# Important issues and systemic challenges of the net-zero transformation of Taiwan's semiconductor industry

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Amid the global net-zero transformation wave, Taiwan's semiconductor industry faces multiple core issues and systemic challenges. The key to its transformation includes international supply chain restructuring, energy system adjustments, technological breakthroughs, and policy framework development. These areas are closely interlinked, forming a highly complex and dynamic system.

## International pressure and policy trends

With international giants such as Apple, Google, and Microsoft requiring carbon neutrality for their supply chains, and mandatory carbon reduction regulations in various countries coming into effect, Taiwan's semiconductor industry is facing cost pressures and changes in the competitive landscape. Although the industry has responded to the needs of sustainable development, such as participating in the RE100 initiative and investing in renewable energy, actual progress has been limited. While international regulations have not yet directly included the semiconductor industry in the scope of mandatory carbon reduction, the EU Carbon Border Adjustment Mechanism (CBAM) may eventually cover products such as semiconductors, which are highly dependent on upstream raw materials and heavily reliant on electricity. Taking TSMC as an example, if outsourced electricity is included in the scope of CBAM taxation, carbon costs will increase significantly, affecting the industry layout and pricing strategy. In addition, international sustainable regulations promote the establishment of new technology standards for the supply chain, and Taiwanese companies must balance technological autonomy with international certification needs.

## Energy structure and green electricity dilemma

Taiwan's semiconductor industry accounts for more than 80% of carbon emissions in Scope 2 (electricity use), and green power procurement has become the primary way to achieve net zero. However, green power trading platforms are constrained by multiple realities such as market structure, supply shortages, and policy-driven

approaches, resulting in a large discrepancy between the carbon reduction timeline of enterprises and the actual amount of green power purchased, and thus the uncertainty of green power supply needs to be included in risk assessment.

International certification standards such as GO and I-REC require high transparency and traceability. In the future, semiconductor products may be included in the scope of mandatory carbon footprint disclosure, and supply chain carbon reduction will become an indispensable component.

## Geopolitics and technological autonomy

As the US-China technological competition intensifies, low-carbon technology has become a strategic asset. Export controls and regional technology alliances have prompted Taiwan's semiconductor industry to reassess the supply chain risks of emission reduction equipment. Although there has been some progress in local R&D, there remain gaps in material durability and system integration, resulting in high transition costs. This is particularly evident in the field of hydrogen energy applications. Import dependence increases the cost of obtaining low-carbon energy and limits the diversity of process decarbonization solutions. In light of the growing investment by international giants in green hydrogen supply chains, local companies need to choose between deepening international cooperation and investing in indigenous R&D.

## Financial innovation and risk control

Climate finance instruments such as sustainability-linked loans and carbon rights pledges can theoretically ease the financial pressure on small and medium-sized enterprises, but in practice, due to issues such as baseline setting and fluctuations in collateral valuation, the financing incentive effect is limited. Taiwan's carbon rights have low international liquidity, which affects their market acceptance as collateral. In the future, it is necessary to establish a cross-departmental coordination platform to integrate environmental science, financial engineering and legal expertise to develop an assessment model that reflects decarbonization potential and actual market conditions.

## Issue independence and policy recommendations

Although the issues of the semiconductor industry's net zero transformation are interrelated, each retains a degree of independence. Corporate internal governance, technology research and development, financial planning and other aspects can operate relatively independently and will not change comprehensively with fluctuations

in green electricity supply or minor adjustments to international standards. Green electricity trading platforms and renewable energy development are constrained by market structure and geographical conditions, and policy formulation also has its own independent logic. The evolution of international standards such as CBAM and ISO 14064 is affected by geopolitics and will not change due to a single company or region. Each node in the supply chain faces different challenges, and the carbon reduction path can develop independently.