mandated from FY2026 in Singapore and from 01 January 2026 in Hong Kong.

⁷ Reuters. [EU Parliament backs exempting 90% of companies from carbon border levy](#). 22 May 2025.

⁸ European Commission. [Carbon Border Adjustment Mechanism](#).

⁹ New Climate. [Navigating the nuances of corporate renewable electricity procurement: Spotlight on fashion and tech](#). 16 January 2024. Page 04.

¹⁰ New Climate. [Navigating the nuances of corporate renewable electricity procurement: Spotlight on fashion and tech](#). 16 January 2024. Page 11.

¹¹ Journal of Sustainable Finance & Investment. [Your emissions or mine? Examining how emissions management strategies, ESG performance, and targets impact investor perceptions](#). 25 November 2022.

over 400 companies that aim to meet 100% of their electricity demand with renewable sources by 2050. More than 36 RE100 member companies are headquartered in South Korea. This initiative, led by the Climate Group in partnership with the Carbon Disclosure Project (CDP)¹², aims to accelerate the shift towards zero-carbon electricity grids.

Despite the rapid global shift toward decarbonization, South Korean companies are significantly lagging behind their peers in managing supply chain carbon risks, amid a persistent shortage of domestic renewable energy supply. RE100 member companies in South Korea, such as Samsung Electronics (currently 31% renewable supplied) and SK Hynix (30%), recorded relatively low RE100 progress compared to global peers, including Apple (98%) and Intel Corporation (97%), according to Climate Group.¹³

South Korea's renewable energy transition trails other countries by at least 15 years, based on the pace of renewable energy generation.¹⁴ The renewable energy share in the grid's power mix reached 10% for the first time in 2024. However, according to the 11th Basic Plan for Long-Term Electricity Supply and Demand (BPLE), South Korea targets achieving 32.95% renewables only around 2038. This is far short of the 2023 levels for the world (30.25%), the Organization for Economic Cooperation and Development (33.49%), and Asia (26.73%).¹⁵

There are growing concerns that increasing supply chain carbon risks, in addition to the shortage of domestic renewable energy, could undermine South Korea's export competitiveness in critical industrial sectors, such as semiconductor clusters and Artificial Intelligence (AI) data centers. Given that the country's economy is highly dependent on international trade, which accounts for about 70%¹⁶ of its Gross Domestic Product (GDP), intensifying supply chain carbon risks in key industries could undermine national economic viability significantly. Rising supply chain carbon expenses in liquefied natural gas (LNG)-powered semiconductor clusters and fossil fuel-based AI data centers could lead to increased counterparty risks and higher production costs. For example, global tech companies could change their suppliers based on Scope 2 and 3 emissions. The lack of domestic renewable energy supplies in South Korea could jeopardize the country's ability to attract global data center investment and even prompt companies to relocate overseas.

Regardless of these emerging risks, the Yongin semiconductor cluster plans to procure 3 gigawatts (GW) of electricity from six LNG-fired power generators from 2030.¹⁷ Meanwhile, Amazon Web Services (AWS), Google, and Microsoft are currently evaluating which Asian countries would be most suitable for large-scale data center investment, partly based on access to renewable electricity supplies.

¹² The Carbon Disclosure Project (CDP). [About Us](#).

¹³ Climate Group RE100. [2024 RE100 Annual disclosure report](#). 22 May 2025.

¹⁴ IEEFA. [Bottlenecks to Renewable Energy Integration in South Korea](#). 05 June 2025.

¹⁵ IEEFA. [South Korea's Economy Risks Missing Out on Global Transition to Renewables](#). 14 August 2024. Page 05.

¹⁶ KITA. [Website](#).

¹⁷ AsiaEnergy. [Yongin semiconductor clusters powered by 6 LNG-fired power generators](#). 22 December 2023.

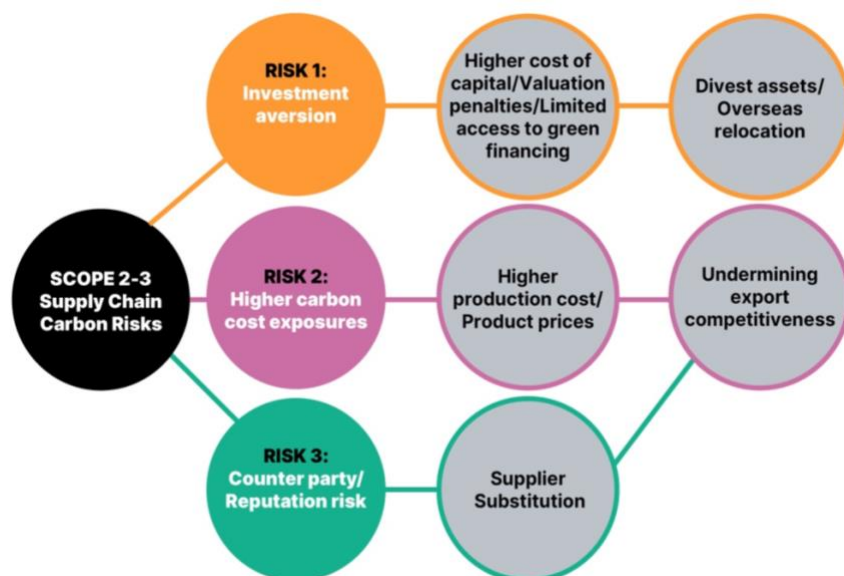
This report will analyze the supply chain carbon risks faced by leading South Korean tech companies, with a focus on Scope 2, Scope 3, and CBAM regulations. It will also address the key challenges highlighted in a previous report by the Institute for Energy Economics and Financial Analysis (IEEFA) titled ‘South Korea’s economy risks missing out on global transition to renewables’.¹⁸

2. Scope 2 and 3 supply chain carbon risks

A growing number of Asian markets, such as Singapore and Hong Kong, have mandated IFRS S2 standards¹⁹, requiring companies to disclose climate-related risks and opportunities, including Scope 1 and 2²⁰ GHG emissions from 2025, and Scope 3 emissions from 2026.

The addition of Scope 2 and 3 emissions, which cover the entire supply chain, including raw materials, transportation, energy use, and the embedded carbon in final product consumption, could substantially increase supply chain carbon risks, such as (1) investment aversion, (2) higher carbon cost exposure, and (3) counterparty and reputational risks (Figure 1).

Figure 1: Scope 2 and 3 supply chain carbon risks



Source: IEEFA.

¹⁸ IEEFA. [South Korea's Economy Risks Missing Out on Global Transition to Renewables](#). 14 August 2024.

¹⁹ IFRS. [IFRS S2 Climate-related Disclosures](#). 2023.

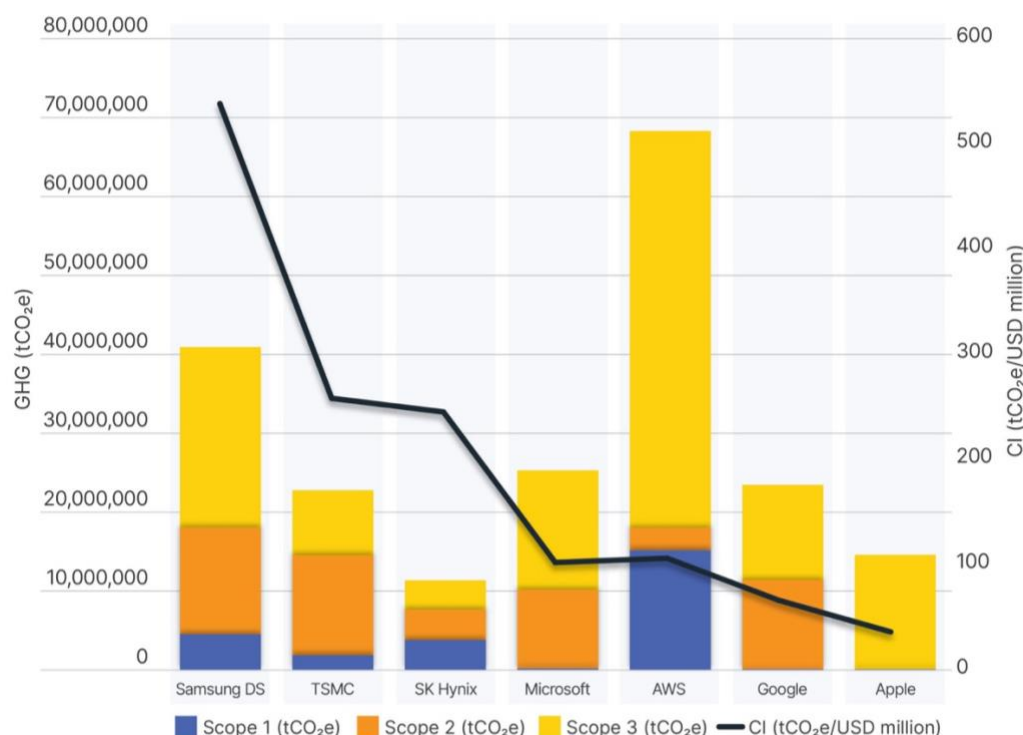
²⁰ All listed companies are mandated to report Scope 1 and 2 GHG emissions from FY2025 in Singapore, and from 01 January 2025 in Hong Kong. Scope 3 GHG emission disclosures are mandated from FY2026 in Singapore and from 01 January 2026 in Hong Kong.

South Korean companies are lagging behind their peers in supply chain carbon risk management, which is exacerbated by a chronic shortage of domestic renewable energy supplies. This situation places the country's exporters at a disadvantage regarding Scope 2 and 3 emissions, which are increasingly the focus of new policies and regulations among importing regions (such as the EU and the United Kingdom) and carbon-conscious companies.

According to IEEFA's analysis, the Scope 1–3 emissions by Samsung Device Solutions (DS)²¹ were around 41 million metric tonnes of carbon dioxide equivalent (MtCO₂e) in 2024. This was the highest among seven leading tech companies, resulting in a carbon intensity of approximately 539 tCO₂e/USD million. SK Hynix ranked second in South Korean emissions intensity at 246 tCO₂e/USD million (Figure 2).

One of the major competitors in the chip industry, TSMC, recorded a carbon intensity of 259 tCO₂e/USD million. In contrast, most downstream buyers, such as Microsoft, AWS, Apple, and Google, reported substantially lower intensities, at or below 100 tCO₂e/USD million.

Figure 2: Scope 1-3 emissions and carbon intensity (CI) by company



Source: IEEFA; Company reports.

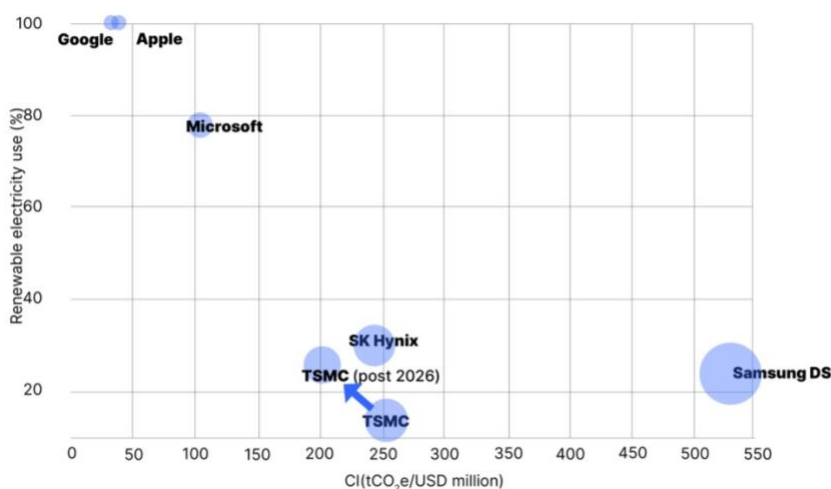
Note: Data is from 2024 reporting. Scope 2 emissions are location-based, while Apple and Amazon's emissions are market-based. The final CI is subject to change depending on the KRW/USD exchange rate.

²¹ Samsung Device Solutions (DS) is a semiconductor department within Samsung Electronics.

A matrix analysis of leading tech companies reveals that Samsung DS and SK Hynix are positioned in the quadrant of high carbon intensity or low renewable electricity use (Figure 3). This highlights their increasing vulnerability to supply chain carbon risks compared to companies such as Apple, Microsoft, and Intel, which have achieved nearly 100% renewable energy usage with relatively low carbon intensity.

A notable decarbonization development is TSMC's 20-year corporate Power Purchase Agreement (PPA) with the Greater Changhua offshore wind farm in Taiwan. The company has contracted the full output of the project's Phase 2B and 4, totaling 920 megawatts (MW). The wind farm began transmitting power in June 2025, with full commissioning expected in 2026. This will significantly reduce TSMC's operational carbon intensity (Figure 3), creating a sharp contrast with South Korea's manufacturing sector.

Figure 3: Matrix analysis of renewable electricity use (%) and carbon intensity (CI) by company



Source: IEEFA; Company reports.

2.1 Investment aversion

A growing number of investors are beginning to exclude carbon-intensive companies from their supply chains. The expected complete inclusion of indirect emissions (Scope 2 and 3) in financial reporting may be a catalyst for this shift. Recently, index providers such as Standard & Poor's and the Financial Times Stock Exchange (FTSE) have launched net-zero benchmark indices in an effort to promote green financing, which excludes carbon-intensive brown firms from portfolios.

The aversion to high carbon intensity investment among green investors may shrink available financing sources, potentially raising the cost of capital²² and reducing corporate valuation as a result

²² MDPI. *Climate Risk and Its Impact on the Cost of Capital—A Systematic Literature Review*. 2024.

of carbon penalties.²³ Increasing focus on the indirect carbon emissions in the global financial sector could recalibrate asset and capital allocations to low-carbon intensive corporations and countries, resulting in divestment and exodus of assets from high-emitters.

As of 2025, foreign investors hold significant stocks in SK Hynix (54.8%)²⁴ and Samsung (48%).²⁵ This could prompt carbon-conscious global investors to divest from high-emitting corporations in South Korea.

2.2 Higher carbon cost exposure

The inclusion of indirect emissions in financial reporting requirements could raise the carbon cost exposure for companies under various regulations, including carbon taxes, emissions trading systems (ETSs), and CBAM.²⁶ Carbon pricing has cascading effects on the entire supply chain as carbon expenses are accrued upstream (raw materials) and downstream (final products) with cost-push dynamics.²⁷ This results in increasing production outlays and final prices, undermining profitability and industrial competitiveness by negatively impacting revenues and profits of high carbon-emitting companies.

IEEFA conducted a scenario analysis (Figure 4) assuming that indirect Scope 2 and 3 emissions were included in South Korea's ETS (K-ETS). Accordingly, Samsung DS's carbon costs under the current 10% paid allocation system²⁸ were approximately USD26 million.

The government is currently debating increasing paid allocation to 15%²⁹ from 2026 onward. Consequently, the ETS expenses borne by Samsung DS would rise by 50% to around USD39.6 million. If the free ETS allowance is abolished and 100% paid allocation is implemented, the ETS costs based on the entire Scope 1–3 emissions would increase tenfold to approximately USD264 million (Figure 4).

ETS price fluctuations and carbon cost volatility, combined with regulatory uncertainty, could further erode the financial stability, predictability, and viability of companies with high carbon footprints.

This analysis focuses exclusively on the K-ETS and does not include supply chain carbon cost exposure arising from broader international regulations, such as carbon taxes or the CBAM. As more countries adopt carbon pricing and rates continue to rise, high-emitting and high carbon intensity companies may face significantly greater financial exposure.

²³ Journal of Sustainable Finance & Investment. [Building benchmark portfolios with decreasing carbon footprints](#). 17 February 2025.

²⁴ SK Hynix. [Ownership Structure](#). Data accessed: August 2025.

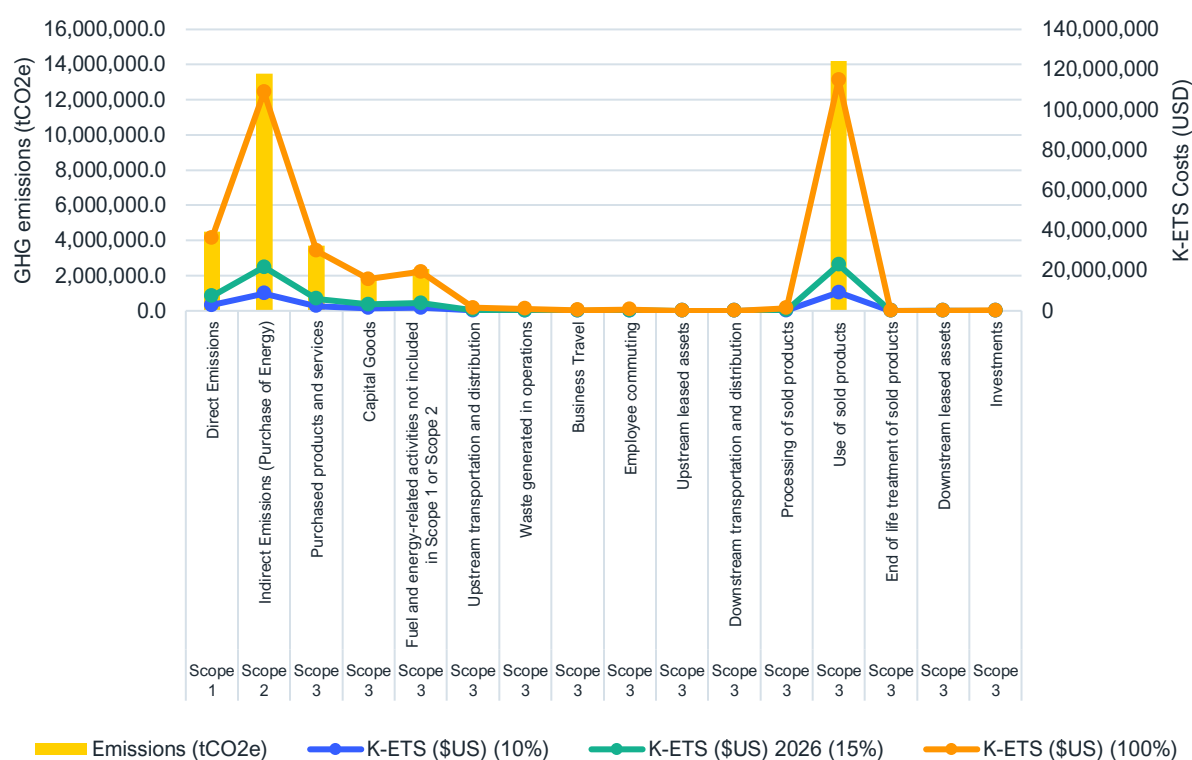
²⁵ Samsung. [Shareholder Structure](#). Data accessed: August 2025.

²⁶ The supply chain carbon risks and financial exposures by the EU CBAM will be discussed in a later section of this report.

²⁷ MDPI. [Climate Risk and Its Impact on the Cost of Capital—A Systematic Literature Review](#). 2024. Page 06.

²⁸ Under the South Korean Emissions Trading System (K-ETS), companies are required to purchase carbon credits if GHG emissions exceed nationally allocated quotas.

²⁹ Hankyung Korea Market. [Carbon allowance costs surge, companies pay an additional 1 trillion KRW per year](#). 02 September 2025.

Figure 4: Samsung's Scope 1–3 financial exposures based on K-ETS


Source: IEEFA, Samsung.

Note: The assumptions of scenario analysis of K-ETS (USD)(10%) refer to the current free ETS allowance of 90%. K-ETS (USD) (15%) refers to the revised allowance of 85% from 2026 onward, and K-ETS (USD) (100%) refers to no free ETS allowance. Scope 2 is location-based.

In this context, SK Hynix plans to supply heat from a joint LNG-fired Combined Heat and Power (CHP) system between SK E&S and Korea Midland Power (KOMIPO), while using electricity from the national grid for its upcoming Yongin semiconductor cluster.³⁰ Using energy, such as heat and electricity, from non-renewable resources for semiconductor manufacturing could expose SK Hynix to substantial carbon costs within the entire supply chain (Figure 5).

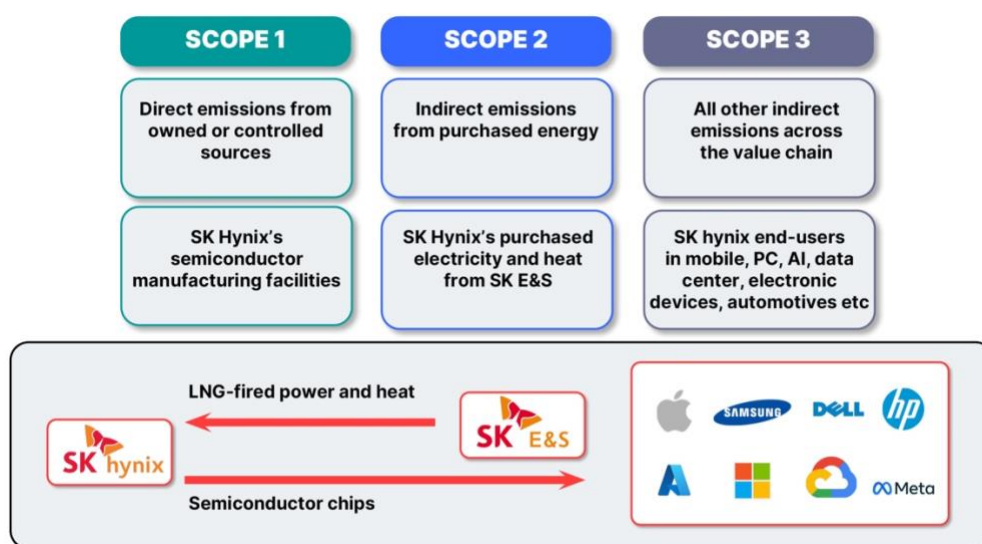
Direct emissions from the proposed LNG-fired CHP are likely to range between 450–500 grams of carbon dioxide equivalent (gCO₂e) per kilowatt-hour (kWh), depending on the technology used and operating profile. This emission level does not include methane losses from the gas supply chain.

Amid accelerating carbon regulations and expanding reporting mandates for indirect emissions, fossil fuel-reliant energy strategies could not only jeopardize the company's financial stability but also its ESG goals.

³⁰ IEEFA. [South Korea's Economy Risks Missing Out on Global Transition to Renewables](#). August 2024. Page 24.

SK Hynix has been a member of the RE100 initiative since 2020, indicating its longer-term commitment to renewable energy. The company aims to achieve 100% renewable electricity use by 2050 under this program. However, with only 30% realized by 2022, it lags behind the global average of 50%, raising concerns about its progress.³¹ Committing to an LNG-fueled CHP asset appears contrary to corporate goals as it would lock in high CO₂ emissions for many years, moving the company further away from its RE100 target.

Figure 5: SK Hynix's Scope 1, 2, and 3 GHG emissions



Source: IEEFA.

2.3 Counterparty and reputational risks

Expanding carbon emission disclosures could increase counterparty and reputational risks. Stricter reporting requirements for Scope 1–3 GHG emissions across entire supply chains could prompt downstream customers and upstream suppliers to avoid companies with high emissions.

For example, South Korean tech companies, such as Samsung DS and SK Hynix, could lose market share if suppliers and buyers shift to businesses with lower GHG emissions to meet environmental commitments and reduce supply chain carbon risks. Semiconductor companies with high emissions embedded in their products could face challenges in procuring feedstocks and parts from upstream suppliers who want to reduce their Scope 3 carbon risks. Similarly, downstream end-users, such as data centers and electronics manufacturers, could be incentivized to switch their chip suppliers from high GHG emitters to low-carbon manufacturers. Google initiated the Google Clean Energy Addendum (CEA) for its suppliers in 2023. This agreement requires suppliers to achieve 100% clean

³¹ RE100. [RE100 Annual Disclosure Report](#). 27 March 2024. Page 68.

electricity by the end of 2029 for products manufactured for Google.³² Intel has aimed to achieve GHG emissions reductions across the semiconductor value chain since 2024.³³

Companies with high GHG emissions risk being excluded from global supply chains that aim to improve carbon management. Higher ESG-rated firms are more likely to focus on reducing indirect emissions, including Scope 3³⁴, and a growing number of international companies are expected to prioritize GHG reductions across their entire supply chains.

Power consumption in the supply chain (Scope 3) is a larger source of carbon emissions than a company's own operations (Scope 1 and 2), especially in the tech sector.³⁵ For example, 97% of GHG emissions are from the Scope 3 category for Microsoft.³⁶ Consequently, several companies have launched carbon reduction initiatives for their supply chains (Table 1).

Table 1: Global tech companies' supply chain carbon reduction initiatives

Company	Supply Chain Carbon Reduction Initiatives	Details
Apple	Supplier Clean Energy Programme ³⁷	✓ Aimed at enabling suppliers' transition to clean, renewable electricity through policy advocacy, data insights, and engagement with experts ✓ In 2024, Apple allocated green bond proceeds to the Supplier Clean Energy Program
TSMC	Low-carbon Supply Chain Management ³⁸	✓ Supplier Joint Renewable Energy Procurement Project ✓ Monitor supplier carbon emissions data ✓ Furnish suppliers with carbon management resources and guidance ✓ Boost supplier incentives for carbon reduction ✓ Partner with suppliers to innovate and execute cost-effective emission reduction programs
Microsoft	Decarbonizing Supply Chain in Asia ³⁹	✓ Help carbon-free electricity access in South Korea, Japan, and Taiwan, where the majority of Microsoft's semiconductors are sourced ✓ Regional industry cooperation for carbon-free electricity policy engagement (e.g. SEMI Energy Collaborative, the Asia Clean Energy Coalition, and Japan Climate Leaders Partnership)
Intel	Supplier Program to Accelerate Responsibility and Commitment (SPARC) ⁴⁰	✓ Achieve net-zero upstream Scope 3 GHG emissions by 2050 ✓ Leadership roles in Semiconductor Climate Consortium (SCC) to reduce GHG emissions across the semiconductor value chain
Google	Google Clean Energy Addendum (CEA) ⁴¹	✓ An agreement asking suppliers to commit to achieving 100% clean electricity by the end of 2029 for the power used to manufacture Google products

Source: IEEFA; Company reports.

³² Google. [2025 Environmental Report](#). June 2025. Page 35.

³³ Intel. [Corporate Responsibility Report 2024-25](#). 2025. Page 40.

³⁴ Journal of Sustainable Finance & Investment. [Your emissions or mine? Examining how emissions management strategies, ESG performance, and targets impact investor perceptions](#). 25 November 2022.

³⁵ New Climate. [Navigating the nuances of corporate renewable electricity procurement: Spotlight on fashion and tech](#). 16 January 2024. Page 11.

³⁶ Microsoft. [2025 Environmental Sustainability Report](#). 2025. Page 82.

³⁷ Apple. [Environmental Progress Report 2025](#). 2025. Page 92.

³⁸ TSMC. [TSMC Climate and Nature Report 2024](#). 2025. Page 39.

³⁹ Microsoft. [2025 Environmental Sustainability Report](#). 2025. Page 82.

⁴⁰ Intel. [Corporate Responsibility Report 2024-25](#). 2025. Page 40.

⁴¹ Google. [2025 Environmental Report](#). 2025. Page 35.

Similarly, global data center investments are focusing on countries that can supply abundant, low-cost renewable energy (Table 2).

Table 2: Global data center investments in Asia with renewable energy

Company	Country	Renewable & Clean power deals
Google	India (Visakhapatnam, Andhra Pradesh)	USD2 billion renewable project to power 1GW data centers ⁴²
Google	Taiwan	Corporate PPA for solar power in 2019, and 10MW of geothermal energy for data centers ⁴³
Google	Singapore	Signed 10-year PPA for waste wood-to-power ⁴⁴
Amazon Web Services (AWS)	Singapore	62MW solar project initiated in 2021 ⁴⁵ , strategic partnership with Keppel to supply renewable energy to data centers in 2024 ⁴⁶
Amazon Web Services	Malaysia	Powering renewables to new AWS Region in Malaysia, investing USD6.2 billion ⁴⁷
Microsoft	Singapore	20-year deal with Sunseap to power its data centers using solar energy ⁴⁸

Source: Company reports.

AWS is partnering with SK Group to build an AI data center in Ulsan, in the southeast of South Korea, powered by SK Gas's LNG-fired CHP⁴⁹ system.

The renewable energy share in the South Korean power mix reached 10% for the first time in 2024. However, according to the 11th Basic Plan for Long-Term Electricity Supply and Demand (BPLE), South Korea is expected to achieve its 32.95% target only around 2038. This is far short of the 2023 levels for the world (30.25%), the Organization for Economic Cooperation and Development (33.49%), and Asia (26.73%)⁵⁰.

South Korea was ranked as the most challenging country for achieving RE100 targets, according to the Climate Group⁵¹ (Figure 6). Out of nine categories, South Korea topped in five critical areas, facing barriers that include high costs or limited supply, a lack of procurement options, frictions or inefficiencies, regulatory barriers, and a lack of data.

⁴² Reuters. [Google to invest \\$6 billion in southern India, data centre-sources say](#). 31 July 2025.

⁴³ Google. [Our first geothermal energy deal in Asia](#). 15 April 2025.

⁴⁴ Datacenter dynamics. [Google signs waste wood recycling PPA for Singapore data centers](#). 01 August 2024.

⁴⁵ Amazon. [Website](#).

⁴⁶ The independent SG. [Keppel sings strategic partnership with AWS to advance AI, data centers, and sustainability](#). 06 December 2024.

⁴⁷ Malaysian Investment Development Authority (MIDA). [Amazon launches data centre in Malaysia, part of US\\$6.2bil investment here](#). 22 August 2024.

⁴⁸ Microsoft. [Microsoft and Sunseap sign agreement on largest-ever solar project in Singapore](#). 01 March 2018.

⁴⁹ Datacenterdynamics. [SK Group and AWS to build AI data center in Ulsan, South Korea](#). 16 June 2025.

⁵⁰ IEEFA. [South Korea's Economy Risks Missing Out on Global Transition to Renewables](#). 14 August 2024. Page 05.

⁵¹ Climate Group. [2024 RE100 Annual disclosure report](#). May 2025. Page 36.

Figure 6: Top 10 RE100 challenging markets

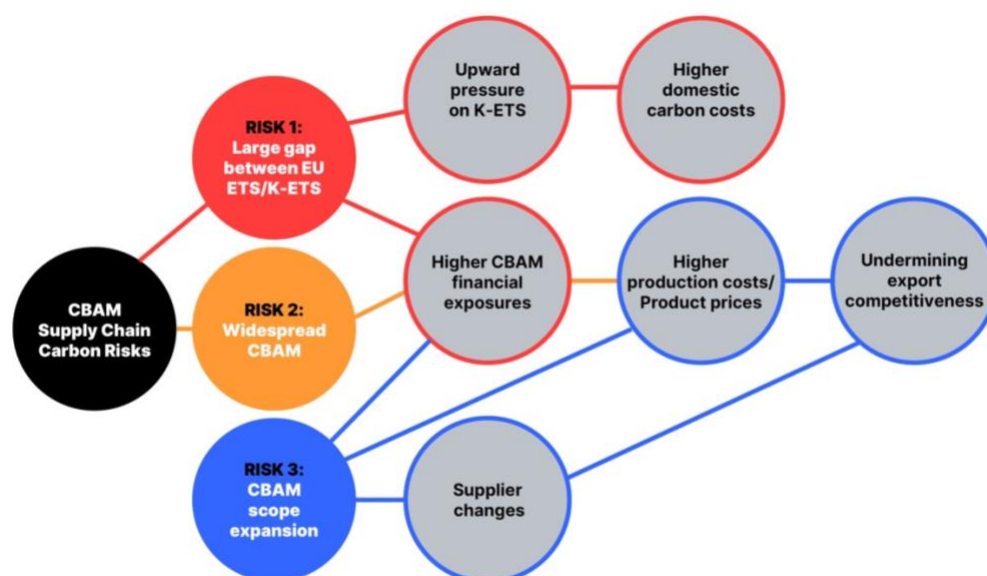
Barriers reported	Republic of Korea	Taiwan, China	Singapore	Japan	China	India	United States of America	Saudi Arabia	Russian Federation	Qatar	Total members citing this barrier
High cost or limited supply	36	43	41	28	8	8	7	3	2	4	145
Lack of procurement options	29	11	8	9	15	13	5	9	10	7	112
Frictions or inefficiencies (small load)	12	7	4	6	3	4	4	3	1	2	45
Regulatory barriers	10	2	1	5	6	10	1	0	6	0	44
Frictions or inefficiencies (landlord-tenant arrangements)	1	4	3	9	3	6	6	1	0	1	23
Frictions or inefficiencies (other)	1	0	1	7	0	5	0	0	1	0	18
Lack of data	4	2	0	2	2	0	1	0	0	0	17
Credibility concerns	3	0	0	0	2	4	1	0	1	0	14
Internal reasons	0	0	2	4	1	1	1	0	0	0	13

Source: Climate Group.

3. CBAM supply chain carbon risks

The CBAM supply chain carbon risks arise as a result of (1) a large gap between the EU ETS and K-ETS, (2) potential for more countries adopting their own CBAMs, and (3) CBAM scope expansion. These factors could undermine South Korea's export competitiveness because of increasing domestic carbon costs, CBAM financial exposure, and supplier substitutions (Figure 7).

Figure 7: Growing supply chain carbon risks for LNG-powered semiconductor clusters



Source: IEEFA.

The EU CBAM, proposed in 2021, aims to prevent ‘carbon leakage’ by taxing imports entering Europe based on the embedded carbon emissions. It requires exporters of goods, including iron, steel, aluminum, cement, hydrogen, electricity, and fertilizer, to report such emissions. This precedes full implementation in 2026, when importers of more than 50 tonnes⁵² of these products annually must publish yearly carbon emissions reports⁵³ and purchase CBAM certificates to offset them.⁵⁴ By increasing the cost of high-emission imports, CBAM could incentivize low-emission production and low-carbon manufacturing.⁵⁵

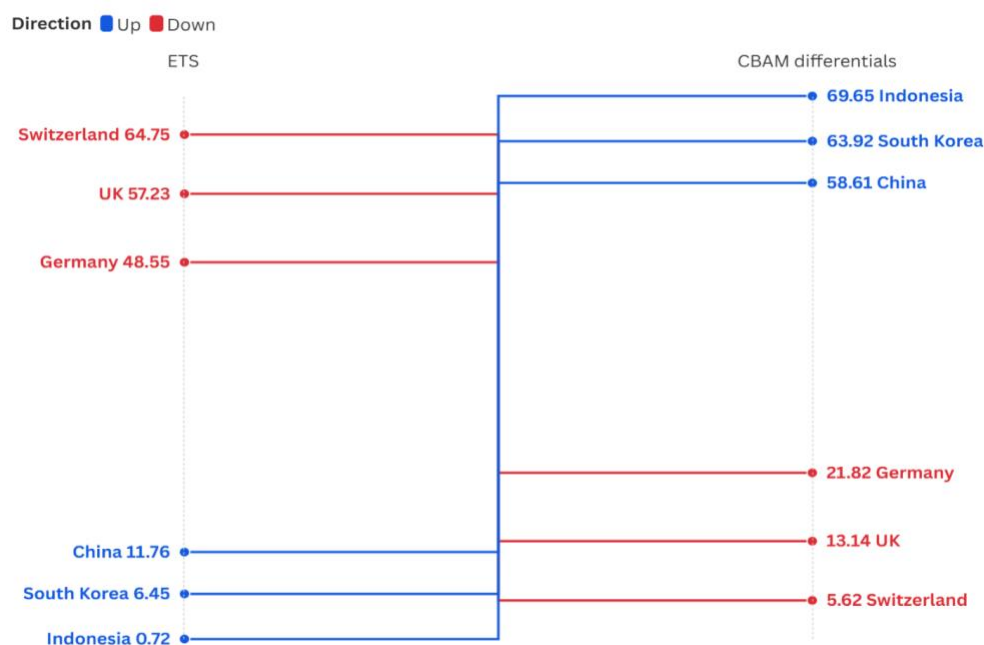
The value of the CBAM certificate will be calculated by multiplying the weekly average of the EU ETS price by the embedded emissions per tonne of imported goods. A larger gap in carbon pricing between exporting countries and the EU could result in higher CBAM costs. South Korea’s relatively low ETS prices could potentially risk global companies and customers switching their suppliers to other countries, which have a narrower gap with the EU ETS (Figure 8).

⁵² Necessary. [Updated: European Parliament supports CBAM amendments](#). 23 May 2025.

⁵³ FTI Consulting. [Implications of the EU’s Carbon Border Adjustment Mechanism for Asia](#).

⁵⁴ The definitive phase, when CBAM certificates must be purchased, was originally slated to start in 2026, but has now been postponed to 2027 under recent proposals. OPIS. [EU Commission Alters CBAM Compliance Threshold and Certificate Timeline](#). 31 March 2025.

⁵⁵ Energies. [A review of carbon pricing mechanisms and risk management for raw materials in low-carbon energy systems](#). 27 June 2025. Page 09.

Figure 8: ETS prices by country vs CBAM differentials estimation


Source: World Bank.

Note: The ETS prices are based on USD/CO₂e on 01 April 2025, or the latest available prior to that.⁵⁶ EU ETS price was based at USD70.37/tCO₂e. The calculation assumed that there is no free carbon credit allowance and no other deductions.

The CBAM is one form of carbon tariff, potentially equalizing carbon pricing between the EU and non-EU countries. If other nations adopt similar mechanisms, global carbon pricing could converge, potentially putting upward pressure on the relatively low ETS in South Korea in the future, thereby adding variable costs in the domestic market (Figure 8).

The United Kingdom (UK)⁵⁷ will implement its CBAM from January 2027 for aluminum, cement, fertilizer, hydrogen, and metals imports that amount to more than GBP50,000 annually.⁵⁸ The UK CBAM requires reporting direct and indirect emissions, which is more stringent than the EU mechanism, which has that criteria for cement and fertilizer only. Canada⁵⁹ and Australia⁶⁰ are also in the process of considering their own CBAM implementation.

⁵⁶ World Bank. [State and Trends of Carbon Pricing Dashboard](#).

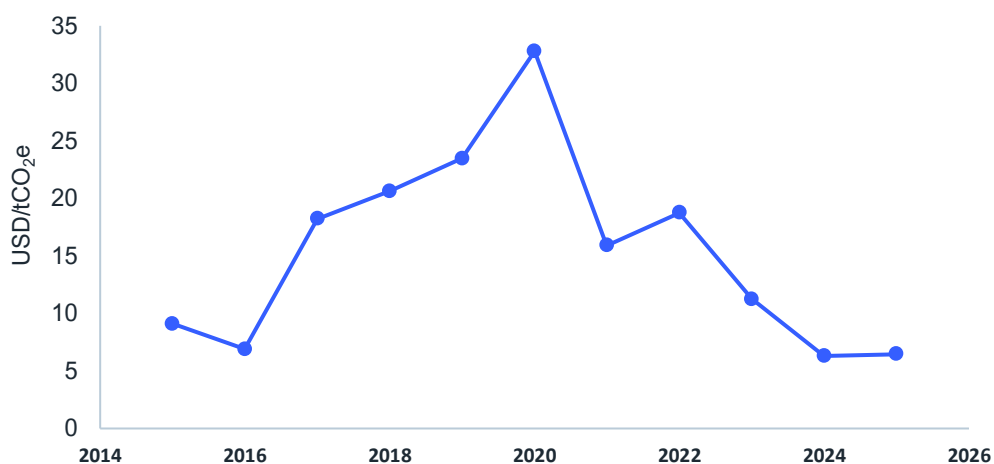
⁵⁷ HM Treasury. [Introduction of a UK Carbon Border Adjustment Mechanism from January 2027: Government response to the policy design consultation](#). 30 October 2024.

⁵⁸ Korea Energy Agency. [Energy Issue Briefing No. 273](#). 25 August 2025.

⁵⁹ Department of Finance Canada. [Exploring Border Carbon Adjustments for Canada](#).

⁶⁰ Minister for Climate Change and Energy. [Speech to Australian Business Economists](#). 15 August 2023.

Figure 9: Korea ETS price by year



Source: World Bank.

Note: The ETS prices are based on USD/CO₂e on 01 April 2025, or the latest available prior to that.⁶¹

While semiconductors and LNG are currently exempt from the CBAM, the energy-intensive nature of their production raises concerns for South Korea's upcoming semiconductor clusters that LNG will power. The EU Commission initiated a public consultation in July 2025 and discussed extending the scope of its CBAM. This revision is likely to continue regularly. The report regarding the expanded scope is expected to be announced by the fourth quarter of 2025.⁶²

The potential inclusion of semiconductors in the EU CBAM, combined with increasing LNG import expenses, would be a significant disadvantage for South Korea's semiconductor industry, which relies on fossil fuel-based energy. The EU is the third-largest export destination for South Korea, accounting for approximately 10% of the country's total exports each year.⁶³ The CBAM costs on the sale of semiconductors entering Europe could undermine South Korean companies' market shares. EU chip customers may decide to switch suppliers from South Korean semiconductor companies, powered by LNG with a higher carbon footprint, to others that use low-carbon electricity.

Additionally, production expenses could further increase if the carbon costs imposed by the EU CBAM are factored into the procurement of LNG-fired power, as this would result in a substantial recalibration of LNG prices in international trading markets. The additional LNG import costs due to the CBAM were estimated at around USD0.30 million British thermal units (MMBtu), or EUR1 per megawatt-hour (MWh) for new LNG plants.⁶⁴

⁶¹ World Bank. [State and Trends of Carbon Pricing Dashboard](#).

⁶² Latham & Watkins. [European Commission Consults on CBAM Extension and Announces Plans to Protect EU Exporters](#). 04 July 2025.

⁶³ European Union. [2025 EU - ROK Trade and Investment Relations](#). 21 April 2025

⁶⁴ Montelnews. [EU may impose border tax on LNG by 2027 – Woodmac](#). 18 September 2024.

Consequently, widespread CBAM implementation could increase supply chain carbon risks for fossil fuel-reliant industries in South Korea, particularly LNG-powered semiconductor clusters, undermining export competitiveness and escalating production expenses (Figure 7).

4. Case study: Scope 2–3 & CBAM exposure for South Korean LNG-powered semiconductors

The semiconductor sector is currently exempt from the EU CBAM. However, given its energy-intensive nature, it could be considered for inclusion in the future. If the EU CBAM expands to cover the semiconductor industry and incorporates indirect emissions, such as Scope 2 and 3, South Korean chipmakers could face significant competitive disadvantages in global trade.

IEEFA conducted a scenario-based case study assuming the semiconductor industry is included in the EU CBAM's scope. The analysis estimates the CBAM certificate cost using an embedded emission factor (EEF) that encompasses the entire supply chain (Scope 1–3). The embedded carbon intensity was based on value⁶⁵ rather than mass, factoring in annual GHG emissions and revenues to determine the value-based EEF.

The following EEF formula is used:

(Annual Scope 1–3 GHG emissions for Samsung DS and SK Hynix) ÷ (Annual revenue of the two companies)

As of October 2025, the CBAM certificate cost calculations are based on mass (tCO₂e per tonne). However, there are ongoing public consultations⁶⁶ on using a value-based approach (tCO₂e/EUR). The policy may expand to incorporate high-value, low-weight downstream manufactured products, such as semiconductors.⁶⁷

Since lightweight semiconductor chips could reduce CBAM certificate costs compared with heavyweight products, IEEFA assumes that the certificate cost calculations were based on value rather than mass.

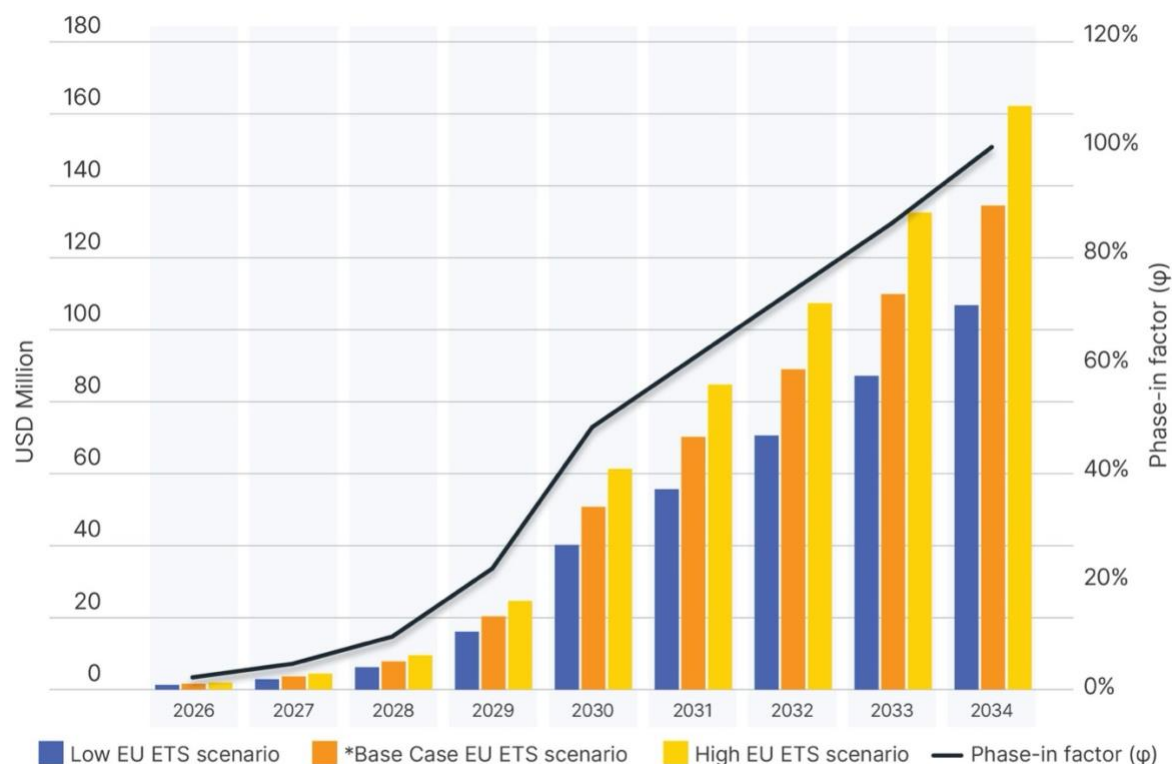
Using this approach, IEEFA estimates that up to USD162 million (approximately KRW233 billion) of CBAM certificate expenses could be incurred in 2034 under the high EU ETS scenario (Figure 10).⁶⁸

⁶⁵As of October 2025, the CBAM certificate cost calculations are based on mass (tCO₂e/t). However, there are ongoing public consultations (European Commission, [Website](#)) on using values (tCO₂e/EUR), given that the CBAM expansion will apply to downstream manufactured products which are high-value-added but low-weight, such as semiconductors (ERCST, 2024).

⁶⁶ European Commission. [CBAM: Public consultation on the extension of CBAM to downstream products](#). 02 July 2025.

⁶⁷ European Roundtable of Climate Change and Sustainable Transition (ERCST). [Including products further down the value chain in the EU CBAM](#). 2024.

⁶⁸ The actual CBAM certificate costs may differ from our simulation results depending on policy specifications, export values, currency exchange rates, and changes in embedded emission factors, among other factors, over time.

Figure 10: EU CBAM cost simulation under three EU ETS scenarios


Source: IEEFA.

According to the EU CBAM cost simulation, the EU importers of South Korean semiconductors will be required to purchase certificates from 2027 onward, based on the emissions reported by exporters. The phase-in factor, starting from 2.5% in 2026, will initially alleviate the CBAM expense. However, costs will increase exponentially by 2034, when the phase-in factor reaches 100%.

Rising EU ETS prices will also increase the CBAM expense. The EU emissions allowance price is expected to reach EUR177/tCO₂e by 2031, nearly 142% higher than in 2025, according to Bloomberg data. IEEFA estimated that the accumulated EU CBAM certificate cost will reach approximately USD588 million (KRW847 billion) from 2026 to 2034 under the high-EU ETS scenario. The base case EU ETS scenario results in a USD488 million (KRW711 billion) expense, while the low-EU ETS scenario forecasts CBAM certificate costs of USD387 million (KRW564 billion) (Table 3).

Table 3: EU CBAM cost simulation under three EU ETS scenarios

Scenario 1 - Low EU ETS				
Year	Phase-in factor (ϕ)	EU ETS forecast (USD)	CBAM certificate cost (USD)	% of total exports
2026	2.5%	87.85	1283980.53	0.1%
2027	5.0%	98.25	2896054.37	0.2%
2028	10.0%	104.85	6208534.85	0.4%
2029	22.5%	119.96	16114271.14	1.0%
2030	48.5%	137.91	40228088.01	2.5%
2031	61.0%	151.14	55688096.93	3.4%
2032	73.5%	158.69	70600884.07	4.3%
2033	86.0%	167.19	87220071.88	5.3%
2034	100.0%	175.69	106781751.87	6.5%
Scenario 2 - Base Case EU ETS				
Year	Phase-in factor (ϕ)	EU ETS forecast (USD)	CBAM certificate cost (USD)	% of total exports
2026	2.5%	109.81	1630371.35	0.1%
2027	5.0%	122.81	3670859.33	0.2%
2028	10.0%	131.06	7862251.30	0.5%
2029	22.5%	149.95	20371754.98	1.2%
2030	48.5%	172.39	50779316.32	3.1%
2031	61.0%	188.92	70228813.64	4.3%
2032	73.5%	198.36	88997738.19	5.4%
2033	86.0%	208.99	109901414.45	6.7%
2034	100.0%	219.61	134493017.19	8.2%
Scenario 3 - High EU ETS				
Year	Phase-in factor (ϕ)	EU ETS forecast (USD)	CBAM certificate cost (USD)	% of total exports
2026	2.5%	131.77	1976762.16	0.1%
2027	5.0%	147.37	4445664.29	0.3%
2028	10.0%	157.27	9515967.75	0.6%
2029	22.5%	179.94	24629238.83	1.5%
2030	48.5%	206.87	61330544.64	3.8%
2031	61.0%	226.7	84769530.36	5.2%
2032	73.5%	238.03	107394592.31	6.6%
2033	86.0%	250.79	132582757.01	8.1%
2034	100.0%	263.53	162204282.51	9.9%

Source: IEEFA.

Note: Detailed calculations of EEF and input parameters are in the Appendix.

 The simulation above was based on the following formula: $[\text{South Korea's semiconductor values exported (USD)} \times \text{Embedded emission factor (tCO}_2\text{e/USD)} \times \text{Phase-in factor (\%)}] \times [(\text{EU ETS price (USD/tCO}_2\text{e)} - \text{K-ETS price (USD/tCO}_2\text{e)})]$

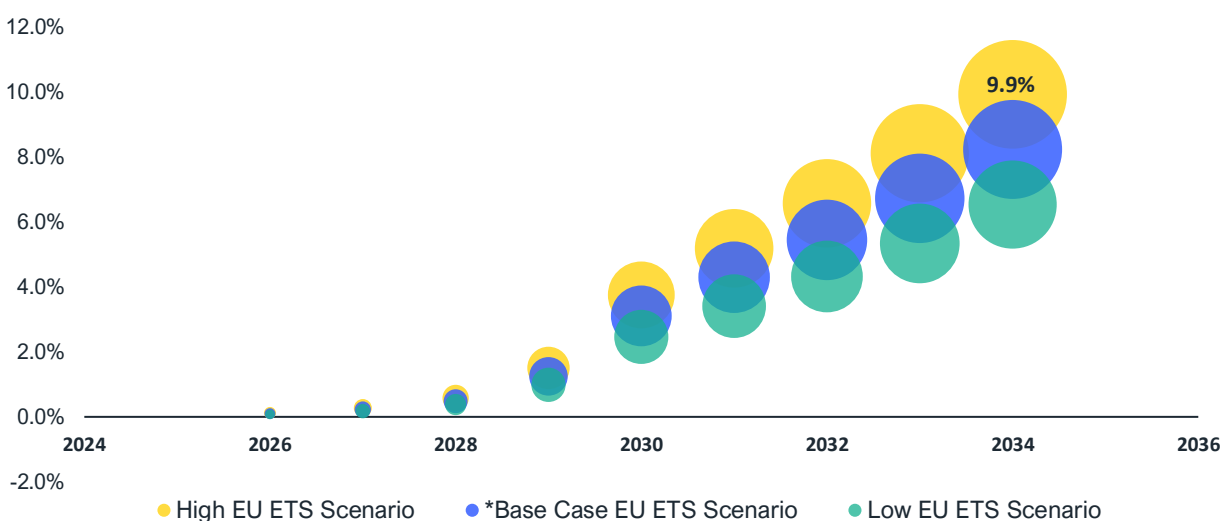
Semiconductor export values to the EU for 2024 were derived from Harmonized System (HS) Codes 8542 and 8541, based on data from the Korea International Trade Association (KITA). The EEF was

calculated as the average of Samsung DS and SK Hynix's Scope 1, 2, and 3 GHG emissions in 2024, divided by their total revenues for the same year.

The base case EU ETS prices were sourced from Bloomberg New Energy Finance, while the low and high EU ETS estimates were predicated on a 20% variation. The K-ETS price was based on August 2025 levels and assumed to remain constant.

The CBAM cost borne by EU importers could reach around 9.9% of total semiconductor exports to the EU in 2034, which could substantially undermine the price competitiveness of South Korean chips to the EU markets (Figure 11).

Figure 11: Shares of CBAM cost in total exports to EU (%)



Source: IEEFA

Note: Total export values were based on those in 2024. The shares of the CBAM cost in total exports were calculated assuming the semiconductor export values remain constant from 2026–2034.

A sharp rise in CBAM expenses for imported South Korean semiconductors could encourage European buyers to shift from high-emission producers to low-carbon providers to mitigate their CBAM financial risk. Carbon prices often pass through the supply chain, especially in raw material costs.⁶⁹ The CBAM certificate expense (a form of carbon pricing) will likely be passed on to EU buyers through higher prices for imported products. This could erode the market share of South Korean semiconductor products in the EU amid intensifying global price competition in the chip industry.

⁶⁹ Energies. [A review of carbon pricing mechanisms and risk management for raw materials in low-carbon energy systems](#). 27 June 2025.

Assuming EU importers of South Korean chips bear 100% of CBAM certificate costs, the expense of deploying those chips in downstream applications within the EU would increase.

Alternatively, in an effort to offset the negative impact of rising CBAM expenses, South Korean chip exporters to the EU may need to offer discounts to buyers to prevent them from switching suppliers. This would significantly reduce their revenues and profits. South Korea exported around USD12 billion worth of semiconductor products globally in 2024⁷⁰, with the EU accounting for approximately 14% of the total.

Given that the case study was based on South Korean semiconductor exports in 2024, the CBAM charge could significantly increase due to the upcoming LNG-powered mega-scale semiconductor clusters in Yongin, scheduled to begin operations in 2027. Additionally, expanding the CBAM scope to include LNG will sharply increase Scope 2 emissions, leading to higher CBAM and electricity procurement expenses. If CBAMs from other jurisdictions, such as the UK CBAM, are also applied, the resulting costs could significantly increase and further weaken South Korea's export competitiveness.

5. Conclusion: Navigating supply chain carbon risks in South Korea

This report examined the growing carbon risks in the supply chain faced by South Korean tech industries, with a focus on Scope 2 and 3 GHG reporting and CBAM regulations. The inclusion of Scope 2 and 3 emissions — which cover the complete supply chain, including raw materials, transportation, energy use, and even final product consumption — could significantly increase risks such as (1) investment aversion, (2) higher carbon cost exposure, and (3) counterparty and reputational risks.

The broader adoption of CBAMs could further elevate these risks for fossil fuel-reliant industries in South Korea, especially LNG-powered semiconductor clusters. This would undermine export competitiveness and raise production expenses due to (1) a large gap between EU ETS and K-ETS prices, (2) CBAM adoption by more countries, and (3) CBAM scope expansion.

Given that South Korea's economy is highly dependent on international trade, which accounts for about 70%⁷¹ of its GDP, intensifying supply chain carbon risks in key industries will impact the country's economic viability significantly. Rising supply chain carbon cost exposure in LNG-powered semiconductor clusters and fossil fuel-based AI data centers could expand counterparty risks and increase production expenses, especially when competitor markets are moving in the opposite direction.

⁷⁰ KITA. [Website](#).

⁷¹ KITA. [Website](#).

Financial investors are increasingly excluding carbon-intensive companies from their portfolios. This could limit access to financing for high-carbon intensity manufacturers, raising the cost of capital and reducing corporate valuations as a result of carbon penalties for high GHG emitters. Consequently, many companies have pledged to transition their operations to 100% renewable energy supplies. Firms with high GHG emissions are at risk of being excluded from global supply chains, which endeavor to improve carbon management across the entire supply chain.

The South Korean government is in the process of promoting RE100 industrial complexes and an 'Energy Highway' to bolster renewable energy use in various industries and streamline the integration of renewable energy in the grid.⁷² The 'Special Act on the Creation and Support of RE100 Industrial Complexes and Energy New Cities' is scheduled for enactment in 2025, while the energy highway plans target building a high-voltage direct current (HVDC) transmission infrastructure.⁷³

However, the tightening of global carbon regulations from 2026 onward, combined with a challenging international economic landscape, is expected to increase supply chain carbon risks in South Korea. The country's persistent shortage of renewable energy continues to hinder its ability to attract global data centers, affecting its industrial competitiveness. As data center investments increasingly flow to countries that can supply abundant, low-cost renewable energy, South Korea risks missing out on these attractive ventures.

IEEFA recommends the following measures for South Korea to address supply chain carbon risks and strengthen the competitiveness of its tech industry, including the semiconductor sector and AI data centers:

⁷² The inadequate grid infrastructure in South Korea was studied in an earlier IEEFA report. [Bottlenecks to renewable energy integration in South Korea](#). 05 June 2025.

⁷³ Lexology. [Trends and future prospects related to the development of the 'RE100 Industrial Complex'](#). 25 August 2025.

Key recommendations

Establish a public-private supply chain carbon risk management system to integrate national-level trade and industry policies with company-level financial strategies.

Enhance renewable energy access by addressing the chronic shortage of renewable energy supplies and expediting grid expansion and modernization.

Remove renewable energy bottlenecks in Power Purchase Agreements (PPAs) and the Renewable Portfolio Standard (RPS) to promote renewable energy procurement.

Devise financial support through government-backed funds, tax rebates, and low-interest loans for small and medium companies to address supply chain carbon risks.

Develop a domestic ETS market to buffer the impact of various carbon pricing policies, including the EU CBAM.

Strengthen international supply chain decarbonization initiatives to recognize up-to-date carbon accounting rules and regulations.

Appendix

Table 4: Scope 1-3 emissions and carbon intensity (CI) by company

Company	Scope 1	Scope 2	Scope 3	Total (tCO ₂ e)	Revenues (USD million)	CI (tCO ₂ e/USD million)	Renewable Electricity Use (%)
Samsung DS	4,489,000	13,480,000	22,900,000	40,869,000	75,805	539	24.30%
Intel	845,000	47,800	23,095,000	23,987,800	54,200	442.6	99.00%
TSMC	1,826,000	12,674,921	8,223,000	22,723,921	87,800	259	14.10%
SK Hynix	3,762,584	3,812,119	3,732,101	11,306,804	46,054	246	30.00%
Microsoft	143,510	9,955,368	15,140,000	25,238,878	245,122	103.0	78%
Apple	55,200	3,300	14,500,000	14,558,500	391,035	37	100%
Google	73,100	11,283,200	12,053,000	23,409,300	350,018	67	100%

Source: IEEFA; Company reports.

Note: Data is based on 2024. Scope 2 emissions are location-based, while Apple and Amazon's emissions are market-based.

The final CI is subject to change depending on the KRW/USD exchange rate.

Table 5: Samsung DS's Scope 1–3 financial exposure based on K-ETS

Category	Details	Emissions (tCO ₂ e)	K-ETS (USD)(10%)	K-ETS USD) 2026 (15%)	K-ETS (USD) (100%)
Scope 1	Direct Emissions	4,489,000	2,896,818	4,345,227	28,968,183
Scope 2	Indirect Emissions (Purchase of Energy)	13,480,000	8,698,844	13,048,266	86,988,440
Scope 3	Purchased products and services	3,705,000	2,390,891	3,586,337	23,908,915
Scope 3	Capital Goods	1,945,000	1,255,137	1,882,706	12,551,374
Scope 3	Fuel and energy-related activities not included in Scope 1 or Scope 2	2,398,000	1,547,465	2,321,197	15,474,650
Scope 3	Upstream transportation and distribution	183,000	118,093	177,139	1,180,926
Scope 3	Waste generated in operations	118,000	76,147	114,221	761,472
Scope 3	Business Travel	41,000	26,458	39,687	264,579
Scope 3	Employee commuting	85,000	54,852	82,278	548,518
Scope 3	Upstream leased assets	3,000	1,936	2,904	19,359
Scope 3	Downstream transportation and distribution	7,000	4,517	6,776	45,172
Scope 3	Processing of sold products	167,000	107,768	161,651	1,077,676
Scope 3	Use of sold products	14,218,000	9,175,086	13,762,630	91,750,864
Scope 3	End of life treatment of sold products	2,000	1,291	1,936	12,906
Scope 3	Downstream leased assets	1,000	645	968	6,453
Scope 3	Investments	27,000	17,424	26,135	174,235
Total		40,869,000	26,373,372	39,560,058	263,733,722

Source: IEEFA, Samsung.

Note: The assumptions of scenario analysis of K-ETS (USD) (10%) refer to free ETS allowance of 90% as of now. K-ETS (USD) (15%) refers to the revised allowance of 85% from 2026 onward, and K-ETS (USD) (100%) refers to no free ETS allowance. The formula refers to Carbon Cost Financial Exposures (USD) = Emissions (tCO₂e) × K-ETS price (USD/tCO₂e) × Paid Allocation Rate (%).

Table 6: EU CBAM cost simulation by 3 EU ETS scenarios

1. Embedded Emission Factor

	Samsung	SK Hynix
Scope 1	4,489,000	3,762,584
Scope 2	13,480,000	3,812,119
Scope 3	22,900,000	3,732,101
Total	40,869,000	113,068,04
Revenue (USD)	77,238,050,837	46,499,494,187
EEF (tCO ₂ e/USD)	0.00,052,913	0.00,024,316
EEF (tCO ₂ e/USD)	0.00038615	

Source: IEEFA, Samsung DS and SK Hynix.

Note: The embedded emission factor formula refers to Scope 1+2+3 GHG Emissions (tCO₂e) ÷ Revenues (USD). All data is for 2024. Scope 2 is location-based. The revenues are subject to change depending on the KRW/USD exchange rate.

2. Input Parameters

Input Parameters	Unit	Value
Value exports to EU (V)	USD	1633968000
Embedded emission factor (EEF)	tCO ₂ e per USD	0.00038615
Effective origin carbon cost paid (K-ETS)	USD/tCO ₂ e	6.45

Source: IEEFA, KITA, World Bank.

Note: Semiconductor export values to the EU for 2024 were derived from Harmonized System (HS) Codes 8542 and 8541, based on data from the Korea International Trade Association (KITA). The EEF was calculated as the average of Samsung DS and SK Hynix's Scope 1, 2, and 3 GHG emissions in 2024, divided by their total revenues for the same year. The K-ETS prices are based on USD/CO₂e on 01 April 2025, or the latest available prior to that.⁷⁴

⁷⁴ World Bank. [State and Trends of Carbon Pricing Dashboard](#).

About IEEFA

The Institute for Energy Economics and Financial Analysis (IEEFA) examines issues related to energy markets, trends and policies. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy. www.ieefa.org

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