



BEYOND TECH HORIZONS

*Navigating South Korea's
growing semiconductor industry
in a sustainability focused landscape*

INTRODUCTION

The global semiconductor industry has not been immune to the challenges presented by the pandemic and the ongoing effects of climate change. Since 2020, these challenges, along with the accelerated digital transformation have put unprecedented pressure on the industry resulting in factory closures and chip shortages. What is increasingly evident, is a global need for a robust and resilient semiconductor value chain.

Forecasts indicate that the global semiconductor market will double by 2030 from its current value of USD 550 billion to an estimated USD 1 trillion. This growth will be primarily driven by increasing digitalisation of electrical devices, industrial machines, and vehicles.

South Korea, one of the largest semiconductor markets, has embarked on a semiconductor journey, backed by government initiatives, including the *K-Semiconductor Strategy* and *K-Chips Act*, aiming to establish the country as a global chip powerhouse in both memory and system chips by 2030.

However, semiconductor production is known for its high energy consumption, so it is crucial the industry recognises and starts to address the environmental impact while also meeting the market demands. South Korea has taken significant steps in this direction by setting a goal to be carbon neutral by 2050 and revising its NDC to include low carbon transition strategies for energy-intensive sectors. Major players in the country have pledged to pursue ambitious targets for reducing greenhouse gas emissions in their production processes, aligning with the global effort to combat climate change and advance chip technologies.

This report provides insights into South Korea’s current market dynamics amid the digital transformation and green transition. It also explores how Swedish companies can contribute to this transformation by fostering innovation and sustainable growth in the semiconductor industry, achieving global and domestic climate goals.



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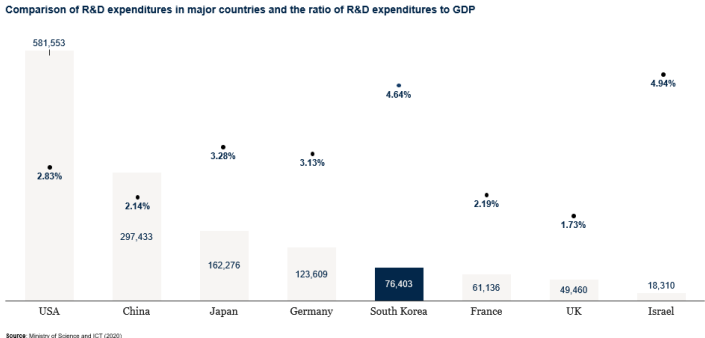
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A PATH TO THE FUTURE

Semiconductors are seen as the foundation of the tech industry, and colloquially in South Korea this importance is reflected by the fact that they are referred to as the ‘rice of the electronics industry’ With the establishment of *Korea Semiconductor* in 1974 (later merged with Samsung), the semiconductor industry has emerged as a crucial pillar of the South Korean economy, accounting for an average of 20 per cent of the nation’s total exports over decades.

The semiconductor industry, known for its high capital and knowledge intensity, has seen significant growth in South Korea due to substantial investments from both public and private sectors. Amongst OECD members, South Korea ranks as one of the top five spenders on research and development, with approximately five per cent of GDP allocated to R&D expenses. This places the country second only to Israel in terms of R&D investment relative to its economy.



In 2022, South Korea maintained its prominent position in the global semiconductor market, dominating an 18 per cent share with sales volume of USD 105 billion. This achievement has consistently secured its place as the second-largest player since 2013. This is primarily driven by the performance of its memory chips segment, dominated by industry leaders such as Samsung and SK Hynix, boasting a remarkable 60 per cent share of the worldwide market.

The system chip industry in South Korea currently holds less than three per cent of the global market share, making it a less competitive sector. The Korean government has introduced various strategies, including the *System Semiconductor Development Strategy* (April 2019), *AI Semiconductor Industry Development Strategy* (Oct 2020), and *K-Semiconductor Strategy* (May 2021), all with the goal of enhancing the competitiveness of the system chip sector and establishing South Korea as a global leader in both memory and system chips by 2030.

Increasing digitalisation and demand for digitised products are driving the growth of the advanced memory and system chip technologies and markets globally. Leveraging its leadership in memory chips, South Korea will actively foster partnership between public and private sectors to establish a thriving ecosystem centred around advanced memory and system semiconductors, which Swedish competitive and expertise lie in.

STRATEGIC INITIATIVES KEY TO GROWTH

The pandemic exposed the vulnerability of the worldwide supply chain, underscoring the need for self-sufficient semiconductor manufacturing. However, achieving complete self-sufficiency may present challenges and numerous markets, including the United States and Europe, have taken proactive steps to support their domestic chip production capabilities and implement strategic subsidies. South Korea has also embraced this global trend by unveiling several initiatives aimed at enhancing its domestic semiconductor industry ecosystem.

Understanding how these strategic initiatives are influencing investment and growth is critical for Swedish companies looking to enter or build on existing market presence.

SYSTEM SEMICONDUCTOR VISION AND STRATEGY (2019)

Considering the imbalance in competitiveness within the memory and system chips, South Korea has acknowledged the need to enhance the competitiveness of the system chips. The government introduced a range of tax incentives, advancing the growth of a system semiconductor ecosystem. By allocating an investment exceeding USD 0.9 billion (est. KRW 1 trillion), the country aims to drive the development of next-generation semiconductor technologies, including Artificial Intelligence (AI) semiconductors.

K-SEMICONDUCTOR STRATEGY (2021)

The strategy aims to strengthen the nation's chip capabilities and position Korean chipmakers as global leaders in both memory and system chips. As part of the strategy, the government plans to offer substantial tax incentives and state subsidies to chip manufacturers, encouraging them to invest a total of USD 460 billion by 2030 through public-private partnership.

K-CHIPS ACT (2023)

The K-Chips Act aims to strengthen South Korea's semiconductor industry by offering incentives to chipmakers for establishing new factories. Large companies investing in manufacturing facilities will receive a 15 per cent tax credit, while smaller firms will benefit from a 25 per cent tax break which applies to both international and domestic companies. This legislation aligns with the Yoon administration's commitment to position the nation as a semiconductor powerhouse and supporting research and development in robotic, AI, power semiconductor, sensors, IoT, and more.

YONG-IN MEGA SEMICONDUCTOR CLUSTER (2023)

The government unveiled the plans for a USD 270 billion 'mega semiconductor cluster' in Gyeonggi Province to be completed by 2042, focusing on logic semiconductor production. Big domestic players in the semiconductor industry plan on capitalising tax incentives to build five foundries within the cluster, producing in-house designs and logic chips for other companies. This governmental support will reinforce South Korea's ongoing semiconductor supply chain restructuring efforts.

EMERGING HUB FOR ADVANCED CHIP TECHNOLOGIES

The rapid expansion of computing capabilities, AI, and connectivity has generated a surge in diverse technology demands. However, as reported by the Korea Institute of S&T Evaluation Planning (KISTEP), South Korea's competitive position in system chips falls behind the United States by approximately two years. This under-development stems from a scarcity of skilled personnel and the high costs associated with chip design tools and IP licensing fees during the initial development stages.

Encouragingly, South Korea has made significant progress in the development of low-power, high-performance, and compact circuit design technologies, particularly for innovative applications like AI chips (GPUs, NPUs, etc.) and power semiconductors. Recognising the significance of these advancements, the Ministry of Trade, Investment, and Energy has committed substantial support, reserving USD 2.9 billion (est. KRW 3.2 trillion) for R&D in three key technologies: power, AI, and automotive semiconductors, all deemed critical for meeting future advancements goals by 2035. This significant investment is expected to further fuel the demand for advanced semiconductor technologies.

Samsung Electronics, one of the leading semiconductor players in Korea, presented their foundry technologies and strategic initiatives at the Foundry Forum 2023. The establishment of the Power Semiconductor TF Team in March demonstrates their dedication to strengthening power semiconductor foundry services. Additionally, the company stressed their plan to foster research and development collaborations with domestic and international universities in the advanced semiconductor technologies. Their forward-looking roadmap includes:

“For over three decades, KTH, RISE, and Electrum Laboratory have excelled in advanced Power Semiconductor tech, particularly Wide Bandgap (SiC) materials. This innovation hub in Kista has driven cutting-edge research, supported growth of startups such as Ascatron and Transic¹. RISE expanded its impact via ProNano at Lund University, focusing on III-nitride (GaN, AlGaN) semiconductor materials. These efforts shape energy and lighting systems, potentially fostering Sweden-South Korea collaborations.”

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¹ Ascatron AB and Transic AB are now merged to Coherent and On Semi Sweden, respectively.

- Initiating mass production of the 2nm process for mobile applications in 2025
- Expansions into High-Performance Computing (HPC) in 2026
- Automotive applications in 2027.

This timeline reflects their commitment to enhancing system semiconductor design capabilities.

South Korea anticipates a steady increase in demand for AI, power, and automotive semiconductors. However, these technologies come with considerable development time, which has led to a reliance on foreign companies for semiconductor IP and technologies through licensing agreements. This dynamic presents promising opportunities for Swedish companies renowned for their expertise and competitiveness in chip design.

ADVANCING SUSTAINABLE GROWTH

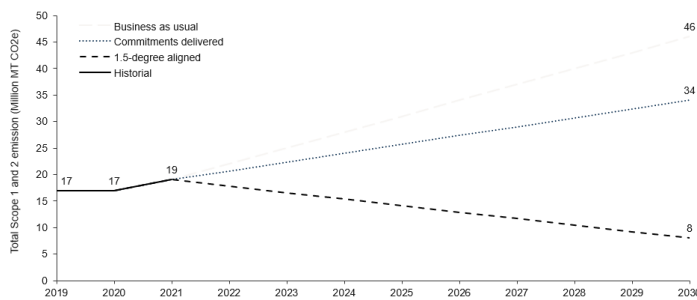
The global manufacturing industry faces the dual challenge of meeting rising demand while aligning with national and global climate goals for carbon neutrality. The semiconductor sector is known for its high energy intensity and in particular in Asia, it's contribution to greenhouse gas (GHG) emission is high as nearly 82 per cent of electricity is powered by fossil fuels. To effectively address global decarbonisation commitments and local regulatory pressures, energy-intensive industries like semiconductors are being urged to transition towards sustainable electricity sources and adopt technologies that can actively reduce emissions.

In Korea, the semiconductor and display sectors play a significant role in generating indirect GHG emissions, contributing approximately 4.7 per cent of the nation's total emissions and around 8.5 per cent of industrial sector emissions. Ranking after the steel, petroleum, and cement industries in terms of emissions, the semiconductor industry has significant control over its GHG footprint, with nearly 80 per cent of its global manufacturing emissions falling under scope 1 or scope 2 categories². Hence, the adoption of proactive carbon reduction measures has become increasingly vital as concerns over emissions grow across industries.

“Achieving sustainable carbon neutrality in the semiconductor and display industries requires a strong emphasis on the advancement of eco-friendly process technologies. The focus should be on the development and supply of low-power semiconductors and highly efficient displays, as these contributions play a pivotal role in reducing carbon emissions within society.”

Sangjoon Lee, Head of Climate Change Division at Korea Energy Economics Institute during the second meeting of the Semiconductor Display Carbon Neutrality Committee

Historical (2019-2021) data from Korea's semiconductor manufacturing sector's GHG emissions and its projection by 2030



Recognising the urgency to address climate change, prominent semiconductor players Samsung

² Under the Greenhouse Gas Protocol, scope 1 are those direct emissions that are owned or controlled by a company, whereas scope 2 and 3 indirect emissions are a consequence of the activities of the company but occur from sources not owned or controlled by it.

Electronics and SK Hynix have demonstrated their commitment to sustainable practices by pledging to achieve net-zero emissions by 2050. In 2023, Samsung obtained Life Cycle Assessment Verification for semiconductor product carbon footprint and plan to extend this approach to its entire value chain. Additionally, Samsung aims to transition all facilities outside South Korea to 100 per cent renewable energy by 2027. In parallel, SK Hynix has established the ECO Alliance, collaborating with other semiconductor companies in South Korea to focus on renewable energy adoption and advanced technologies to effectively reduce CO₂ emissions.

Innovative technologies are poised to play a crucial role in attaining carbon neutrality as they significantly reduce chip power consumption and mitigate emissions across the wafer processing life cycle. Emphasising the adoption of renewable energy and alternative materials like SiC and GaN will be crucial in curbing the chip industry's carbon emissions.

OPPORTUNITIES FOR COLLABORATION

Achieving carbon neutrality in the semiconductor industry necessitates collaborative efforts across the value chain. In May 2023, South Korea strengthened its ties with the EU by establishing the *Korea-EU Green Partnership*. This aims to jointly advance research and development in cutting-edge semiconductor technologies, spanning AI, power, automotive, and advanced devices. Additionally, the *EU Chips Act* presents a promising opportunity for South Korean investment in semiconductor manufacturing.

Sweden, a prominent innovation hub in Europe, holds untapped potential for collaboration with the South Korean semiconductor industry. Despite not fully recognising its competitiveness in this sector, Sweden possesses several complementary areas that offer opportunities for synergistic partnership. The country plays a vital role in the global semiconductor ecosystem, boasting a robust national innovation system and strong presence of end-users (OEMs) in the advanced technologies.

RISE's [previous analysis on the semiconductor industry](#) indicates that Swedish companies actively engage in both the selling and purchasing aspects of the electronics sector, showcasing their expertise in the development of advanced materials and components such as compound semiconductors, power electronics, high-frequency electronics, photonics, MEMS (micro electromechanical systems), and sensors. These technologies are essential for the advancement of telecoms, transport, and industrial applications, which has a significant portion of the current demand from Asian suppliers and customers.

RIDING THE SUSTAINABILITY WAVE

To capitalise on the current trend of developing sustainable semiconductor production in South Korea and establish a foothold in the market, Swedish companies must carefully analyse both the industry dynamics and cultural nuances. Here are essential actions for successful market entry and effective navigation of opportunities:

- Collaborate with Team Sweden (Business Sweden, Embassy of Sweden, Vinnova, RISE etc.) to leverage Sweden's global position as a powerhouse of innovation, sustainability, co-creation, and equality through the semiconductor industry events, publications, and other promotional activities
- Gain a comprehensive understanding of the market structure, key players in each value chain, and sourcing channels
- Demonstrate unwavering commitment and engagement with partners and customers, acknowledging the extended decision-making and production processes prevalent in hierarchical corporate structures
- Identify and collaborate with suitable local partners who can serve as sales or marketing representatives, facilitating timely customer engagement and smooth communication in the local language

BUSINESS SWEDEN – WHAT CAN WE OFFER?

Business Sweden works with both Swedish and international companies to accelerate innovative technologies and solutions in semiconductor materials to equipment, scale-up production methods, and promote sustainability across value chains.

Our global perspective, coupled with local knowledge and teams on the ground in over 40 markets can:

- Connect companies and other stakeholders in international markets to support business, investment, and R&D collaboration opportunities
- Identify new segments and sales potential in export markets which offer scalable options for sustainable investments in Swedish semiconductor value chain.
- Support Swedish companies to expand in globally with solutions and innovations that can accelerate sustainable semiconductor development and production.



We help Swedish companies grow global sales and international companies invest and expand in Sweden.

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