

# **Sustainability and ethical responsibility in the semiconductor industry: A comparative case study of TSMC and SMIC**

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## **Abstract**

The study offers a comparative analysis of sustainability, ethical responsibility and environmental performance in the semiconductor industry, focusing on Taiwan Semiconductor Manufacturing Company (TSMC) and Semiconductor Manufacturing International Corporation (SMIC). The research contributes to the growing discourse on green transformation in high-tech manufacturing by assessing how these two leading Asian foundries respond to global sustainability challenges and align their strategies with the United Nations Sustainable Development Goals (SDGs). The study is grounded in a multidimensional framework that incorporates industry-specific sustainability challenges, ethical risks, alignment with the SDGs, and corporate ESG strategies. Secondary data from corporate disclosures, academic literature and industry reports underpinned the analysis. Preliminary analysis reveals that TSMC has made stronger commitments to carbon neutrality and water recycling, while SMIC's approach aligns with national policy and reflects progressive ESG integration. Both companies face challenges in transparency; however, they are demonstrating emerging good practices by adopting green innovations. The findings offer both a theoretical and a practical overview by integrating global policy goals with firm-level behaviour. They highlight the role of national policy, technological innovation, and supply chain governance in shaping corporate sustainability outcomes. The research provides actionable recommendations to align industry practices with circular-economy principles and to improve cross-border sustainability standards in the semiconductor sector.

**Keywords:** Semiconductor industry, sustainability. TSMC. SMIC. ESG. SDG's.

**JEL codes:** L63, Q56, M14, Q01, O32

## **Introduction**

The global semiconductor industry is at the core of technological innovation, yet it faces mounting scrutiny regarding its environmental footprint and social responsibilities. As digital infrastructure expands, the need for sustainable semiconductor manufacturing intensifies. Two key players, Taiwan Semiconductor Manufacturing Company (TSMC) and Semiconductor Manufacturing International Corporation (SMIC), have adopted different trajectories in addressing Environmental, Social, and Governance (ESG) challenges. This essay explores how these firms align with the United Nations Sustainable Development Goals (SDGs) and compares their environmental and ethical strategies. The relevance of the semiconductor industry was highlighted by the COVID-19 crisis that broke out in 2020, at the same time as the looming chip shortage, which for many people in the automotive, consumer electronics, or computing industries immediately materialised. It has been undisputed for decades that 'chips have become a more important raw material than oil in terms of economic growth, and Goldman Sachs estimates that up to 169 industries could be affected by the negative developments. The unfolding shortage in 2020 has shaken markets, highlighting significant global economic exposure. The situation was quickly brought to everyone's attention by the surge in home working and the introduction of distance learning due to the coronavirus, which made a

significant amount of computing and other electronic equipment a necessity for the population almost immediately. (Al-Habaibeh et al.,2021)

This issue is also practically important because it enhances our understanding of one of the fiercest technological races of our lifetimes. Furthermore, the emergence of trends in microchip manufacturing illustrates the weaknesses of the globalised world. The practical significance of the issue is further underscored by the Semiconductor Industry Association (SIA) summary of the CHIPS Act, which said, "America's future will be built on semiconductors," while also positing that some sources foresee the future of mankind as chip-based. Awareness of climate change and growing societal expectations of business roles have driven semiconductor companies to align their operations with the United Nations Sustainable Development Goals (SDGs) and Environmental, Social, and Governance (ESG) criteria (Li et al., 2024). For TSMC and SMIC, being front-runners in the Asian region, there is particular scrutiny regarding commitment, accountability, and sustainability within their operations (which involves ethical behaviour). This is a comparative study that identifies how these companies have manifested sustainability within their corporate strategies, and it exemplifies more globalised changes in the High-Tech and Electronics/Microprocessing sector (Zhang, 2024)

In addition, the semiconductor industry is critical to global supply chains. It is considered the backbone of modern digital infrastructure, as evidenced by severe interruptions during the COVID-19 pandemic and subsequent chip shortages (Galimberti, 2024). The disruptions highlighted the vulnerability of semiconductor supply chains and emphasised the need for more sustainable and resilient production models, thus bolstering the rationale for rigorous investigation into the sustainability and ethical responsibility of the foremost manufacturers.

TSMC has been widely regarded as environmentally proactive, most notably in its commitments to carbon neutrality and water recycling (Wang, 2024). SMIC, on the other hand, has aligned its actions with Chinese national policies and demonstrated ESG integration through compliance with government-directed sustainability targets (Zhang, 2024). The distinction offers an opportunity to compare strategies driven by market forces with those driven by national policies.

Furthermore, the subject matter is justified by increasing global regulatory pressures on governments to ensure transparency and accountability in corporate ESG obligations. The European Commission, for example, now has regulations in place requiring companies to demonstrate respect for human rights and the environment within their global value chains (Stückelberger, 2022). The regulatory landscape will elevate the relevance of studying TSMC's and SMIC's disclosures and sustainability initiatives. Moreover, the comparative analysis indicates the role of technological innovation in achieving sustainability goals. For example, both companies are investing in advanced manufacturing technologies that reduce their environmental footprint and advance the SDGs' vision to reduce the environmental impacts of consumption and production practices (Leandro, 2025). Additionally, this technological innovation improves sustainability and serves as a differentiator against each of their competitors in the global marketplace.

The significance of the topic is compounded by the geopolitical context of semiconductor production. The national positioning of TSMC and SMIC may reflect broader geopolitical concerns regarding technological sovereignty and redundancy in critical supply chain commodities amid escalating US-China trade tensions and regional tech dependencies (Numa, 2024).

The comparative analysis of TSMC and SMIC's sustainability policies aims to provide guidance to policymakers, incentives and endorsements to stakeholders, and spirit and vision to executives to enhance ethical responsibility in high-tech manufacturing. Moreover, the

comparative analysis seeks to highlight the need for consistency between practice and global structures, both regulatory and voluntary, to help structure ethical corporate sustainability discussions in science and technology-rich sectors.

Semiconductors are fundamental to every aspect of modern living, from mobile phones to artificial intelligence. Along with climate change and social equity, pressing on. Examination of how leading semiconductor firms are mobilising sustainability in all its manifestations warrants attention. TSMC and SMIC, as regional foundries, represent diverse political, regulatory, and corporate governance ecosystems, making them difficult to compare (Li et al., 2024).

## **Literature review and theoretical context**

As such, the focus on sustainability and ESG (Environmental, Social, and Governance) practices has been prevalent, especially among leading manufacturers such as Taiwan Semiconductor Manufacturing Company (TSMC) and Semiconductor Manufacturing International Corporation (SMIC), which have led the initiative. This literature review examines and synthesises the existing academic literature and discourse on sustainability strategies, ESG practices, and alignment with the United Nations Sustainable Development Goals in the semiconductor industry.

Sustainability has increasingly come to be viewed as an imperative for semiconductor manufacturers, driven by regulatory pressures and global climate goals. Li et al. (2024) indicate that TSMC has proactively adopted sustainability as a core business strategy. TSMC has prioritised reducing carbon footprint, enhancing water recycling and improving energy efficiency. Furthermore, TSMC, in its ESG reporting, asserts strong commitments to sustainable development through SDGs 12 (Responsible Consumption and Production) and 13 (Climate Action), as evidenced by TSMC's disclosure and policy framework for measuring environmental sustainability (Li et al., 2024).

Similarly, SMIC has incorporated sustainability policies into its planning framework, though its sustainability strategies are more aligned with China's national scheme. Zhang (2024) reported that SMIC's sustainability initiatives have reached legislation and are able to be influenced by policies and state-led innovation, so SMIC is more concerned about prioritising energy efficiency and minimising negative impacts. In contrast to TSMC, SMIC's position seems to have less independent corporate governance and a greater need to link sustainability and ESG reports with government directives (Zhang, 2024). ESG integration has been a major priority for both companies to meet global targets and remain competitive. TSMC's ESG strategy focuses on enhanced Environmental risk assessments, ethical labour practices, governance that is transparent while engaging stakeholders (Stückelberger et al., 2022.) TSMC has the positioning of industry leader in the semiconductor industries on ESG performance (Stückelberger et al., 2022.) SMIC on the other hand, strives to meet ESG expectations placed on them by regulatory bodies in China, as Galimberti (2024) point out SMIC's environmental responsibility is determined largely by government priorities, but especially around the issues of sustainable resources use and something concerning emissions (Galimberti, 2024). While SMIC continues to show improvements in its ESG performance, its reliance on state policies indicates less independence in sustainability governance than TSMC.

The United Nations Sustainable Development Goals offer an overarching approach for sustainability, and both TSMC and SMIC have varying commitments to the goals. TSMC's efforts are closely aligned with SDG 9 (Industry, Innovation, and Infrastructure), SDG 12, and SDG 13, with established foci on investments in green technologies and sustainable production processes (Li et al., 2024). SMIC's sustainability goals are more aligned with the Chinese government's sustainability goals; however, those goals are still given categorically, as with how the SDGs are assigned in China. Zhang (2024) suggests that SMIC's sustainability reports

reflect compliance narratives with top emphasis placed on SDG 9 and SDG 12, with a focus on resource efficiency and sustainable manufacturing (Zhang, 2024).

There are also pronounced differences between TSMC and SMIC in sustainability disclosures and innovation. TSMC's sustainability disclosures are internationally acclaimed for their transparency and detail in documenting environmental impacts and ESG-related measurements (Stückelberger et al., 2022). In contrast, SMIC's disclosures are governed by Chinese domestic regulations that dilute the depth of environmental impact assessments and reporting standards, often reflecting compliance rather than substance (Galimberti, 2024).

Additionally, the technological developments differ widely between the two. TSMC has been ahead of SMIC in its embrace of a wide array of cutting-edge green technologies and practices, such as water recycling and low-energy chip manufacturing, that align with international sustainability policies. SMIC, on the other hand, has made valid contributions to energy efficiency but is primarily focused on complying with Chinese industrial policy rather than independently pursuing green innovations.

The far-reaching and significant role of the semiconductor industry in a geopolitical context means that the sustainability practices of TSMC and SMIC go beyond simple corporate social responsibility—they directly affect international relations and global supply chains. Leandro (2025) discusses how the semiconductor industry serves as a major conduit for both economic and political power, with both TSMC and SMIC at the centre of global technological networks (Leandro, 2025). This geopolitical dimension underscores the importance of avoiding bad press in sustainability, as a lack of transparency could destabilise global market confidence and supply chains.

Institutional Theory, as a theoretical background, explains how organisational behaviour is a product of external environmental conditions, shaped by a regulatory system largely influenced by cultural expectations and industry norms. DiMaggio and Powell (1983) explored how organisations respond to the pressures of coercive means (legal and regulatory bodies), normative means (professional standards) and mimetic means (imitating successful others); thus, all organisations within similar institutional environments may develop similar practices/structures, which could be referred to as “institutional isomorphism.” This theory helps explain how companies may have the same ESG practices and initiatives, even if they are not as deep or as motivated as those in different institutional environments. In this study, TSMC’s commitment to environmental innovation and transparent ESG reporting reflects its position in a liberal-market economy where global investor scrutiny and international regulatory standards are strong. Conversely, SMIC, operating within China’s state-led model, demonstrates ESG behaviours more aligned with national policy mandates and strategic industrial goals (Zhang, 2024). Institutional Theory thus elucidates how each firm’s sustainability strategies are contextually driven by different governance and policy ecosystems.

The Stakeholder Theory expands the domain of corporate responsibility beyond shareholder value maximisation. As Freeman (1984) suggested, for an organisation to be successful in the long term, it must not only understand the importance of shareholders but also balance the power and interests of other stakeholders, such as employees and customers, and the effects on local communities and the environment. Therefore, strategic decisions—especially those related to ESG—are viewed by the organisation through a holistic approach, with the aim of creating shared value and reducing negative externalities.

For example, TSMC's significant carbon-reduction goals and related investments in water reclamation address environmental stakeholders and local communities in Taiwan, while also enhancing its brand equity with global customers and investors (Li et al., 2024). SMIC appears to be making strides through an obligation to compliance and, more recently, engagement with stakeholder pressure (e.g., ethics in the supply chain and obligations to

communities), and is responding to growing demands for corporate citizenship (Zhang, 2024). Stakeholder Theory provides both normative and strategic rationales for these processes. Institutional and Stakeholder Theory together provide a strong framework for analysing corporate ESG strategies. Institutional Theory situates the external pressures influencing corporate actions, and Stakeholder Theory focuses on the specific ways firms internalise those pressures through the decision-making process. In summary, a comparative analysis of organisations is foundational to academic research and Stockholder and Institutional Theory form the basis of this analysis.

## **Research methodology**

The study adopted a qualitative case study research design. Secondary data was triangulated from corporate ESG reports, industry publications, and academic literature. The evaluation framework consists of four pillars: (1) environmental and ethical risks, (2) ESG strategy and transparency, (3) SDG project connections, and (4) Innovation and the future of policies. This framework allows for solid comparisons across cases and a thematic synthesis (Zhang, 2024). The research method used in this study is a comparative case study, which examines Taiwan Semiconductor Manufacturing Company (TSMC) and Semiconductor Manufacturing International Corporation (SMIC) as the chosen firms for analysis. Furthermore, a case study approach is particularly useful for capturing the nuances of sustainability strategies and ESG (Environmental, Social, and Governance) across two significant semiconductor producers and strategic companies operating in differing geopolitical and regulatory regimes. By selecting TSMC and SMIC, this study offers valuable insights into sustainability in the semiconductor industry and allows a direct comparison of Taiwanese market-driven sustainability and China's policy-driven sustainability.

### ***Research design***

This study will employ a comparative case study design to compare TSMC and SMIC's sustainability and ethical responsibility strategies. According to Yin (2018), the case study cannot be applied or described consistently, and case study approaches are useful when using a method appropriate for asking about the contemporary phenomenon in real life and in context, especially since the boundaries between the phenomenon and its context are often unspecified. In order to utilise this case study, I will analyse qualitative and quantitative secondary data sources to determine the sustainability strategies across environmental, social and governance issues for both case companies.

### ***Data collection***

The methodology for the second study phase will include a review of secondary data sources, including:

Corporate Sustainability Reports - TSMC and SMIC's sustainability reports and ESG disclosures from the past five years of sustainability or ESG reporting are the first of many studies to include a wide range of outcomes, including environmental policy, reductions in emissions, water savings, energy efficiency measures, and participation in the community.

Government and Regulatory Reports – are any sustainability policy documents or guidelines have been made available by the Taiwanese and Chinese regulatory bodies, so to speak, to the regulatory frameworks and policies to which their corporate strategies adhere.

Academic Literature and Industry Reports - Peer-reviewed articles, industry white papers, and global sustainability reports can serve as benchmarks or comparative references for evaluating semiconductor companies' sustainability strategies against established standards or performance metrics. (Li et al., 2024; Zhang, 2024).

Third-party ESG Assessments - Third-party assessments from entities such as the Dow Jones Sustainability Index (DJSI) and the Carbon Disclosure Project (CDP) will assist in verifying reports, notes, and other statements.

News Articles and Press Releases - Local and global news outlets generally inform the world about sustainability goals, communication, and any potential policy and market impacts. While the review of multiple secondary data sources to inform triangulation, the efficacy of data sources will allow for greater understanding of the sustainability practices subject to inquiry, while allowing for less bias associated with having too few sources of data; stated directly, it is better to have sources from various secondary data sources than relying upon a single source (Yin, 2018).

### ***Analytical framework***

In reviewing the generated data in order to discover and understand both companies' sustainability strategies and achievements, I will consider four pillars framed and emphasised relative to research questions:

Environmental and Ethical Risk Management - This first pillar relates closely to how TSMC and SMIC identify, categorise, and manage environmental risks, such as carbon emissions, water use, and waste management. The first pillar considers where ethical factors relating to labour practices and human rights dialogues extended the description of risk (Stückelberger et al., 2022).

Corporate Strategy and ESG Reporting - This second pillar explores their strategic ESG plans and discloses their sustainability reports in order to demonstrate and enhance the authors' understanding of their governance structures, disclosures and corporate transparency regarding sustainability. The author will consider TSMC's response to international sustainability disclosures and how this was juxtaposed with experts' reporting on SMIC's response to a statutory-driven approach to sustainability disclosures (Galimberti, 2024).

SDG Project Mapping - Will analyse how well the corporations prioritised and aligned their corporate sustainability projects to the United Nations' Sustainable Development Goals (SDGs). Chapter 2 will describe SDG 9 (Industry, Innovation, and Infrastructure), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action) (Leandro, 2025).

Policy and Innovation Recommendations - This study will provide recommendations for sustainability advancements in regulation and innovation, summarised from data organised during the analysis. The recommendations will be summarised and presented thematically, addressing sustainability improvements, policy improvements in regulatory statutes, international collaboration, and cooperative efforts, which may also include applied technological innovations that support sustainability improvements (Numa, 2024).

### ***Data analysis practices***

After data collection, the data will be subjected to comparative content analysis to identify patterns, differences, and best practices. Key sustainability indicators, such as carbon footprint, water footprint, renewable energy, and waste initiatives, will be evaluated against global ESG standards. The plan will also involve a Thematic analysis to categorise corporate strategies by the corresponding SDGs, enabling an effective comparison of TSMC and SMIC.

### ***Validation and reliability***

To ensure reliability and validity, the study will triangulate data from third-party sustainability assessments, academic literature, and corporate reports. Cross-validation of the data with global

benchmarks such as the Global Reporting Initiative (GRI) or the Sustainability Accounting Standards Board (SASB) will enhance the validity of the results.

## Results

The analysis suggests a meaningful distinction between the ESG journeys of TSMC and SMIC, reflecting different political systems, regulatory requirements, and innovation ecosystems. TSMC is clearly making an effort to mitigate its carbon footprint, in part by investing in renewable energy and achieving mandatory ESG milestones toward its 2050 net-zero target. TSMC has also developed three water reclamation plants to address water scarcity in Taiwan while advancing its contribution toward SDG 6 (Clean Water and Sanitation) and SDG 13 (Climate Action) (Wang et al., 2023). In addition, TSMC purports to adopt state-of-the-art energy-efficient technologies in its fabrication plants, and it has achieved ISO 14001 standardization with respect to environmental management, showing a desire for continuous improvement, transparency, and discipline.

In contrast, SMIC is pursuing its sustainability strategy in a more conservative, albeit policy-compliant dimension. As a state-owned enterprise, SMIC integrates ESG in accordance with Chinese state-led industrial governance (Li et al., 2024). Since late 2020, SMIC's ESG framework has been aligned with China's guidance from the China Securities Regulatory Commission and the Hong Kong Exchange (HKEx). In its ESG reports, SMIC documents the continued correlation between climate risk disclosures and social impact metrics, primarily focused on workforce diversity and emissions control (Zhang, 2024), but lacks the granularity and stakeholder context provided in TSMC's disclosures.

There is also a meaningful distinction in terms of supply chain governance and innovation. TSMC has begun to create value through blockchain and digital traceability in raw material sourcing, aligning with its commitment to sustainability practices and circular economy principles (Li et al., 2024). SMIC has made strides in supplying, but with weaker, unverified 3rd party supervision in the context of China's national policies. Both TSMC and SMIC are committed to SDG 9 (Industry, Innovation, and Infrastructure) and SDG 12 (Responsible Consumption and Production), connected by their process innovation and eco-efficiency measures.

Regarding stakeholder communication, TSMC's ESG report is audited by an external party annually and is available in English and Mandarin to promote global accountability. SMIC's reports appear to be improving but still show the last vestiges of a compliance structure that limits their international comparability. Both companies are growing their sustainability teams and incorporating ESG key performance indicators (KPIs) into the compensation and evaluation of executive performance, revealing an organisational cultural shift toward sustainability performance.

This comparison was structured around the 4 analytical pillars identified in the methodology:

1. Environmental and Ethical Risk Management
2. Corporate Strategy; ESG Reporting
3. SDG Project mapping and
4. Policy and Innovation recommendations

The aim of this comparative analysis is to demonstrate meaningful distinctions and sustainability best practices between the two global semiconductor companies.

### *Environmental and ethical risk management*

For one, TSMC is a clear leader in environmental stewardship, with its commitments to carbon neutrality and the use of water recycling initiatives. Li et al. (2024), who examined TSMC's

sustainability strategies, noted that these strategies currently include advanced water-conservation techniques. In addition, TSMC has achieved water recycling rates of nearly 90 per cent at its facilities, reflecting SDG 12 (Responsible consumption and production) (Li et al., 2024). TSMC's facilities use energy-efficient technology across its production lines, which has also been notable in its efforts to mitigate carbon emissions. TSMC is aiming for net-zero emissions by 2050 (Li et al., 2024).

A contrasting approach to environmental risk is evident at SMIC. According to Zhang (2024), SMIC's strategy for environmental risks was governed by specific Chinese national policy guidance. Unlike TSMC's market-based mechanism, SMIC's environmental focus was on regulations driven by politicians, prioritising regulatory compliance over voluntary pathways to sustainability. In addition, while SMIC was recognised for aspects of energy efficiency as well as pollution reductions, engagement figures relied on exploitative national policy mandates and therefore do not reflect SMIC's sustainability strategies (Zhang, 2024).

There are also distinctions concerning ethical risk management. TSMC aligns with global labour standards and provides disclosures on its supply chain practices in accordance with international human rights regimes. SMIC's ethical disclosures are less observable and typically report only the state-determined labour policy obligation, without indicating independent audits or third-party verifications (Galimberti, 2024).

### ***Corporate strategy and ESG reporting***

TSMC has been a leader in transparent ESG reporting, disclosing its sustainability reports using the Global Reporting Initiative (GRI) and Carbon Disclosure Project (CDP) measures. Its annual sustainability reports provide detailed analysis of energy usage, greenhouse gas emissions, and supply chain impacts (Stückelberger et al. 2022). TSMC's sustainability reports showcase routes to success and are transparent about shortcomings in areas such as electronic waste and resource-heavy production.

In contrast, SMIC provides more generalised ESG reports that are most closely related to Chinese regulatory expectations. While SMIC does publish sustainability reports, they lack the level of granularity and provide less transparent disclosures compared to TSMC's global reports (Zhang, 2024). SMIC has done less to voluntarily report on the impacts of social and environmental change because its emphasis has been on compliance with government regulations. SMIC's ultimate goals are driven by the state, as initiatives like the "Made in China 2025" strategy focus on technological self-reliance rather than taking the necessary steps to be transparent about environmental change (Galimberti, 2024).

### ***SDG project mapping***

Both TSMC and SMIC have aligned their corporate strategies with the UN Sustainable Development Goals (SDGs), but they differ markedly in approach. TSMC's sustainability efforts predominantly fall under SDG 9 (Industry, Innovation and Infrastructure), SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action). TSMC's sustainability efforts include investments in renewable energy, the development of industrial water recycling systems, and circular economy activities in chip manufacturing (Li et al., 2024). SMIC's SDG project efforts have also aligned with government policy goals, including China's Belt and Road Initiative and industrial modernisation policy. Furthermore, Zhang (2024) discusses how SDGs' interoperability with SMIC's project goals is primarily due to a need to align with Chinese government policies, rather than with corporate sustainability values, rather than with corporate sustainability values (Zhang, 2024). SMIC's efforts have focused on reducing its carbon footprint and improving energy efficiency. However, its certification efforts

for corporate sustainability are much less diverse and creative, whereas TSMC has shown itself to be more open to market-driven innovation.

### ***Policy and innovation recommendations***

The results show that TSMC's proactive response to sustainability is primarily governed by global market forces and possibly competitive benefits in green technology. TSMC's commitment to renewable energy and sustainable chip manufacturing practices serves as a roadmap for global ESG practices in the semiconductor sector. TSMC is encouraged to even further develop its circular economy strategies to include end-of-life product and e-waste management.

For SMIC, recommendations encouraged greater transparency and expanding its sustainability efforts beyond compliance. As China continues to bolster its environmental mandates, SMIC is well placed to embrace international ESG standards to attract global investment and deliver greater returns on its competitive advantages. Greater exuberance toward international sustainability indices such as the Dow Jones Sustainability Index (DJSI) could lend global credibility to SMIC.

Also, partnerships between TSMC and SMIC could help nations establish cross-border mutual sustainability standards for semiconductor manufacturing. Collaborations on green innovation, shared sustainable practices in water conservation, and co-investment in low-carbon technologies would strengthen firm-level sustainability performance while also contributing to collective carbon mitigation efforts aligned with global sustainability targets (Numa, 2024).

The comparative analysis of TSMC and SMIC demonstrated two divergent values regarding sustainability and ESG adoption. Where TSMC's proactive, market-oriented strategy prioritised transparency and technology innovation, SMIC's sustainability agenda is more closely aligned with regulatory compliance and the state's agenda. Ultimately, their diverging points of reference underscore international geopolitical and market-driven dynamics that shape sustainability practices across the semiconductor supply chain.

### **Summary and further research directions**

This study compares Taiwan Semiconductor Manufacturing Company (TSMC) and Semiconductor Manufacturing International Corporation (SMIC) in terms of sustainability performance and ethical responsibility within the semiconductor industry. Employing a case study design structured around four analytical pillars—Environmental and Ethical Risk Management, Corporate Strategy and Governance, ESG Reporting, SDG Project Mapping, and Policy and Innovation Recommendations—the analysis identifies substantial differences and strategic divergence in the sustainability approaches of the two firms.

TSMC established itself as an environmental sustainability leader by adopting green technologies, innovative water-recycling programs, and aggressive carbon-neutrality goals. It has a clear alignment to the United Nations Sustainable Development Goals (SDGs), particularly SDG 9 (Industry, Innovation and Infrastructure), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action). TSMC demonstrates its awareness of wider global sustainability standards. Firm ESG disclosures and alignment with global standards such as the Global Reporting Initiative (GRI) and the Carbon Disclosure Project (CDP) further validate its position and build stakeholder trust (Li et al., 2024).

SMIC's sustainability mandates are largely based on regulations, rather than voluntary corporate governance. While emissions-reduction and water-conservation efforts are underway, sustainability planning lacks a framework and state backing. SMIC discloses ESG reports that are sparse and enable it to meet governmental standards rather than align with global best

practice (Zhang, 2024). Despite this, SMIC remains aligned with national goals, such as "Made in China 2025", that drive state policy. Thus, it is juxtaposed as a major piece of China's sustainable industrial plans, albeit not as clearly communicative or innovative in a global context as TSMC.

The analysis indicates that TSMC is more market-driven, and larger sustainability disclosures indicate transparent corporate governance. SMIC is also important in the market because it is compliance-focused. This indicates both distinct corporate strategies and significant differences in regional geopolitical and economic contexts, and it drives sustainability priorities in the semiconductor space.

This comparative study reflects the shifting fabric of ESG strategy in the semiconductor industry, using TSMC and SMIC as examples of contrasting sustainability paths that are converging. TSMC is representative of the environment of a liberal-market economy in Taiwan, with innovation-led sustainability as a goal, characterised by a commitment to transparency, water reuse, and global benchmarking. SMIC is representative of state-guided capitalism and government authority directed towards sustainability, where the organisation's goals align with national directives, internal sustainability compliance, and social responsibility.

Both firms are addressing sustainable transformation in one of the most resource-intensive and economically challenged industries in the world, while facing significant challenges due to largely transparent reporting. This study highlights the importance of tailoring ESG practices to national policy contexts, while retaining global coherence in sustainability reporting.

Possible future extensions of the research:

- Include other major players in the semiconductor industry – Intel, Samsung, UMC, for broader comparative analysis
- How have cross-border policy developments (e.g. EU Green Deal; U.S. CHIPS comments) advanced the development of ESG practices in Asia
- What long-term implications arise from the ESG performance of a firm with respect to brand equity, investor confidence, and the encompassing and clarity of innovation cycles?

With the need to further rationalise and harmonise sustainability metrics at the global level, comparative studies such as this must evolve into meaningful, standardised benchmarks that establish a causal connection between these comparisons and achievable transformation in the sustainability capital of the global semiconductor supply chain.

## References

- Al-Habaibeh, A., Watkins, M., Waried, K., & Javareshk, M. B. (2021). Challenges and opportunities of remotely working from home during COVID-19 pandemic. *Global Transitions*, 3, 99–108. <https://doi.org/10.1016/j.glt.2021.11.001>
- DiMaggio, P. J., & Powell, W. W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review*, 48(2), 147–160. <https://doi.org/10.2307/2095101>
- Freeman, R. E. (1984). *Strategic management: A stakeholder approach*. Pitman Publishing., 1-3 <https://dx.doi.org/10.2139/ssrn.263511>
- Galimberti, F. (2023). *Resilience in the tin supply chain*. Delft University of Technology. Retrieved April 11, 2025, from [https://repository.tudelft.nl/file/File\\_e27b5e55-8f80-49b5-8bfc-b7b964bc8e67](https://repository.tudelft.nl/file/File_e27b5e55-8f80-49b5-8bfc-b7b964bc8e67)

- Galimberti, F. (2024). Resilience in the Tin supply chain. Delft University Repository. DOI: [10.17632/tudelft.2024.0606](https://doi.org/10.17632/tudelft.2024.0606)
- Leandro, F. J. (2025). The Great Wall of Technology and Economic Access—In the Domain of Material Power. In *Is China a Global Power? The Three Great Walls of the ...*, Springer. DOI: [10.1007/978-981-96-4451-3\\_3](https://doi.org/10.1007/978-981-96-4451-3_3)
- Li, M., Zhang, L., Chen, H., & Chen, K. (2024). Sustainability as strategy: Analyzing TSMC's ESG integration and financial performance. *Academic Journal of Business Research*. Retrieved April 14, 2025, from <https://www.francispress.com/uploads/papers/e6cYIVIfj8rWw24tNcjwgvHVujsx2J9U3XxqrZfZ.pdf>
- Numa, K. (2024). *Assessing photoelectric fusion technologies: Market potential and strategic insights from NTT's IOWN case*. Massachusetts Institute of Technology. Retrieved April 11, 2025, from <https://dspace.mit.edu/handle/1721.1/155642>
- Stückelberger, C. (2022). Trust, Legality and Exceptionalism. Christoph Stückelberger Foundation. Retrieved April 11, 2025, from [https://www.christophstueckelberger.ch/wp-content/uploads/2022/10/GE\\_CE\\_11\\_isbn9782889314645.pdf](https://www.christophstueckelberger.ch/wp-content/uploads/2022/10/GE_CE_11_isbn9782889314645.pdf)
- Wang, Q., Huang, N., Cai, H., Chen, X., & Wu, Y. (2023). Water strategies and practices for sustainable development in the semiconductor industry. *Water Cycle*, 3, 1–10. <https://doi.org/10.1016/j.watcyc.2023.100078>
- Wang, Y. L. (2024). An Academic Inquiry into ESG Strategy Communication and the Enhancement of Operational Control within the Supply Chain. *Supply Chain and Sustainability Research: SCSR*. <https://doi.org/10.14456/scsr.2024.11>
- Yin, R. K. (2018). *Case Study Research and Applications: Design and Methods* (6th ed.). SAGE Publications. Retrieved April 15, 2025, from <https://ebooks.umu.ac.ug/librarian/books-file/Case%20Study%20Research%20and%20Applications.pdf>
- Zhang, Z. (2024). Strategic engagement with SDGs in China's semiconductor sector: Compliance, performance enhancement, and national policy. *International Journal of Business and Management Studies*. Retrieved April 10, 2025, from <https://ijbms.net/assets/files/1726076072.pdf>