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Taiwan at the Core:
Strategic Partner in the Global Semiconductor Landscape and Realignment

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EXECUTIVE SUMMARY

Taiwan at the Core: Strategic Partner in Global Semiconductor Landscape and Realignment offers a clear, authoritative, and timely guide to understanding how semiconductors have become the strategic backbone of the modern global economy—and why Taiwan sits at its very center. As chips power everything from artificial intelligence and advanced computing to electric vehicles and defense systems, this book explains how Taiwan's dominance—commanding over 78% of the global foundry market—has made the island an indispensable anchor of the world's digital infrastructure.

Written from a policy-oriented and global perspective, the book examines the ongoing "semiconductor strategic realignment," unpacking Taiwan's core position in the global semiconductor ecosystem; the revitalization efforts of United States, Japan and Europe; China's aggressive expansion in mature-node manufacturing amidst advanced-node constraints; South Korea's pivotal dominance in AI-driven High Bandwidth Memory (HBM); and the emerging roles of economies such as Singapore and India are collectively reshaping the industry. Readers will gain a coherent understanding of the global semiconductor supply chain, the forces driving its reconfiguration, and the geopolitical and economic implications that will define the next decade of technological competition.

Beyond analysis, Taiwan at the Core positions Taiwan as a critical strategic partner for governments and enterprises alike. With its unparalleled AI ecosystem, world-class talent base, and robust intellectual property protection, Taiwan offers a uniquely trusted environment for advanced R&D and regional operations. Crucially, the book underscores a central message: global supply chain resilience and shared prosperity in the Angstrom Era are inseparable from peace and stability across the Taiwan Strait—making Taiwan not only a technological leader, but a cornerstone of the future global order.

Please feel free to reach out to the Economic Division of the Taipei Representative Office in Singapore should you have any enquiries or are seeking partnership opportunities of investment or collaboration in the field of semiconductors and AI in Taiwan.

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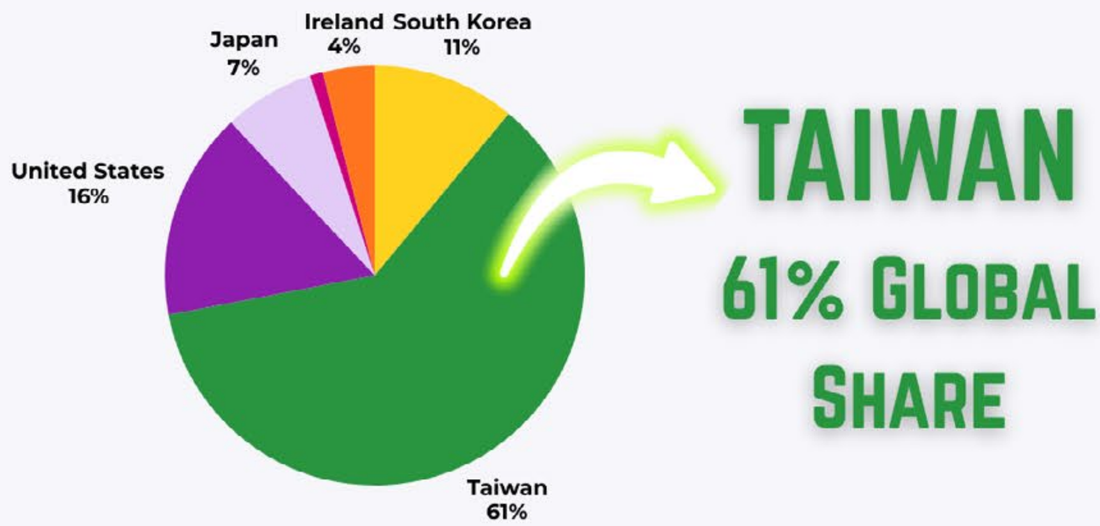
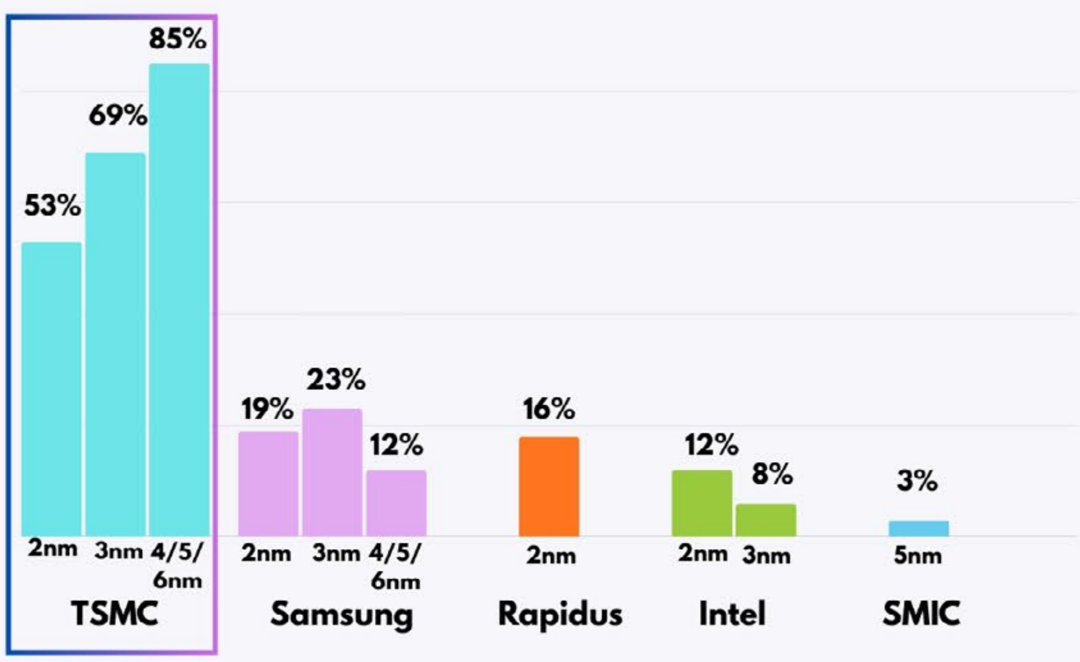
Taiwan at the Core

Global Shares and Rankings of Taiwan IC Industry: 2025(p)

Global Sub-6nm Node Capacity Share by Country: 2029



Global Sub-6nm Node Capacity Share: 2029



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*Figures 9, 14, 59, 60, 61 have been updated.

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*Tables 11, 12, 17, 34 and 46 have been updated.

Preface

Building upon this framework, the updated June edition integrates pivotal industry data and policy shifts from **2026Q1**, capturing the initial impacts of the "Angstrom Era" transition and the latest realignments in global capacity. Recognizing that the semiconductor landscape moves at a velocity that often outpaces traditional publishing, this work is designed as a living resource to be continuously updated as new information is discovered and harnessed through global supply chains and governmental policies. We have established a protocol for continuous data synchronization, ensuring that as new foundry benchmarks and geopolitical shifts emerge, the core analysis remains tethered to the most current empirical evidence available. The analysis contains newly updated figures, tables and analysis **highlighted in red** containing information about 2026Q1 and predictions for the semiconductor industry up to 2028.

Semiconductors—often likened to the "oil" of the twenty-first century—have become the indispensable backbone of the modern global economy. From breakthroughs in artificial intelligence and high-performance computing to the proliferation of electric vehicles, defense systems, and consumer electronics, chips now underpin nearly every dimension of technological and economic activity. As the industry advances toward a trillion-dollar scale by 2027, driven by surging demand for AI and data-intensive applications, Taiwan's role in the global semiconductor supply chain has never been more crucial.

Taiwan's centrality is not merely a function of industrial success or market competitiveness. It is deeply intertwined with national security, technological sovereignty, and the strategic industrial policies of major powers. With more than 78 percent of global foundry market share and an overwhelming majority of advanced-node manufacturing capacity, Taiwan's stability and leadership form a critical pillar of the world's digital infrastructure. As the industry enters the "Angstrom Era," Taiwan remains the gravitational center of manufacturing, retaining over 90 percent of its most advanced capacity at home.

In this context, preserving peace and stability across the Taiwan Strait is not simply a regional concern, but a global imperative. Economies committed to sustained growth, technological advancement, and shared prosperity all have a direct stake in safeguarding the resilience of the global semiconductor supply chain—and, inseparably, in maintaining peace and stability across the Taiwan Strait. Taiwan, therefore, is not merely a participant in the semiconductor ecosystem; it is one of the indispensable anchors.

The primary objective of Taiwan at the Core: Strategic Partner in the Global Semiconductor Landscape and Realignment is to offer a comprehensive, policy-oriented analysis of the forces reshaping the global semiconductor industry. The book examines the strategic initiatives of the United States; South Korea's dominance in memory and its pivot toward the AI era; the revitalization efforts of Japan and Europe; China's expansion in mature-node manufacturing; and the emerging roles of economies such as Singapore and India. Together, these dynamics define an era of "semiconductor strategic realignment," in which partnership with Taiwan is a strategic necessity rather than an option.

Readers will readily recognize that the semiconductor industry is marked by an extraordinary pace of innovation and an equally dense accumulation of data. Given the breadth of regional coverage and the rapid evolution of market conditions, synchronizing every data point in real time is inherently challenging. Some statistics may therefore reflect minor time lags or discrepancies. The aim of this work is not a static snapshot, but a coherent framework capturing dominant trends, policy directions, and structural transformations.

It is my hope that this book will contribute to a deeper and more nuanced understanding of the challenges and opportunities confronting the global semiconductor ecosystem, and serve as a practical reference for governments, industries, and academic institutions as they prepare for the next phase of technological transformation.

TUNG Chen-Yuan, Ph.D.
Taiwan's Representative to Singapore
June 19, 2026

I. Global Semiconductor Market

1. Overall Market

Semiconductors, or "chips," are integral to our modern world, driving innovation and efficiency across a plethora of applications, from medical devices and clean energy to transportation and advanced defense systems. With increasing demand for semiconductors across various sectors, the global semiconductor industry is poised to become a trillion-dollar industry by 2027. The importance of semiconductors, therefore, extends far beyond the realm of technology; they are the lifeline of modern economies and crucial to a nation's strategic interests.

Semiconductors encompass the broad family of materials and devices built on the unique electrical properties of semiconductor substances such as silicon, gallium nitride, and silicon carbide. Within this broad domain, integrated circuits (ICs) represent the most advanced and value-added category, integrating millions or billions of transistors and passive components onto a single chip to execute complex computational and control functions. In essence, ICs are a major subset of the semiconductor industry, and their technological sophistication makes them the foundation of modern computing, communications, automotive electronics, and consumer devices.

In 2024, the World Semiconductor Trade Statistics (WSTS)[1] data clearly illustrates the dominance of ICs within the global semiconductor market. Total worldwide semiconductor revenue reached US$ 630,549 million, of which ICs accounted for US$ 539,505 million, representing 85.6% of the entire market. By contrast, Discrete Semiconductors contributed US$ 31,026 million (4.9%), Optoelectronics totaled US$ 41,095 million (6.5%), and Sensors amounted to US$ 18,923 million (3.0%). These figures demonstrate that although the semiconductor industry spans several distinct device categories, ICs overwhelmingly generate the majority of economic value and remain the key driver of industry growth.

Within the IC segment itself, the market is further divided into four major product categories with distinct functions. In 2024, Logic ICs were the largest subsegment at US$ 215,768 million, representing 40.0% of total IC revenue. Memory ICs followed at US$ 165,516 million (30.7%), reflecting their crucial role in data storage and high-performance computing. Analog ICs, supporting power management and signal conversion, generated US$ 79,588 million (14.8%), while Micro ICs—microprocessors and microcontrollers—contributed US$ 78,633 million (14.6%). Together, these figures highlight how Logic and Memory dominate IC value creation, with Analog and Micro remaining indispensable to system architecture.

Based on the full-year 2025 data released by the WSTS in March 2026, the semiconductor industry experienced one of the strongest annual expansions in its history. Global revenue reached US$ 795.6 billion in 2025, marking a 26.2% year-over-year growth. Growth accelerated over the course of the year, culminating in 4Q 2025 revenues of US$ 238.9 billion, up 38.4% compared to 4Q 2024. This exceptional

1 The World Semiconductor Trade Statistics (WSTS) is a non-profit mutual benefit organization whose mission is to serve as an authoritative source of global semiconductor market data and forecasts. Its monthly data are submitted by representatives of member companies and are characterized by a high degree of timeliness, accuracy, and comprehensive market coverage.

surge is driven primarily by strong demand across key application areas, particularly data center infrastructure and AI-related systems.

Growth in 2025 was broad-based across most semiconductor product categories but was clearly led by Logic and Memory devices. According to the 2025 WSTS data, Logic devices delivered the largest contribution to overall market expansion, reaching US$ 299.5 billion with a 38.8% YoY growth, supported by demand for high-performance chips used in data centers, AI accelerators, and advanced computing systems. The Memory segment also recorded strong growth, reaching US$ 230.0 billion (up 39.0% YoY), continuing its recovery supported by improved pricing and strong demand for high-bandwidth and high-capacity memory solutions. Other categories, including Sensors (+10.4%), Analog (+8.7%), and Microprocessors (+7.9%), recorded solid growth, while Discrete devices remained slightly negative (-1.0%) on a full-year basis (see Table 1).

Table 1. Global Semiconductor Market: 2022-2025

Unit: US$ Billion

Segment	2022		2023		2024		2025	
Analog	89.0	20.1%	81.2	-8.7%	79.6	-2.0%	86.5	8.7%
Discretes	34.0	12.0%	35.5	4.5%	31.0	-12.7%	30.7	-1.0%
Logic	176.6	14.0%	178.6	1.1%	215.8	20.8%	299.5	38.8%
Memory	129.8	-15.6%	92.3	-28.9%	165.5	79.3%	230.0	39.0%
Micro	79.1	-1.4%	76.3	-3.5%	78.6	3.0%	84.9	7.9%
Optoelectronics	43.9	1.2%	43.2	-1.6%	41.1	-4.8%	43.0	4.7%
Sensors & Actuators	21.8	13.7%	19.8	-9.4%	18.9	-4.1%	21.0	10.4%
Total	574.1	3.3%	526.9	-8.2%	630.5	19.7%	795.6	26.2%

Source: World Semiconductor Trade Statistics, "Global Semiconductor Market grows 26% in 2025 to $796 billion," March 6, 2026.

By 2026, the growth trajectory by the WSTS is set to strengthen further as the global semiconductor market reaches an estimated US$ 1,511,248 million, representing 89.9% annual growth. Several structural forces underpin this expansion: the proliferation of generative AI, rapid adoption of AI-accelerated data centers, increased semiconductor content in electric and autonomous vehicles, and the widespread integration of sensors and optoelectronics into smart devices and industrial systems.

IC revenues are projected to climb to US$ 1,412,326 million, with Memory and Logic showing the fastest growth due to persistent demand for high-bandwidth and high-capacity computing. This trend suggests a sustained cycle of innovation and capacity investment, positioning semiconductors—especially ICs—at the center of global technological transformation through the mid-2020s (see Table 2).

Table 2. Global Semiconductor Market: 2025-2027

Spring 2026	Amounts in US$M			Year on Year Growth in %		
	2025	2026	2027	2025	2026	2027
Americas	256,476	543,654	701,439	31.4	112.0	29.0
Europe	54,694	86,643	101,587	6.7	58.4	17.2
Japan	44,723	57,050	67,332	-4.3	27.6	18.0
Asia Pacific	439,747	823,900	1,043,326	30.3	87.4	26.6
Total World - $M	**795,640**	**1,511,248**	**1,913,683**	**26.2**	**89.9**	**26.6**
Discrete Semiconductors	30,728	33,188	35,712	-1.0	8.0	7.6
Optoelectronics	43,042	44,218	46,436	4.7	2.7	5.0
Sensors	20,894	21,516	23,002	10.4	3.0	6.9
Integrated Circuits	700,975	1,412,326	1,808,533	29.9	101.5	28.1
Analog	86,519	95,358	101,662	8.7	10.2	6.6
Micro	84,867	101,655	121,966	7.9	19.8	20.0
Logic	299,547	411,371	522,820	38.8	37.3	27.1
Memory	230,042	803,941	1,062,085	39.0	249.5	32.1
Total Products - $M	795,640	1,511,248	1,913,683	26.2	89.9	26.6

Source: World Semiconductor Trade Statistics, "Global Semiconductor Market Approaches USD 1 Trillion in 2026," December 2, 2025.

From 2015 to 2024, the global semiconductor market exhibited pronounced cyclical dynamics, shaped by technology transitions, demand fluctuations, and macroeconomic conditions. Growth was relatively subdued in 2015–2016, reflecting a temporary plateau in industry expansion.

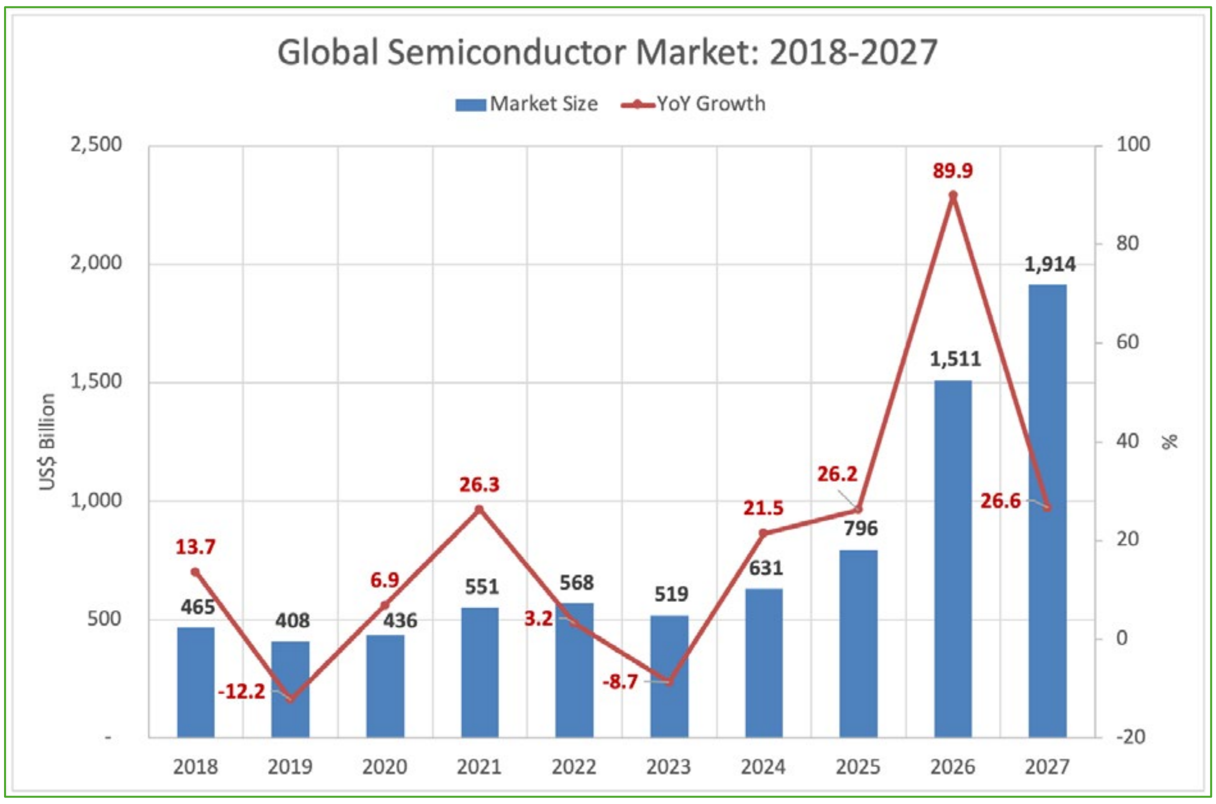
A strong upcycle emerged in 2017 (21.6%) and 2018 (13.7%), driven by robust memory pricing and expanding demand from data centers and mobile devices. This momentum reversed sharply in 2019, when the market contracted by -12.0% amid a downturn in the memory segment.

The industry entered a renewed growth phase from 2020 to 2022. After rebounding in 2020 (6.8%), the market surged in 2021 (26.2%), supported by pandemic-driven digitalization and exceptional demand for cloud infrastructure, computing, and consumer electronics. Growth moderated to 3.3% in 2022, before the sector experienced another correction in 2023 (-8.2%), reflecting inventory adjustments, weakening end-market demand, and broader macroeconomic headwinds.

In 2024, the market returned to strong expansion, reaching US$ 630.5 billion with a 19.7% year-over-year increase. This recovery was primarily driven by a rebound in memory prices and accelerating investment in AI-related applications.

Looking ahead, WSTS projects continued robust momentum in 2026, with a further 89.9% increase, bringing the market to approximately US$ 1.51 trillion. Beyond 2026, growth is expected to continue above historical industry trends. The market is forecast to reach US$ 1,913.7 billion in 2027, corresponding to annual growth rates of 26.6%. This trajectory suggests a transition from cyclical recovery to structurally driven expansion, underpinned by sustained demand from generative AI, high-performance computing, electric and autonomous vehicles, and the continued scaling of cloud and edge infrastructure (see Figure 1).

Figure 1. Global Semiconductor Market: 2017-2027



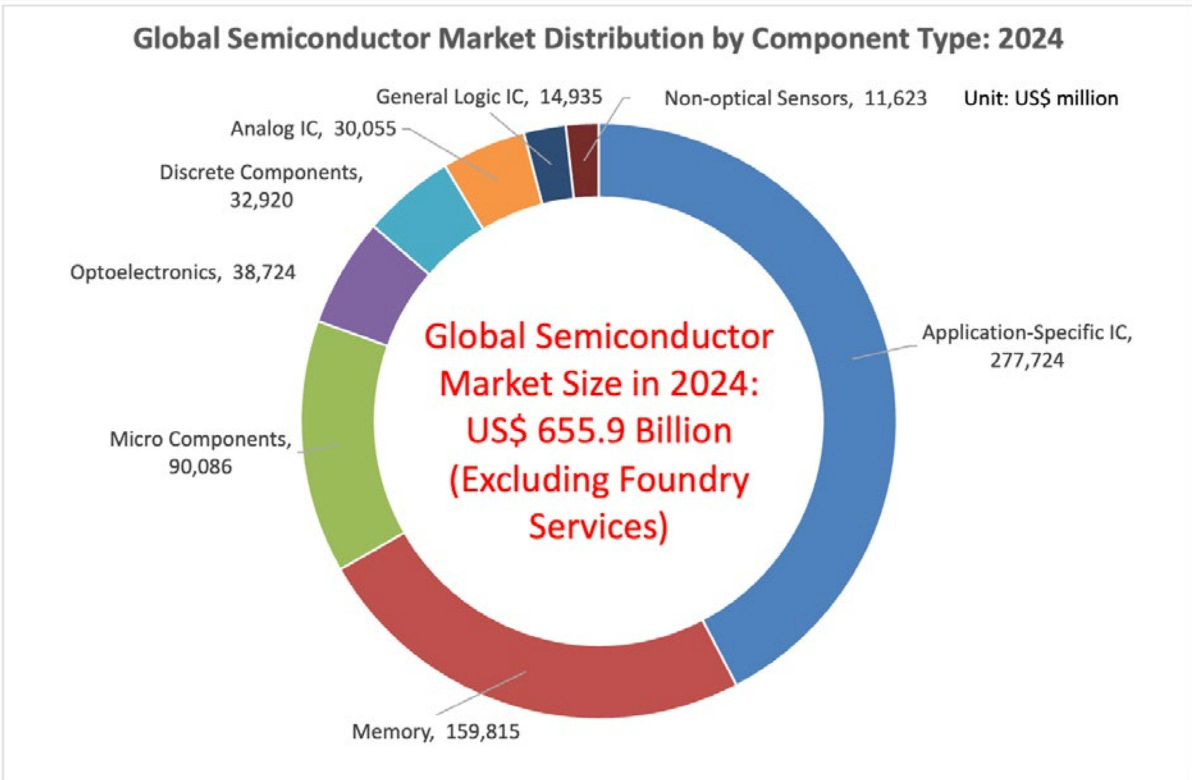
Source: World Semiconductor Trade Statistics, "Global Semiconductor Market Surges Beyond USD 1.5 Trillion in 2026 Driven by Extraordinary Memory Expansion," June 2, 2026.

2. Structural Composition

In 2024, the global semiconductor market reached US$ 655.9 billion, excluding foundry services. Structurally, the market is divided between general-purpose integrated circuits (ICs) and application-specific ICs (ASICs). General-purpose ICs account for 57.7% of total market value, while ASICs comprise the remaining 42.3%, reflecting accelerating demand for customized, high-performance solutions driven by AI, cloud computing, advanced networking, and automotive applications. This balance underscores a market no longer defined solely by scale, but increasingly by specialization.

Within general-purpose ICs, memory remains the largest category, generating US$ 159.8 billion in revenues and highlighting the data-intensive foundations of the modern digital economy. Micro components (US$ 90.1 billion) further demonstrate the pervasive role of semiconductors across industrial, automotive, and consumer systems. Meanwhile, smaller yet indispensable segments—such as optoelectronics, discrete components, and analog ICs—continue to play critical supporting roles in system integration, power management, and signal processing. Taken together, the 2024 market distribution points to a clear shift toward a workload- and system-driven semiconductor landscape, where customized silicon gains strategic value alongside high-volume foundational components (see Figure 2).

Figure 2. Global Semiconductor Market Distribution by Component Type: 2024

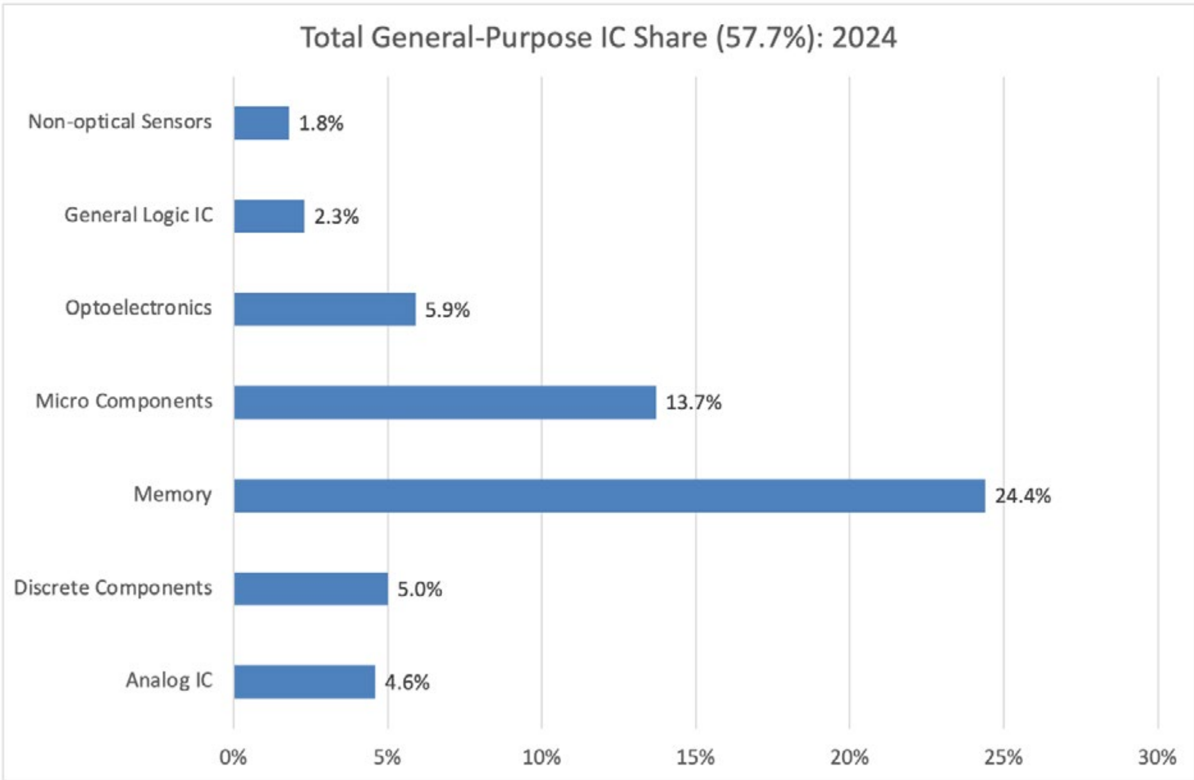


Source: Sayumi Chung, "Market and Technology Trends in AI Semiconductors and IC Design," ITRI, October 28, 2025, p. 7.

Within the general-purpose IC segment, memory clearly dominates, accounting for 24.4% of the total global semiconductor market and standing as the single largest component category overall. This reflects sustained and structurally embedded demand from data centers, cloud services, AI workloads, and consumer electronics. Micro components, including microcontrollers and general-purpose processors, represent 13.7%, underscoring their extensive deployment across automotive, industrial, and consumer applications where reliability, flexibility, and cost efficiency remain paramount.

Other general-purpose categories, while smaller in market share, play indispensable enabling roles. Optoelectronics contribute 5.9%, supported by displays, optical communications, and imaging technologies. Discrete components and analog ICs, at 5.0% and 4.6% respectively, provide essential functions in power management, signal conditioning, and overall system stability. Although general logic ICs and non-optical sensors account for more modest shares, they remain critical to system integration and sensing capabilities. Taken together, the structure of the general-purpose IC segment highlights the enduring importance of standardized, high-volume components as the technological backbone of the semiconductor industry, even as customization gains momentum elsewhere (see Figure 3).

Figure 3. Total General-Purpose IC Share: 2024

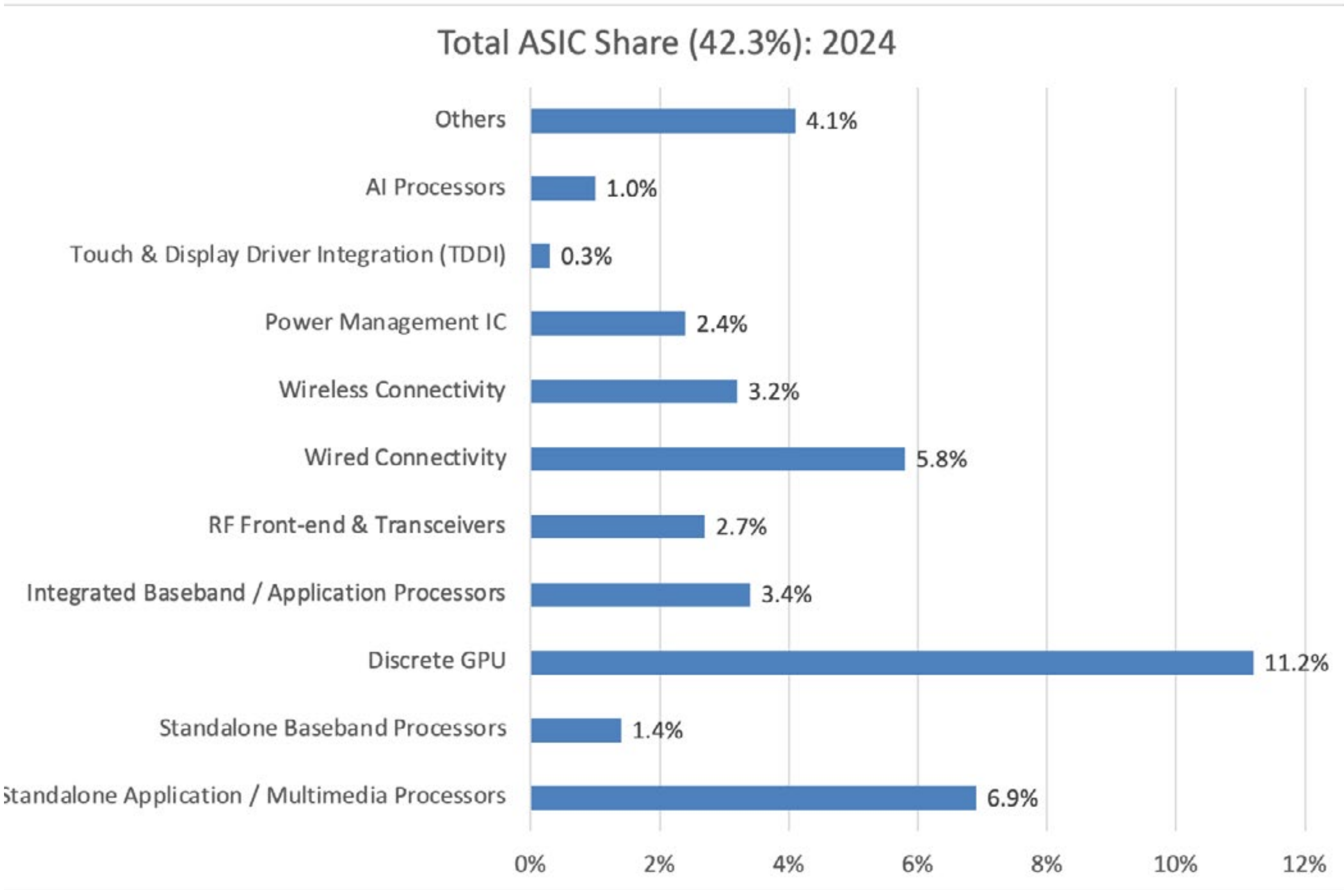


Source: Sayumi Chung, "Market and Technology Trends in AI Semiconductors and IC Design," ITRI, October 28, 2025, p. 7.

By contrast, the ASIC segment, comprising 42.3% of the market, is shaped by a different set of dynamics centered on performance optimization and system-level integration. Discrete GPUs emerge as the largest ASIC category, accounting for 11.2% of total semiconductor revenues, driven by the rapid expansion of AI training, high-performance computing, and advanced graphics workloads. Standalone application and multimedia processors, at 6.9%, continue to benefit from demand in smartphones, consumer devices, and edge computing platforms. Connectivity-related ICs form another major pillar of the ASIC segment, with wired connectivity at 5.8%, wireless connectivity at 3.2%, and RF front-end and transceivers at 2.7%, reflecting the growing importance of data transmission in cloud, networking, and IoT environments. Integrated baseband and application processors contribute 3.4%, particularly in mobile systems, while power management ICs (2.4%) remain critical enablers across all application-specific designs. Smaller but strategically important categories—including dedicated AI processors, standalone baseband processors, touch and display driver integration (TDDI), and other specialized devices—further illustrate the increasing granularity of application-driven chip design.

Taken together, the 2024 semiconductor market exhibits a clear dual structure. General-purpose ICs continue to dominate in terms of scale and volume, anchored by memory, while ASICs—led by discrete GPUs—are gaining strategic prominence as demand shifts toward AI, data-intensive computing, and highly optimized electronic systems. This coexistence of scale efficiency and specialization increasingly defines both the competitive dynamics and the technological trajectory of the global semiconductor industry (see Figure 4).

Figure 4. Total ASIC Share: 2024



Source: Sayumi Chung, "Market and Technology Trends in AI Semiconductors and IC Design," ITRI, October 28, 2025, p. 7.

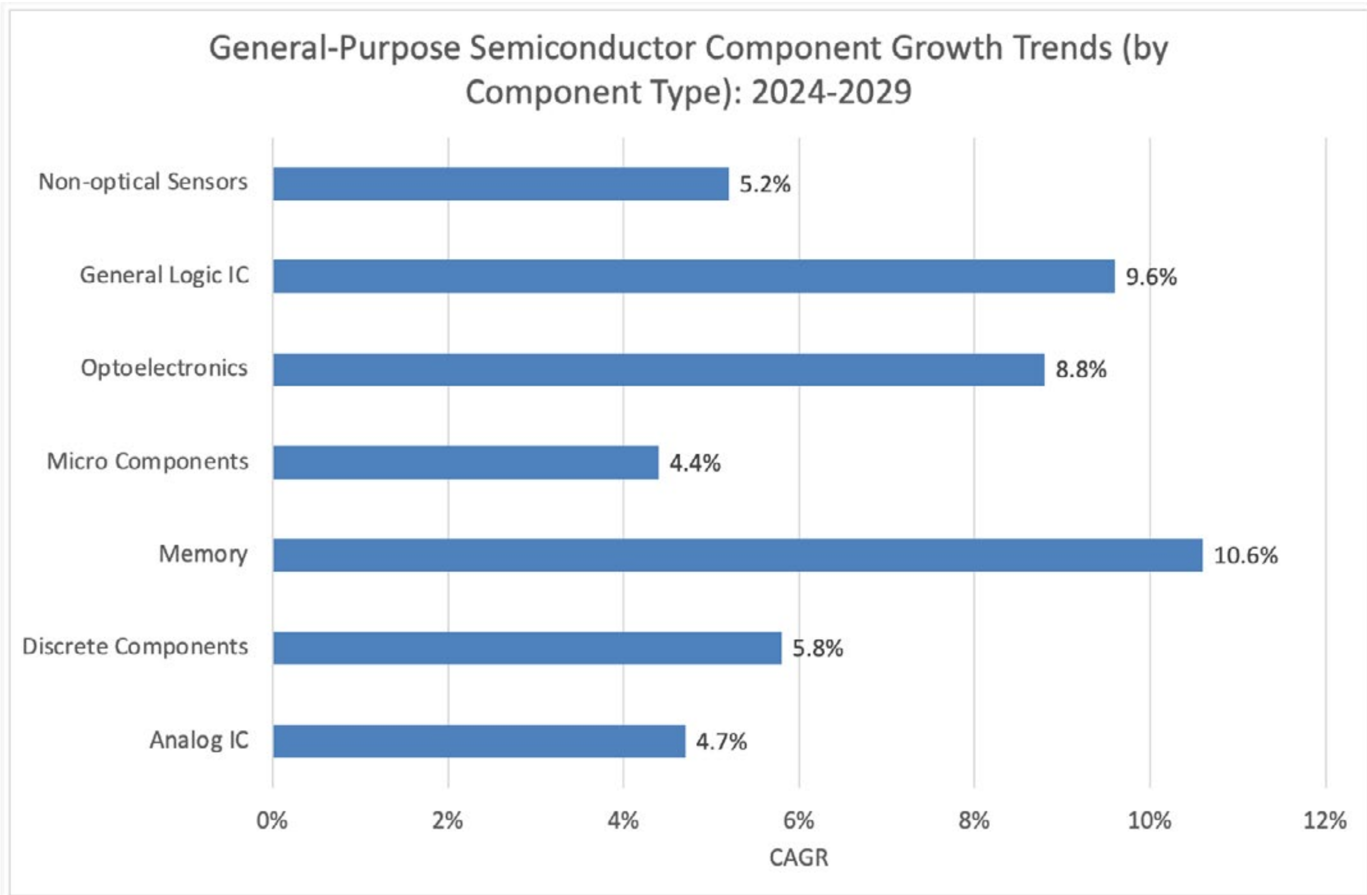
The outlook for general-purpose semiconductor components points to particularly strong momentum in memory, alongside solid medium-term growth in optoelectronics and general logic ICs. Memory is expected to experience exceptionally strong growth in 2026, with year-over-year expansion projected to exceed 30%. This surge is driven primarily by the rapid increase in HBM (High Bandwidth Memory) production capacity, as well as rising end-device memory demand fueled by AI applications, including AI servers, accelerators, and increasingly memory-intensive edge and consumer devices. Supported by these structural drivers, the memory segment is forecast to achieve a 2024–2029 CAGR of 10.6%, making it the fastest-growing category among general-purpose ICs over the medium term.

Furthermore, according to TrendForce's latest research in May 2026, the shift in AI development from large-scale model training toward inference-centric Agentic AI applications is driving a structural expansion in memory demand. As AI systems require high-bandwidth and high-capacity memory to handle continuous iterative cycles and as KV cache capacity scales proportionally with larger context windows, the overall memory market is projected to reach US$ 889.3 billion in 2026 and surge to more than US$ 1.28 trillion in 2027, reflecting a 44% YoY growth.

Specifically, DRAM market revenue could reach US$ 618.7 billion in 2026, surging 303% YoY, and is projected to further expand to US$ 903.3 billion in 2027, up 46% YoY. Meanwhile, as generative AI progresses towards agent-based systems where heavy users consume up to four times more tokens, the NAND Flash market is expected to jump by 280.7% YoY to US$ 270.6 billion in 2026, and further expand to nearly US$ 379.4 billion in 2027 as it maintains a strong annual growth of 40.2%.

Beyond memory, optoelectronics and general logic ICs are also expected to deliver strong growth performance over the next five years. Optoelectronics benefits from expanding demand in displays, optical communications, and sensing applications, particularly in data centers, automotive systems, and industrial automation. General logic ICs, meanwhile, are supported by broad-based system complexity, increasing integration requirements, and steady demand across computing, networking, and embedded applications. Together, these trends suggest that while memory will be the primary growth engine in the near term, optoelectronics and general logic ICs will provide sustained and resilient growth through the second half of the decade (see Figure 5).

Figure 5. General-Purpose Semiconductor Component Growth Trends (by Component Type): 2024-2029



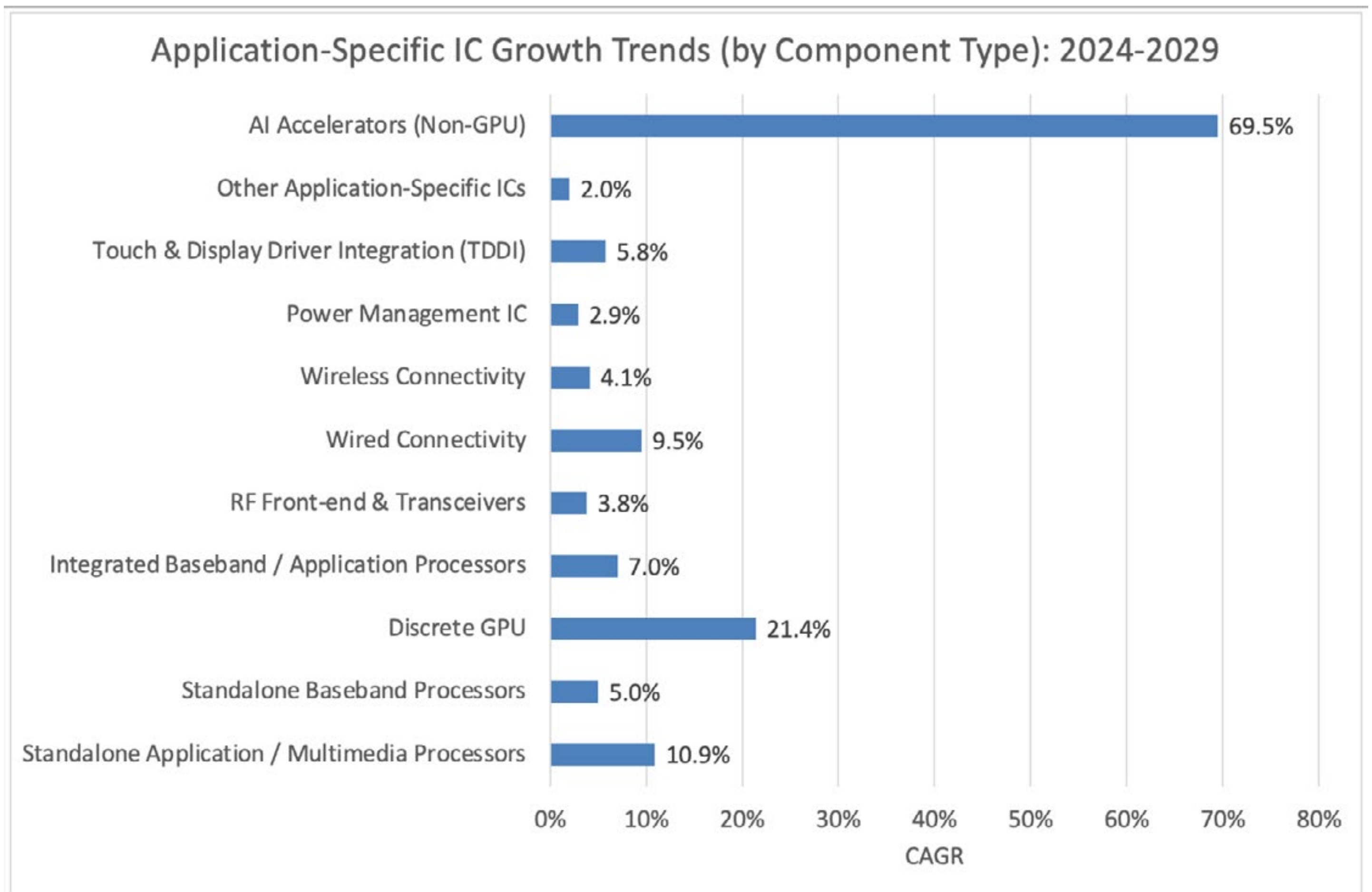
Source: Sayumi Chung, "Market and Technology Trends in AI Semiconductors and IC Design," ITRI, October 28, 2025, p. 8.

The ASIC market is being reshaped by the rapid expansion of AI computing, with AI processors emerging as the most dynamic growth engine. In 2025, AI processors are projected to record an exceptional year-over-year growth rate of 143.2%, reflecting explosive demand from AI training, inference, and customized acceleration workloads. Over the 2024–2029 period, the segment is expected to achieve a five-year CAGR of 69.5%, the highest among all ASIC categories. This growth is led by key players such as Broadcom, which held a 45.2% market share in 2024, and Alchip Technologies, both benefiting from hyperscaler-driven demand for custom AI silicon.

In parallel, discrete GPUs became the largest segment within ASICs in 2024, underscoring their central role in AI and high-performance computing. Strong demand momentum is expected to continue, driving growth rates of 57.4% in 2025 and 23.1% in 2026. The market remains highly concentrated, with NVIDIA commanding a dominant 93.3% market share in 2024, reflecting its technological leadership and ecosystem advantages in AI computing.

Meanwhile, standalone application and multimedia processors, although no longer the largest ASIC segment, continue to demonstrate resilient growth. The category is projected to maintain double-digit growth in both 2025 and 2026, supported by sustained demand in smartphones, consumer electronics, and edge computing. Over the five-year horizon, the segment is expected to post a CAGR of 10.9%, with Apple accounting for 42.4% of market share in 2024, highlighting the enduring importance of vertically integrated system design in this market (see Figure 6).

Figure 6. Application-Specific IC Growth Trends (by Component Type): 2024-2029



Source: Sayumi Chung, "Market and Technology Trends in AI Semiconductors and IC Design," ITRI, October 28, 2025, p. 8.

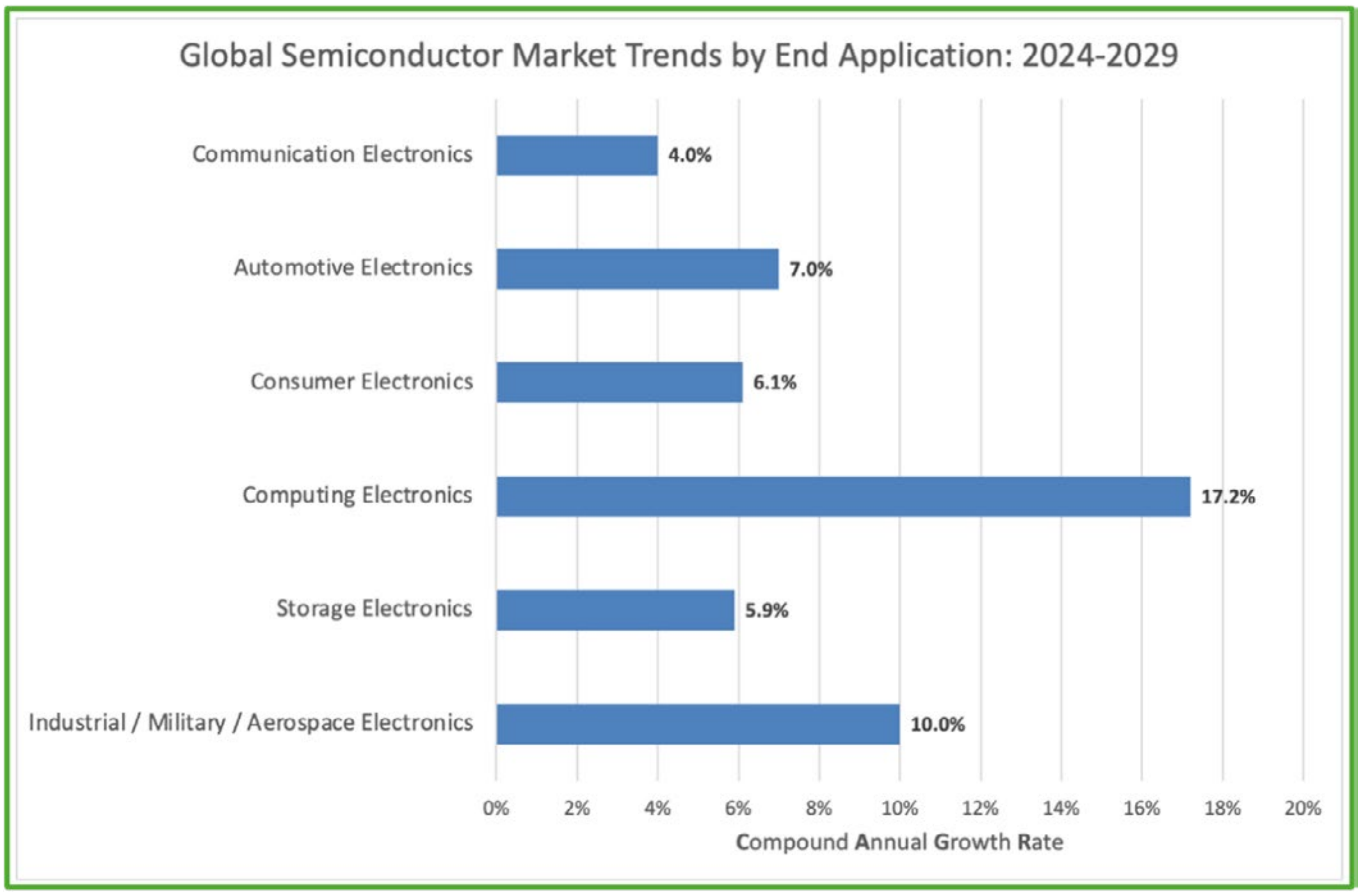
3. End Application

On the end-application of the global semiconductor supply chain, Gartner's 2025 data highlights that Computing Electronics remained the largest application market, reaching US$ 323.7 billion (40.8% share), followed by Communication Electronics at US$ 211.2 billion (34.4%), and Automotive Electronics at US$ 87.4 billion (11.3%). The computing semiconductor market is expected to exhibit a strong CAGR of 24.4% from 2024 to 2029.

In the automotive sector, driven by vehicle electrification and the widespread adoption of high-end Advanced Driver Assistance Systems (ADAS), the global automotive semiconductor market is projected to officially surpass the US$ 100 billion milestone in 2026, reaching US$ 107.7 billion. The average semiconductor value per vehicle is expected to more than double from US$ 860 in 2024 to US$ 1,902 by 2034.

According to the ITRI, Computing Electronics is the fastest-growing segment in the market. Its compound annual growth rate (CAGR) is 17.2% over a 5-year period from 2024 to 2029, a forecast that shows its increasing demand for such services over all else. It is followed by Industrial / Military / Aerospace Electronics (10.0%), Automotive Electronics (7.0%), Consumer Electronics (6.1%), Storage Electronics (5.9%), and Communication Electronics (4.0%). These trends bellies real-events playing out such as the AI race where high-performance computing and industrial/military electronics are in high demand in the industry (see Figure 7).

Figure 7. Global Semiconductor Market Trends by End Application: 2024-2029



Source: Sayumi Chung, "Market and Technology Trends in AI Semiconductors and IC Design," ITRI, October 28, 2025, p. 3.

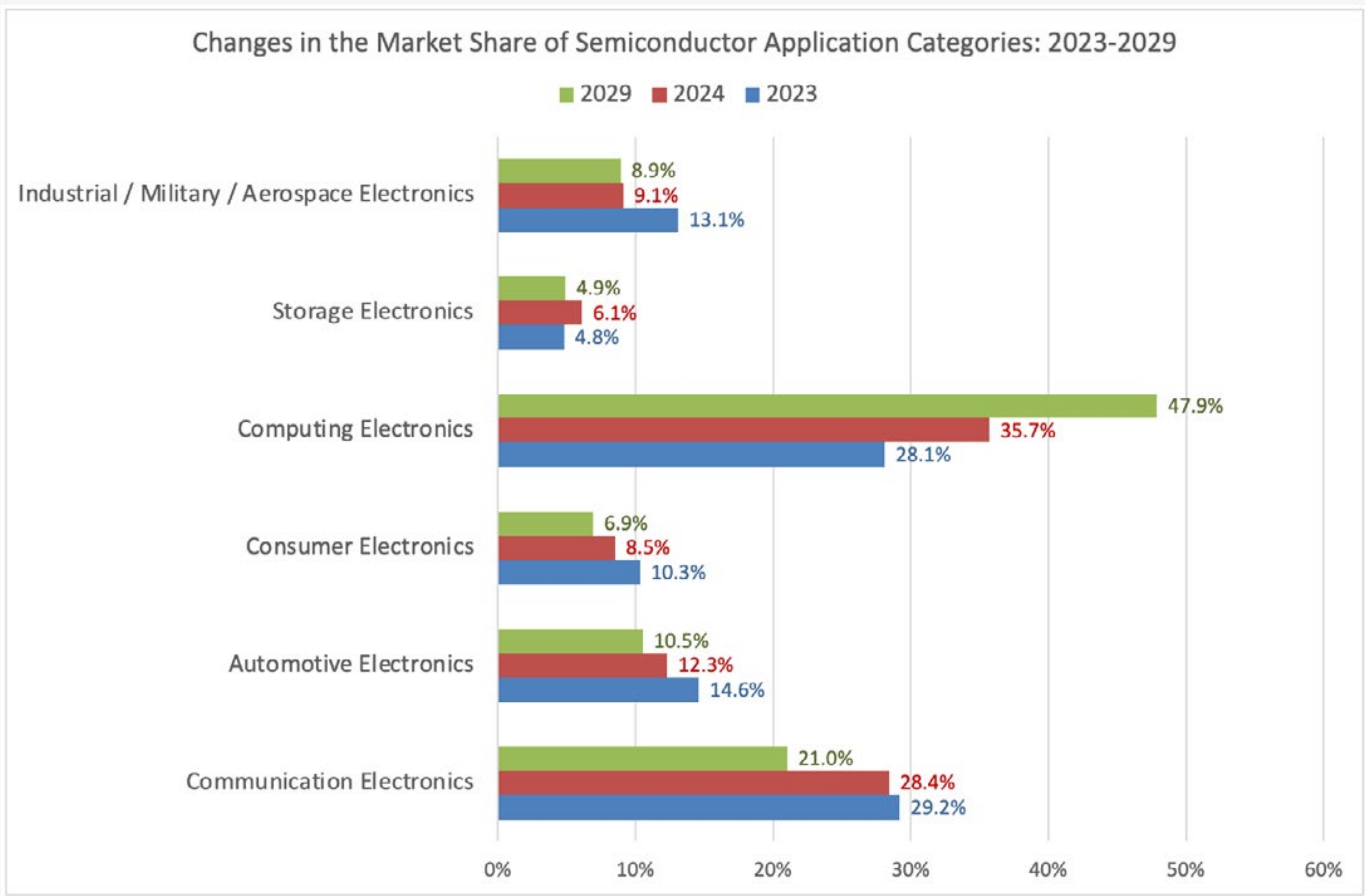
In terms of market share, in 2023, Communication Electronics was the largest application segment, accounting for 29.2%, followed by Computing Electronics at 28.1% and Automotive Electronics at 14.6%. With the rapid expansion of AI and cloud data center demand, Computing Electronics overtook all other segments in 2024, becoming the largest application market with an impressive annual growth rate of 53.9%. Industrial Technology Research Institute (ITRI)[2] further projects strong structural growth in this segment, with increases of 35.4% and 23.9% expected in 2025 and 2026, respectively.

By 2029, the market share of Computing Electronics is forecast to surge to 47.9%, solidifying its position as the dominant application category within the semiconductor industry. Communication

2 Taiwan's leading non-profit applied research and development organization, founded in 1973, that drives industrial innovation, economic growth, and societal well-being through tech R&D, nurturing major companies like TSMC and UMC, and focusing on areas like smart living, green energy, and intelligent vehicles.

Electronics is expected to decline to 21.0% but will remain the second-largest segment, while Automotive Electronics will hold third place with a 10.5% share (see Figure 8).

Figure 8. Changes in the Market Share of Semiconductor Application Categories: 2023-2029



Source: Sayumi Chung, "Market and Technology Trends in AI Semiconductors and IC Design," ITRI, October 28, 2025, p. 4.

From an end-market perspective, 2025 growth was primarily driven by the Computer Segment, which expanded by more than 60% year-over-year, according to WSTS. This exceptional performance reflects continued investment in data center infrastructure and AI-related computing platforms, making it by far the largest contributor to overall semiconductor market growth. Furthermore, Government-related demand increased by 15%, supported by defense and infrastructure spending. The Industrial segment also returned to growth with an increase of 5%, suggesting that the inventory corrections and weaker capital expenditure environment seen in previous years are gradually easing.

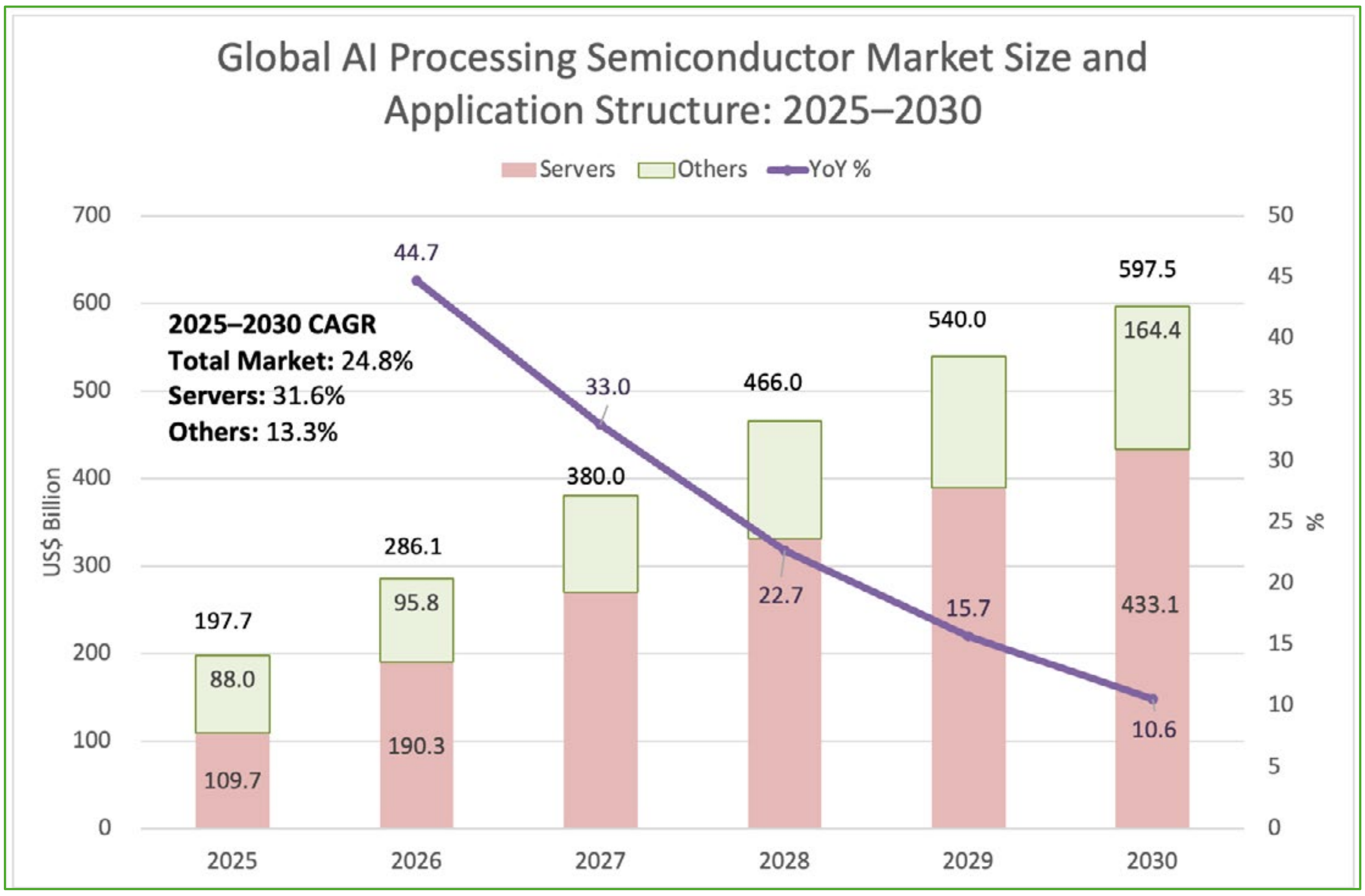
4. AI-oriented Semiconductors

AI-oriented semiconductors have emerged as the primary growth engine of the global semiconductor industry, reflecting the rapid proliferation of artificial intelligence across cloud infrastructure, enterprise applications, and intelligent devices. According to Gartner's first-quarter 2026 forecast, the global AI processing semiconductor market is expected to reach US$ 286.1 billion in 2026, representing a robust 44.7% year-on-year increase. Although annual growth is projected to gradually moderate as the market matures, total revenue is still expected to expand from US$ 197.7 billion in 2025 to US$ 597.5 billion by 2030, equivalent to a strong 24.8% compound annual growth rate (CAGR) over the 2025–2030 period.

The market's expansion will be driven overwhelmingly by the server segment, underscoring the central role of AI data centers in the industry's growth trajectory. Revenue from server-oriented AI semiconductors is projected to increase from US$ 109.7 billion in 2025 to US$ 190.3 billion in 2026, a remarkable 73.5% year-on-year increase. Over the longer term, server-related AI semiconductor revenue is forecast to grow at a 31.6% CAGR between 2025 and 2030, significantly outpacing the overall market. Consequently, the server segment's share of total AI semiconductor demand is expected to rise from 55.5% in 2025 to 66.5% in 2026, before reaching 72.5% by 2030. This trend highlights the sustained wave of hyperscale data-center investment and the growing computational requirements of advanced AI models.

By contrast, non-server applications—including PCs, smartphones, edge devices, and automotive systems—will continue to expand but at a more moderate pace. Revenue from these segments is projected to rise from US$ 88.0 billion in 2025 to US$ 164.4 billion by 2030, corresponding to a 13.3% CAGR over the forecast period. As a result, their share of the overall AI semiconductor market is expected to gradually decline as AI infrastructure spending becomes increasingly concentrated in large-scale computing environments (see Figure 9).

Figure 9. Global AI Processing Semiconductor Market Size and Application Structure: 2025–2030



Source: Ashley Ju, "2026 Global AI Chip Market Dynamics and Structural Shifts," ITRI, June 2, 2026, p. 2.

Within the AI server semiconductor market, GPUs remain the dominant computing architecture, supported by their unmatched capability in large-scale model training and high-performance inference. Nevertheless, the market is gradually diversifying. GPU market share is projected to decline from 82.2% in 2025 to 80.0% in 2026, and further to 64.9% by 2030, as alternative architectures gain traction. Despite this moderation in share, GPU revenue is still expected to grow at a healthy 25.5% CAGR between 2025 and 2030, reflecting the continued expansion of AI workloads worldwide.

Meanwhile, AI accelerators and other non-GPU custom chips are gaining momentum as cloud service providers (CSPs) increasingly design proprietary silicon to improve performance efficiency, optimize energy consumption, and reduce operating costs. This segment is projected to achieve an impressive 53.3% CAGR during 2025–2030, with its share of the AI server semiconductor market expected to reach 27.1% by 2030. The rapid rise of custom AI chips signals a broader industry shift toward more specialized computing architectures tailored to specific workloads.

Perhaps the most consequential development is the emergence of AI inference as the dominant driver of semiconductor demand. Gartner forecasts that 2026 will mark the first year in which AI inference revenue surpasses training revenue, signaling a fundamental shift in the economics of AI computing. Inference-related semiconductor revenue is projected to increase from US$ 51.0 billion (46.4% of the market) in 2025 to US$ 102.0 billion (53.4%) in 2026, before accounting for 77.1% of total AI server semiconductor revenue by 2030.

This transition is being fueled by the rapid adoption of Agentic AI, enterprise AI deployments, and increasingly sophisticated reasoning models. As these systems perform more complex multi-step reasoning, verification, and decision-making tasks, inference-token consumption is expected to grow by approximately fivefold annually, creating a powerful and enduring source of demand for advanced AI semiconductors throughout the remainder of the decade.

In 2024, the global AI semiconductor market totals US$ 138.8 billion, with GPUs dominating at 51% of the market. This reflects their indispensable role in large-scale AI training and high-performance computing. Standalone application and multimedia processors account for 20%, while integrated baseband/application processors contribute 14%, underscoring the continued importance of AI-capable processors embedded in smartphones and consumer devices. At this stage, AI accelerators (non-GPU) represent only 7% of the market, placing them well behind GPUs and integrated processors, while microprocessors account for another 7% and other components remain marginal at around 1%.

By 2029, the market expands dramatically to US$ 438.5 billion, more than tripling in size over five years. GPUs remain the largest single category, but their share declines to 44%, reflecting diversification rather than weakness. In absolute terms, GPU revenues continue to grow strongly, supported by a 2024–2029 CAGR of 22%, ensuring that GPUs remain the backbone of AI computing infrastructure.

The most striking structural change comes from AI accelerators (non-GPU). Their market share surges from 7% in 2024 to 21% in 2029, elevating them to the second-largest segment in the AI semiconductor market. This expansion is underpinned by an exceptional 2024–2029 CAGR of 55.5%, far outpacing all other component categories. The data clearly reflect the strategic shift by cloud service providers and hyperscalers, who are increasingly investing in in-house AI ASICs to achieve higher energy efficiency, lower operating costs, and tighter optimization for specific AI workloads.

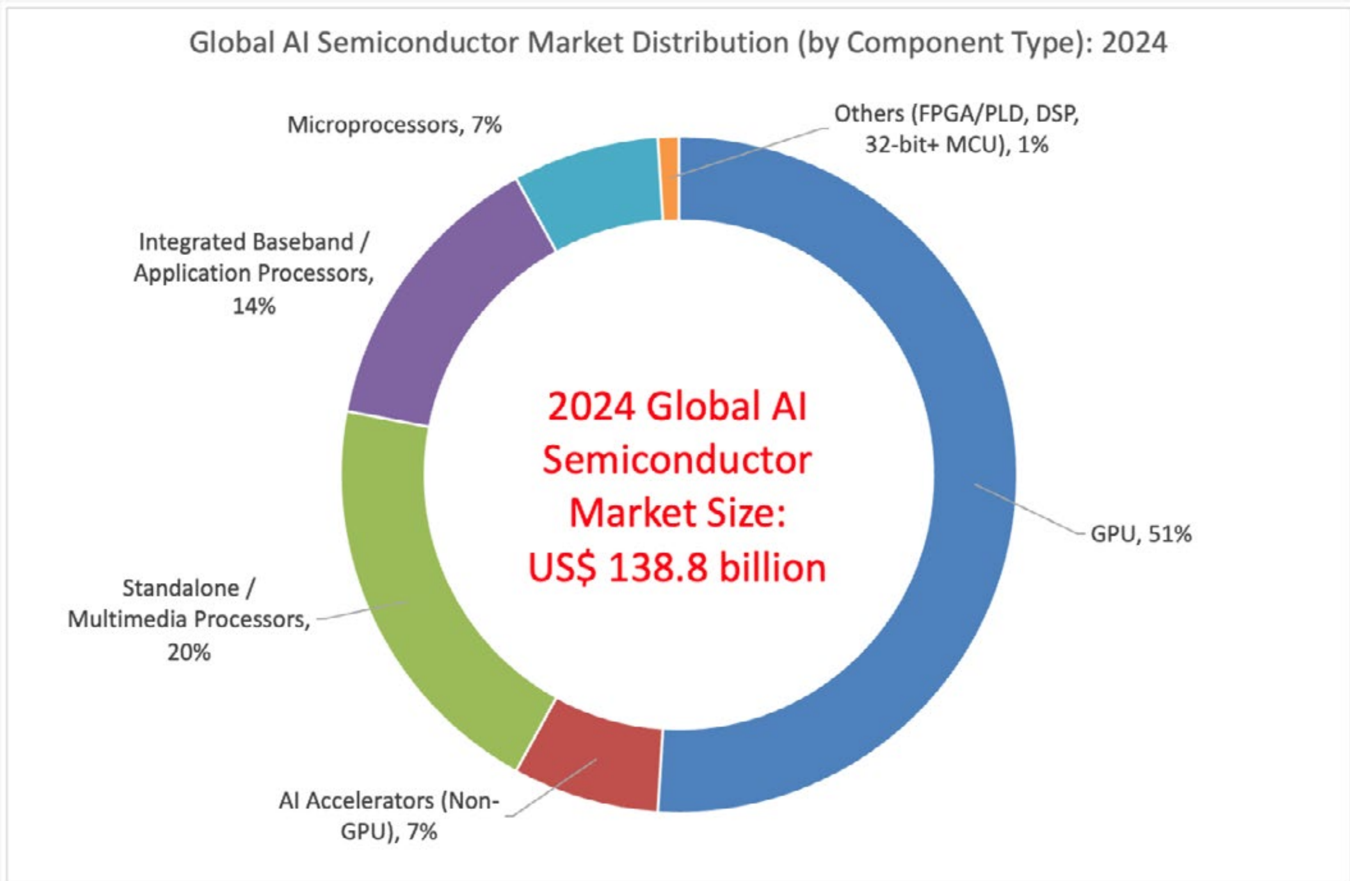
Meanwhile, integrated processors, including standalone application/multimedia processors and integrated baseband/application processors, see their combined market share decline in relative terms—

from 34% in 2024 to 21% in 2029 (14% and 7%, respectively). However, this should not be interpreted as stagnation. Despite losing share to faster-growing AI-specific chips, these integrated solutions continue to expand in absolute value, supported by a 2024–2029 CAGR of 16.6% for standalone application/multimedia processors and 10.3% for integrated baseband/application processors. This indicates that smartphone processors and other integrated AI-capable chips remain on a solid double-digit growth trajectory, driven by AI inference at the edge and broader adoption across consumer devices.

Microprocessors also increase their share from 7% to 13% between 2024 and 2029, supported by a robust 44.1% CAGR, reflecting growing AI-related functionality in industrial, automotive, and embedded systems. Smaller categories grouped under "others" maintain a limited share of around 1%, but still record a high 45.4% CAGR, indicating niche but rapidly emerging applications.

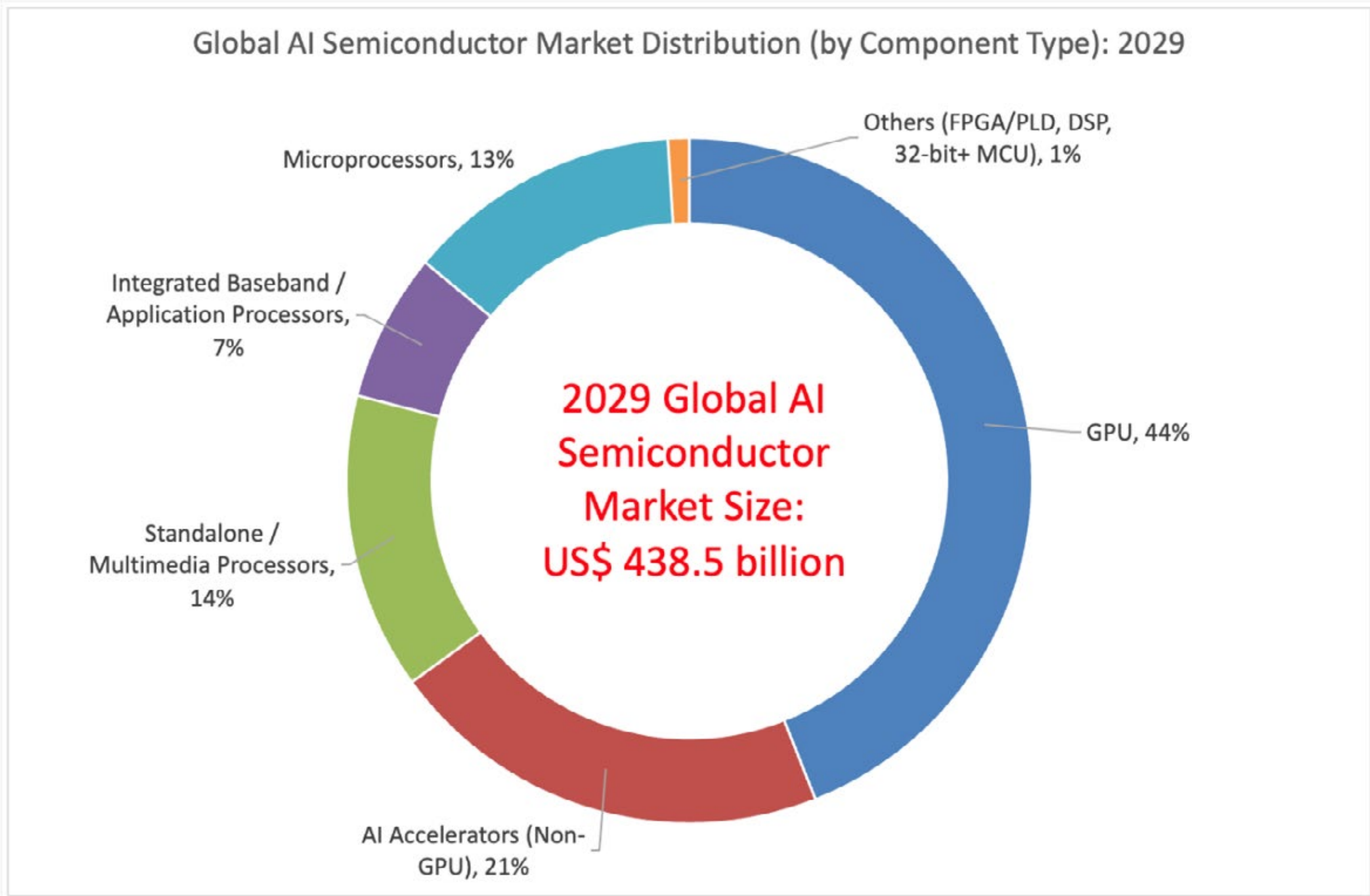
Taken together, the numerical evidence shows a market in which GPUs continue to dominate in absolute scale, AI ASICs rapidly close the gap through explosive growth, and integrated processors sustain healthy double-digit expansion despite relative share erosion. Rather than a zero-sum transition, the AI semiconductor market is evolving into a multi-layered ecosystem, where different chip architectures grow simultaneously, each aligned with distinct performance, cost, and deployment requirements across cloud, edge, and consumer environments (see Figures 10, 11 and 12).

Figure 10. Global AI Semiconductor Market Distribution (by Component Type): 2024



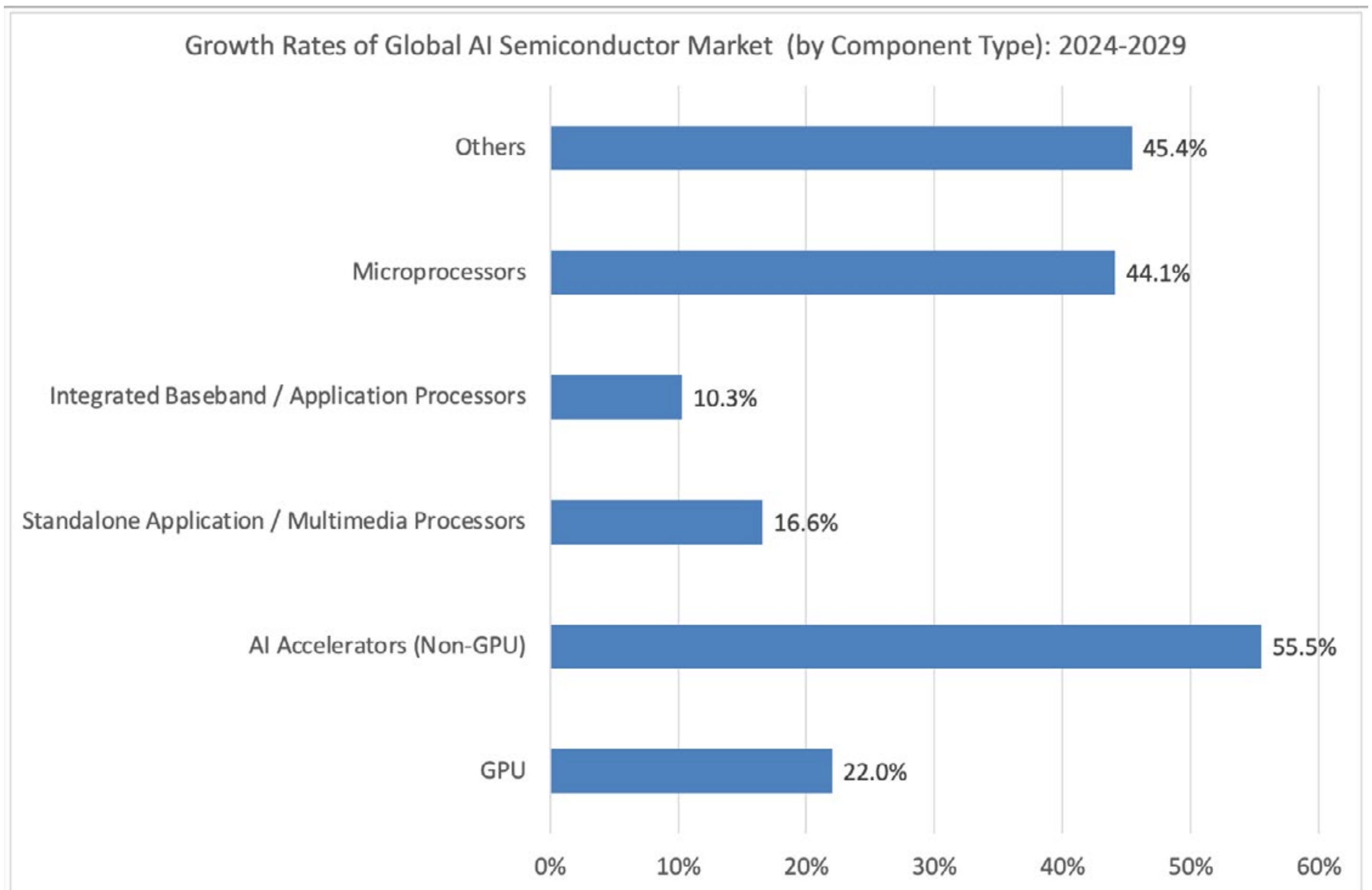
Source: Sayumi Chung, "Market and Technology Trends in AI Semiconductors and IC Design," ITRI, October 28, 2025, p. 20.

Figure 11. Global AI Semiconductor Market Distribution (by Component Type): 2029



Source: Sayumi Chung, "Market and Technology Trends in AI Semiconductors and IC Design," ITRI, October 28, 2025, p. 20.

Figure 12. Growth Rates of Global AI Semiconductor Market (by Component Type): 2024-2029



Source: Sayumi Chung, "Market and Technology Trends in AI Semiconductors and IC Design," ITRI, October 28, 2025, p. 20.

The penetration of AI PCs is accelerating rapidly. It is projected that AI PCs will account for 55% of global PC shipments in 2026, climb to 77% in 2027, and surpass 90% to reach a 91% market share by 2028, driven by the end of Windows 10 support and the demand for edge computing privacy.

Simultaneously, edge AI is entering a new era with the launch of advanced mobile processors utilizing TSMC's third-generation 3nm process in late 2025. This includes Apple's M5 chip 7, Qualcomm's Snapdragon 8 Elite Gen 5 (featuring an "Agentic AI" architecture for proactive intent understanding), and MediaTek's Dimensity 9500.

5. Data Center Processors

The rapid adoption of generative AI applications—including large language models, multimodal AI, and AI-driven cloud services—is fundamentally reshaping demand for data center processors. These workloads require massive parallel processing, high memory bandwidth, and superior energy efficiency, characteristics that strongly favor GPUs and custom AI ASICs over traditional CPU-centric architectures. As a result, both segments are projected to expand significantly over the next five years, with the GPU market approaching nearly US$ 190 billion by 2029, while the AI ASIC market is expected to reach around US$ 60 billion.

In 2024, the data center processor market remains heavily GPU-centric. GPUs account for roughly 70% of total market value, reflecting their dominant role in AI training and large-scale inference. CPUs continue to play an important supporting role, representing approximately 16%, primarily in general-purpose computing and legacy workloads. DPUs and SmartNICs account for about 7%, highlighting their growing importance in offloading networking, storage, and security tasks, while AI ASICs represent roughly 6%, still at an early stage of adoption but already demonstrating strong momentum.

NVIDIA continues to push the boundaries of AI computing. Following its Blackwell Ultra architecture in 2025, NVIDIA is introducing the Rubin architecture in 2026, which integrates the new proprietary Vera CPU and HBM4 memory, paving the way for the future Feynman architecture planned for 2028.

By 2029, the market structure shifts markedly toward a more accelerator-centric configuration. GPUs remain the largest segment, maintaining a share of around 64%, underscoring their enduring importance in AI training and high-performance computing. The most notable change, however, is the rapid rise of AI ASICs, whose market share is projected to exceed 20%, driven by hyperscalers' efforts to deploy in-house, workload-optimized silicon to improve performance per watt and reduce total cost of ownership. In contrast, the CPU share declines to around 10%, reflecting its diminishing role in AI-centric data center architectures as compute-intensive workloads increasingly migrate to accelerators.

Overall, the data point to a clear transition toward an accelerator-dominated data center computing model, in which GPUs provide scalable, general-purpose AI compute, AI ASICs deliver highly efficient and customized acceleration, and CPUs increasingly function as orchestration and control engines rather than the primary source of computing power.

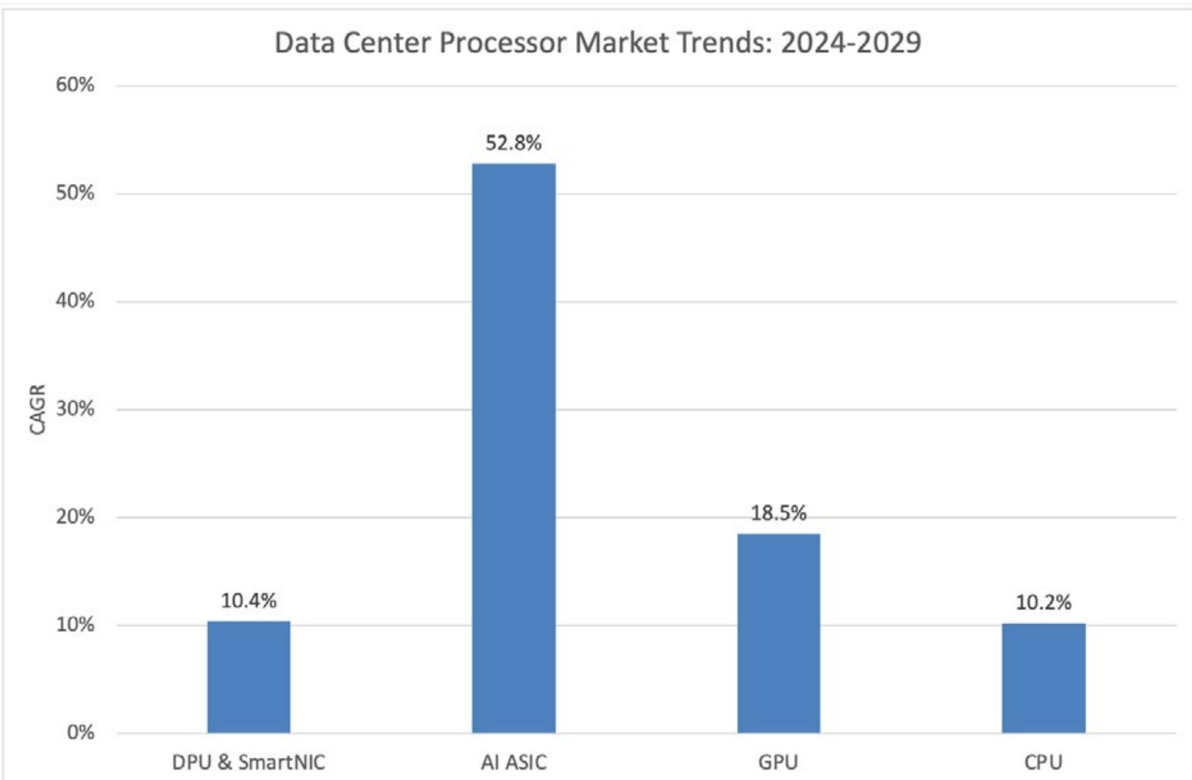
Within this broader shift, the AI ASIC market is expanding at an exceptional pace. Total market value is projected to exceed US$ 25 billion by 2027, reflecting the strategic pivot by major cloud platforms toward proprietary, workload-optimized silicon. In 2025, the AI ASIC market alone is estimated to reach US$ 14.2 billion, underscoring how rapidly custom accelerators are moving from experimental deployments to large-scale production.

Among vendors, Google's TPU stands out as the clear pioneer and market leader in self-developed AI ASICs. In 2025, Google is expected to account for approximately 40.2% of the global AI ASIC market, a position built on early investment in TPU architecture and deep integration with internal AI workloads across training and inference. AWS ranks second, with an estimated 29.3% market share, driven by the rollout of Trainium 2, which significantly expands AWS's in-house AI compute capacity and acts as a key catalyst for market growth in 2025.

Other notable participants include Huawei, with 17.6% market share, reflecting strong domestic demand and vertically integrated deployment, and Intel Gaudi, accounting for 4.5%. Microsoft and Meta remain smaller contributors at this stage, with shares of 1.4% and 0.4%, respectively, while other vendors collectively represent 6.6% of the market.

Taken together, these trends indicate that AI ASICs are no longer niche solutions, but have become a strategic pillar of cloud infrastructure investment. As hyperscalers pursue greater performance efficiency, cost control, and supply-chain resilience, self-developed AI ASICs are set to play an increasingly central role alongside GPUs, driving sustained expansion of the AI computing ecosystem through the second half of the decade (see Figure 13).

Figure 13. Data Center Processor Market Trends: 2024-2029



Source: Sayumi Chung, "Market and Technology Trends in AI Semiconductors and IC Design," ITRI, October 28, 2025, p. 25.

Driven by the expanding deployment of AI infrastructure, global Cloud Service Providers (CSPs) are significantly accelerating their investments. According to TrendForce's latest findings in May 2026, the combined capital expenditures of the world's top nine CSPs—Google, AWS, Meta, Microsoft, Oracle, ByteDance, Tencent, Alibaba, and Baidu—are projected to reach approximately US$ 830 billion in 2026, representing a massive 79% YoY growth. The pace of CapEx expansion among North American CSPs exceeds the global average, underscoring that AI infrastructure has become a core long-term strategic priority, with investments increasingly concentrated in high-performance GPU clusters, in-house ASICs, and next-generation data centers.

In the AI ASIC race, Google maintains its formidable leadership; its 2026 CapEx guidance has been raised to US$ 180–190 billion (with growth exceeding 100% YoY). Driven by Gemini AI applications, its next-generation TPU v8 systems are projected to account for nearly 78% of the AI servers shipped to the company, further widening the gap with GPU-based systems. Other major CSPs are also advancing their proprietary silicon alongside heavy GPU procurement to optimize cost efficiency and AI workload suitability.

Amazon's (AWS) CapEx is expected to exceed US$ 230 billion this year, with growth of over 50% driven by demand for AI cloud services, and its next-generation Trainium 3 is expected to ramp up starting 2Q 2026, while GPUs are expected to represent nearly 60% of its AI server build-out.

Meta has revised its CapEx range upward to US$ 125–145 billion (representing approximately 85% YoY growth), though its in-house MTIA ASIC platform faces software-hardware tuning challenges, keeping its infrastructure predominantly (over 80%) reliant on NVIDIA and AMD GPUs.

Microsoft has increased its CapEx outlook to US$ 190 billion (implying approximately 130% YoY growth) and continues to deploy its Maia 200 chips for high-efficiency inference alongside NVIDIA rack-scale systems.

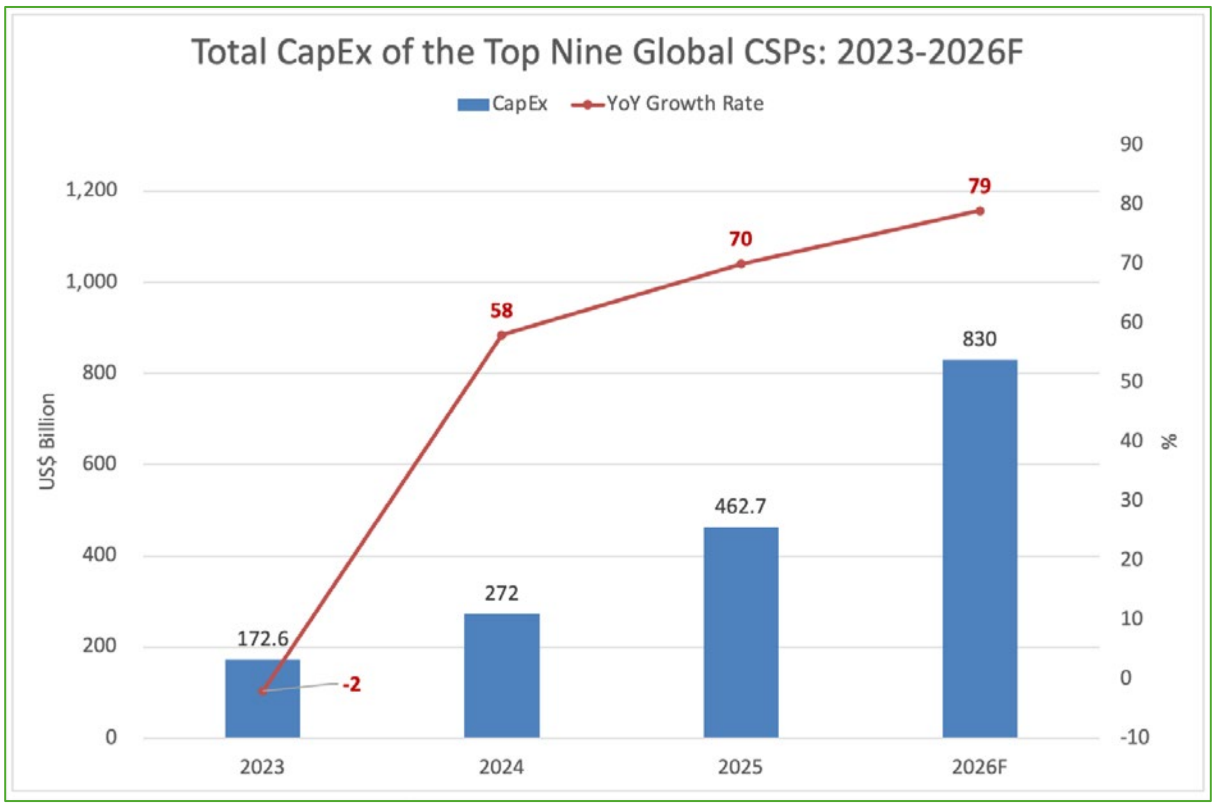
Meanwhile, Chinese CSPs—including ByteDance, Tencent, Alibaba, and Baidu—are actively advancing in-house ASICs (such as Baidu's next-generation Kunlun chips) and collaborating with local partners to diversify compute sources. Alibaba and ByteDance are the main drivers of expansion among them, though their strategies diverge. Alibaba is focusing on localized nodes and sovereign cloud offerings through Alibaba Cloud to penetrate emerging markets, enlarging its global footprint to 29 regions and 94 availability zones. In contrast, ByteDance is aggressively expanding overseas through TikTok across eight countries, including major investments in Europe, Thailand, and Malaysia, making it the most geographically aggressive Chinese CSP.

For instance, TrendForce estimates that over half of ByteDance's investment will be allocated to procuring AI chips, utilizing both NVIDIA H200 solutions and domestic alternatives like Cambricon, subject to U.S.-China regulatory developments. The sharp rise in CapEx also signals sustained momentum in data center construction, led primarily by AWS, Microsoft, Google, Meta, and Oracle. As of the end of

2025, these five North American CSPs had deployed 800–900 data centers globally, with AWS accounting for the lion's share.

Sustained AI demand will continue to drive global data center growth, with total installed power capacity expected to reach approximately 155 GW in 2026 (a 29% YoY increase). Consequently, AI servers are projected to surpass general-purpose servers in total electricity consumption in 2026 due to significantly higher power consumption per unit, which will in turn support growth in key components such as HVDC power systems and liquid cooling systems.

Figure 14. Total CapEx of the Top Nine Global CSPs: 2023-2026F



Source: TrendForce, "North American AI Data Center Expansion Drives 2026 CapEx of Top Nine CSPs to US$830 Billion, Says TrendForce," May 5, 2026.

6. Capital Expenditure

From 2021 to 2025, global semiconductor capital expenditure (CapEx) moved away from a classic boom-and-bust cycle toward structural rebalancing. Industry CapEx rose from US$ 153.1 billion in 2021 to US$ 182.0 billion in 2022 amid post-pandemic shortages, then corrected to US$ 164.0 billion in 2023 as memory markets weakened and inventories accumulated. Spending eased further to US$ 155.0 billion in 2024 before recovering modestly to US$ 160.0 billion in 2025. Crucially, CapEx never returned to pre-2021 levels, instead stabilizing at a historically elevated plateau—evidence that long-term strategic considerations increasingly outweigh short-term cyclical adjustment.

Beneath this headline stability, investment composition shifted markedly. Memory CapEx peaked at US$ 66.2 billion in 2022, fell sharply in 2023, and then stabilized at US$ 56–58 billion in 2024–2025, with its share of total CapEx declining before a mild rebound. This suggests tighter capital discipline and a gradual erosion of memory's structural dominance. By contrast, foundries emerged as the clear beneficiary: their CapEx rose steadily from US$ 37.9 billion in 2021 to US$ 52.4 billion in 2025, lifting their share from 24.8% to 32.8%, reflecting sustained demand for advanced logic, AI-related chips, and geographically diversified manufacturing. IDMs followed a surge-and-normalization pattern, with policy-driven investment peaking in 2023 before moderating as projects shifted from expansion to execution.

At the firm level, these trends are even clearer. Samsung Electronics reduced CapEx and market share, signaling a move away from aggressive scale expansion, while Micron rebounded strongly after a deep 2023 cut, positioning for AI-driven memory demand. SK hynix stabilized after sharp volatility. Among foundries, TSMC remained the single most influential investor, raising CapEx from US$ 30.0 billion to US$ 40.0 billion and expanding its share to 25.0%, reinforcing its role as the anchor of advanced manufacturing. SMIC increased spending within mature nodes under external constraints, while Intel's post-2023 pullback highlights the financial and operational challenges of IDM transformation.

Overall, semiconductor CapEx between 2021 and 2025 became less about indiscriminate capacity expansion and more about strategic reallocation—away from highly cyclical segments and toward foundries, advanced logic, and geopolitically resilient manufacturing footprints. The industry is not merely building more fabs; it is redefining the logic of capital deployment (see Tables 3 and 4).

Table 3. Semiconductor Capital Expenditures: 2021-2025

Unit: US$ Billion

Category / Company	2021	2022	2023	2024	2025
Memory Companies	59.5	66.2	55.1	55.7	58.1
Samsung	38.1	37.1	37.0	33.9	30.3
Micron Technology	9.7	12.0	7.0	8.1	14.0
SK Hynix	11.7	14.7	6.4	11.7	11.2
Others (Memory)		2.5	4.6	2.0	2.5
Foundries	37.9	50.9	47.4	43.4	52.4
TSMC	30.0	36.3	32.0	29.8	40.9
SMIC	4.3	6.4	7.5	7.3	7.3
UMC	1.8	2.7	3.0	2.9	1.8
GlobalFoundries	1.8	3.1	1.8	0.6	0.7
Others (Foundries)		2.5	3.1	2.8	2.6
IDMs	26.4	33.6	61.5	55.9	49.5
Intel	20.3	24.8	25.8	25.1	20.0

Texas Instruments	2.5	2.8	5.1	4.8	5.0
STMicroelectronics	1.8	3.5	4.1	2.5	2.3
Infineon Technologies	1.8	2.4	3.2	3.0	2.7
Others	29.4	30.9	23.3	20.5	19.6
Total CapEx	153.1	182.0	164.0	155.0	160.9

Source: Semiconductor Intelligence, press releases. TSMC News Release, Jan 15, 2026.

Table 4. Share of Semiconductor Capital Expenditures: 2021-2025

Category / Company	2021	2022	2023	2024	2025
Memory Companies	38.9%	36.4%	33.6%	35.9%	36.3%
Samsung	24.9%	20.4%	22.6%	21.9%	18.9%
Micron Technology	6.3%	6.6%	4.3%	5.2%	8.8%
SK Hynix	7.6%	8.1%	3.9%	7.5%	7.0%
Others (Memory)	0.0%	1.4%	2.8%	1.3%	1.6%
Foundries	24.8%	28.0%	28.9%	28.0%	32.8%
TSMC	19.6%	19.9%	19.5%	19.2%	25.0%
SMIC	2.8%	3.5%	4.6%	4.7%	4.6%
UMC	1.2%	1.5%	1.8%	1.9%	1.1%
GlobalFoundries	1.2%	1.7%	1.1%	0.4%	0.4%
Others (Foundries)	0.0%	1.4%	1.9%	1.8%	1.6%
IDMs	17.2%	18.5%	37.5%	36.1%	30.9%
Intel	13.3%	13.6%	15.7%	16.2%	12.5%
Texas Instruments	1.6%	1.5%	3.1%	3.1%	3.1%
STMicroelectronics	1.2%	1.9%	2.5%	1.6%	1.4%
Infineon Technologies	1.2%	1.3%	2.0%	1.9%	1.7%

Others	19.2%	17.0%	14.2%	13.2%	12.3%
Total CapEx	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Semiconductor Intelligence, press releases.

II. Global Semiconductor Supply Chain

1. Business Models

The global semiconductor industry carries strategic importance worldwide and is expanding rapidly. The following sections will further examine the complex semiconductor ecosystem and the global semiconductor supply chain. The semiconductor industry encompasses a diverse landscape of companies with varying business models. Because of high degrees of specialization and capital-intensive production processes, not many companies are involved in the design and production of chips.

According to Gartner[3], the combined growth rate of the ten largest semiconductor vendors reached 41.1% in 2024, pushing their share of the global market from 49.3% in 2023 to 58.8%. The overall semiconductor market climbed to US$ 655.9 billion in 2024, an annual increase of 21.0%. Some companies—such as Samsung, Intel, and SK Hynix—operate across all major stages of production, while others, including NVIDIA, Qualcomm, Broadcom, and Advanced Micro Devices (AMD), are leading players specializing primarily in chip design.

According to the 2024 rankings, NVIDIA surged to the top position with US$ 76.7 billion in revenue, achieving a remarkable 120.1% year-over-year growth. Samsung Electronics followed in second place with US$ 65.7 billion, recording a strong 60.8% increase from 2023. Intel ranked third with US$ 49.8 billion in revenue and a modest 0.8% growth rate. SK hynix rose to fourth place, generating US$ 44.2 billion and posting an impressive 91.5% expansion.

Qualcomm placed fifth with US$ 33.0 billion, growing 12.8%, while Broadcom ranked sixth with US$ 27.8 billion and an 8.5% growth rate. Micron climbed to seventh with US$ 27.6 billion, supported by a notable 71.0% increase. AMD secured the eighth position at US$ 24.1 billion, expanding 8.2%, and Apple ranked ninth with US$ 20.5 billion, growing 13.6%. MediaTek completed the top ten with US$ 15.9 billion in revenue and 18.5% year-over-year growth (see Table 5).

Table 5. Top 10 Semiconductor Vendors by Revenue: 2023-2024

Unit: US$ Million

2024 Rank	2023 Rank	Vendor	2024 Revenue	2024 Market Share (%)	2023 Revenue	2024-2023 Growth (%)
1	3	NVIDIA	76,692	11.7	34,846	120.1
2	2	Samsung Electronics	65,697	10.0	40,868	60.8

3 Gartner is a global research and advisory company founded in 1979, focused on providing senior executives and their teams with actionable, objective, and evidence-based business and technology insights.

3	1	Intel	49,804	7.6	49,427	0.8
4	6	SK hynix	44,186	6.7	23,077	91.5
5	4	Qualcomm	32,976	5.0	29,229	12.8
6	5	Broadcom	27,801	4.2	25,613	8.5
7	12	Micron Technology	27,619	4.2	16,153	71.0
8	7	AMD	24,127	3.7	22,307	8.2
9	8	Apple	20,510	3.1	18,052	13.6
10	13	MediaTek	15,934	2.4	13,451	18.5
Top 10 Semiconductor Vendors			**385,346**	**58.6**	**273,023**	**41.1**
Others (outside top 10)			**270,536**	**41.2**	**269,031**	**0.6**
Total Market			**655,882**	**100.0**	**542,054**	**21.0**

Source: Gartner, "Gartner Says Worldwide Semiconductor Revenue Grew 21% in 2024,"April 10, 2025.

However, according to Gartner's preliminary results for 2025, worldwide semiconductor revenue totaled US$ 793.4 billion, an increase of 21% year-over-year, driven heavily by AI infrastructure spending. NVIDIA extended its lead significantly, becoming the first vendor to cross US$ 100 billion in semiconductor sales, reaching US$ 125.7 billion with a 63.9% growth. Samsung Electronics retained the No. 2 spot with US$ 72.5 billion, while SK hynix moved into the No. 3 position with US$ 60.6 billion, fueled by strong demand for high-bandwidth memory (HBM). Conversely, Intel continued to lose market share, dropping to No. 4 with US$ 47.9 billion. AI semiconductors, including processors, HBM, and networking components, accounted for nearly one-third of total sales in 2025 (see Table 6).

Table 6. Top 10 Semiconductor Vendors by Revenue: 2025

Unit: US$ Million

2025 Rank	2024 Rank	Vendor	2025 Revenue	2025 Market Share (%)	2024 Revenue	2025-2024 Growth (%)
1	1	NVIDIA	125,703	15.8	76,692	63.9
2	2	Samsung Electronics	72,544	9.1	65,697	10.4
3	4	SK Hynix	60,640	7.6	44,186	37.2
4	3	Intel	47,883	6.0	49,804	-3.9
5	7	Micron Technology	41,487	5.2	27,619	50.2
6	5	Qualcomm	37,046	4.7	32,976	12.3
7	6	Broadcom	34,279	4.3	27,801	23.3
8	8	AMD	32,484	4.1	24,127	34.6

9	9	Apple	24,596	3.1	20,510	19.9
10	10	MediaTek	18,472	2.3	15,934	15.9
		Top 10 Semiconductor Vendors	**495,134**	**62.2**	**385,346**	**28.5**
		Others (outside top 10)	**298,315**	**37.6**	**270,536**	**10.3**
		Total Market	**793,449**	**100.0**	**655,882**	**21.0**

Source: Gartner, Press Release, January 12, 2026.

Depending on their level of integration and business model, semiconductor companies can be categorized into four main types: integrated device manufacturers (IDMs), fabless design firms, foundries, and outsourced semiconductor assembly and test (OSAT) companies.

U.S.-headquartered companies such as Intel and Texas Instruments are leading IDMs while NVIDIA, Qualcomm, Broadcom and AMD are dominant fabless companies. Taiwan-headquartered companies such as TSMC and United Microelectronics Corporation (UMC) are key foundries while ASE Technology Holding Co., Ltd. (ASEH) is a world leader in assembly, packaging, and testing of semiconductors (see Table 7).

Table 7. Type of Semiconductor Company by Business Model

TYPE	DESCRIPTION	EXAMPLES
IDMs	Companies that design, manufacture, and sell their own semiconductor products. They handle both the design and production processes in-house.	· Intel · Samsung · STMicroelectronics · Texas Instruments
Fabless companies	Companies focus solely on chip design and development and outsources the manufacturing (fabrication) process to external foundries.	· NVIDIA · Qualcomm · AMD · MediaTek
Foundries	Companies with specialized manufacturing facilities that produce semiconductor wafers based on designs provided by fabless companies. They offer fabrication (front-end manufacturing) services to multiple clients.	· TSMC · Samsung · UMC · GlobalFoundries
OSATs	Companies handle the assembly, packaging, and testing (back-end manufacturing) of semiconductor chips. They take the bare semiconductor dies (chips) and package them into final products (such as integrated circuits).	· ASE Technology Holding · Amkor Technology

In terms of function, the semiconductor supply chain spans seven key sectors, beginning with R&D, where future device capabilities are defined, and design, where engineers create chip architectures and circuits. These blueprints then move to front-end manufacturing, where wafers are fabricated, followed by back-end processes that cut, assemble, test, and package the chips for shipment. Supporting these core stages are EDA and core IP providers offering crucial design software and patents, equipment suppliers delivering advanced tools like lithography machines, and materials producers supplying ultra-pure silicon, gases, and chemicals essential for manufacturing (see Table 8).

Table 8. Sectors in Semiconductor Supply Chain

	SECTOR	DESCRIPTION
1.	Research & Development (R&D)	The R&D sector determines the future capabilities and performance of semiconductor devices.
2.	Design	The blueprints for semiconductor devices, including the architecture and circuit design are created by engineers during this phase.
3.	Front-End Manufacturing: Wafer Fabrication	After the design stage, semiconductor chips are fabricated in facilities often referred to as fabs or foundries.
4.	Back-End Manufacturing: Assembly, Testing and Packaging (ATP)	After the wafers are fabricated, they are cut into individual chips, assembled into packages, tested for quality and functionality, and then prepared for shipment.
5.	Electronic Design Automation (EDA) and Core Intellectual Property (IP)	EDA refers to the software tools used for designing semiconductor devices. Core IP involves the essential designs and patents that are part of the semiconductor devices.
6.	Equipment and Tools	This sector provides the specialized machinery and tools required for semiconductor manufacturing, such as lithography equipment, etchers, and testers.
7.	Materials	Semiconductors require high-purity materials, including silicon, various gases, and chemicals used throughout the manufacturing process.

Semiconductor firms must make substantial investments in talent, facilities, and equipment. Because research and development, design, and advanced manufacturing all require significant capital expenditures, the industry remains defined by exceptionally high barriers to entry. As a result, despite global demand, only a limited group of countries and companies possess the technical depth, infrastructure, and financial capacity to participate meaningfully in production.

TrendForce Analysis

The production of integrated circuits (ICs) is generally divided into three core stages: circuit design, wafer fabrication, and packaging and testing.

From the perspective of wafer manufacturing, within a semiconductor fabrication plant (fab), the most critical scaling-related process steps include thin-film deposition, photolithography, etching, and ion implantation. Thin-film deposition involves growing conductive or insulating layers on the wafer surface using physical vapor deposition (PVD) or chemical vapor deposition (CVD). Photolithography applies photoresist to the wafer and uses extreme ultraviolet (EUV) or deep ultraviolet (DUV) exposure systems to project circuit patterns from a photomask onto the wafer. Etching then removes the unprotected portions of the thin film—either through plasma-based dry etching or chemical wet etching—to form precise circuit patterns. Ion implantation introduces dopant atoms into the silicon lattice to adjust the electrical conductivity of specific regions, thereby forming transistor structures.

After completing the front-end-of-line (FEOL) transistor fabrication, the process proceeds to back-end-of-line (BEOL) metallization, where multilayer interconnects are formed. At this stage, copper-based damascene processes are primarily used to create complex interconnection networks between devices. Chemical mechanical planarization (CMP) is employed to ensure an extremely flat surface for each layer, facilitating subsequent stacking and processing. Once wafer fabrication is completed, wafers undergo wafer probing (CP test) to screen and identify electrically qualified dies.

The process then moves to packaging, where qualified dies are diced and encapsulated within protective substrates. By adopting advanced packaging technologies such as CoWoS (Chip on Wafer on Substrate) or three-dimensional (3D) stacking, system-level integration can be further enhanced. However, according to TrendForce's latest findings in April 2026, AI demand has surged rapidly since 2023, leading to capacity bottlenecks in 2.5D/3D advanced packaging. The consumption of wafer and packaging resources per chip is increasing exponentially as the demand for AI compute drives larger chip sizes.

The shortage of CoWoS has persisted, extending upstream to production equipment and downstream to substrates, packaging materials, and other critical components. The resource competition triggered by AI has spread across the entire semiconductor supply chain. Industry leader NVIDIA, leveraging its experience and strong supply chain control, was among the first to identify tightening capacity and preemptively secured large volumes of 4/3 nm wafer capacity, CoWoS packaging, as well as key materials such as T-glass, substrates, PCBs, HBM, and SSDs. While other tech giants like Google also have strong demand, delays in securing critical components have led to material shortages, constraining product growth.

Despite TSMC's ongoing capacity expansion, CoWoS has remained in short supply since 2023, prompting customers to seek alternative capacity sources . OSAT providers such as SPIL and Amkor have benefited from this spillover demand, and alternative technologies like EMIB and FOEB are also gaining traction, with Intel leveraging its U.S.-based manufacturing advantage.

TrendForce expects that the severe shortage in global 2.5D packaging capacity will begin to ease slightly by 2027, aided by order spillover and TSMC's plan to expand CoWoS capacity by over 60% by 2027.

Finally, the packaged products undergo comprehensive functional and reliability testing to ensure compliance with design specifications before shipment (see Figure 15).

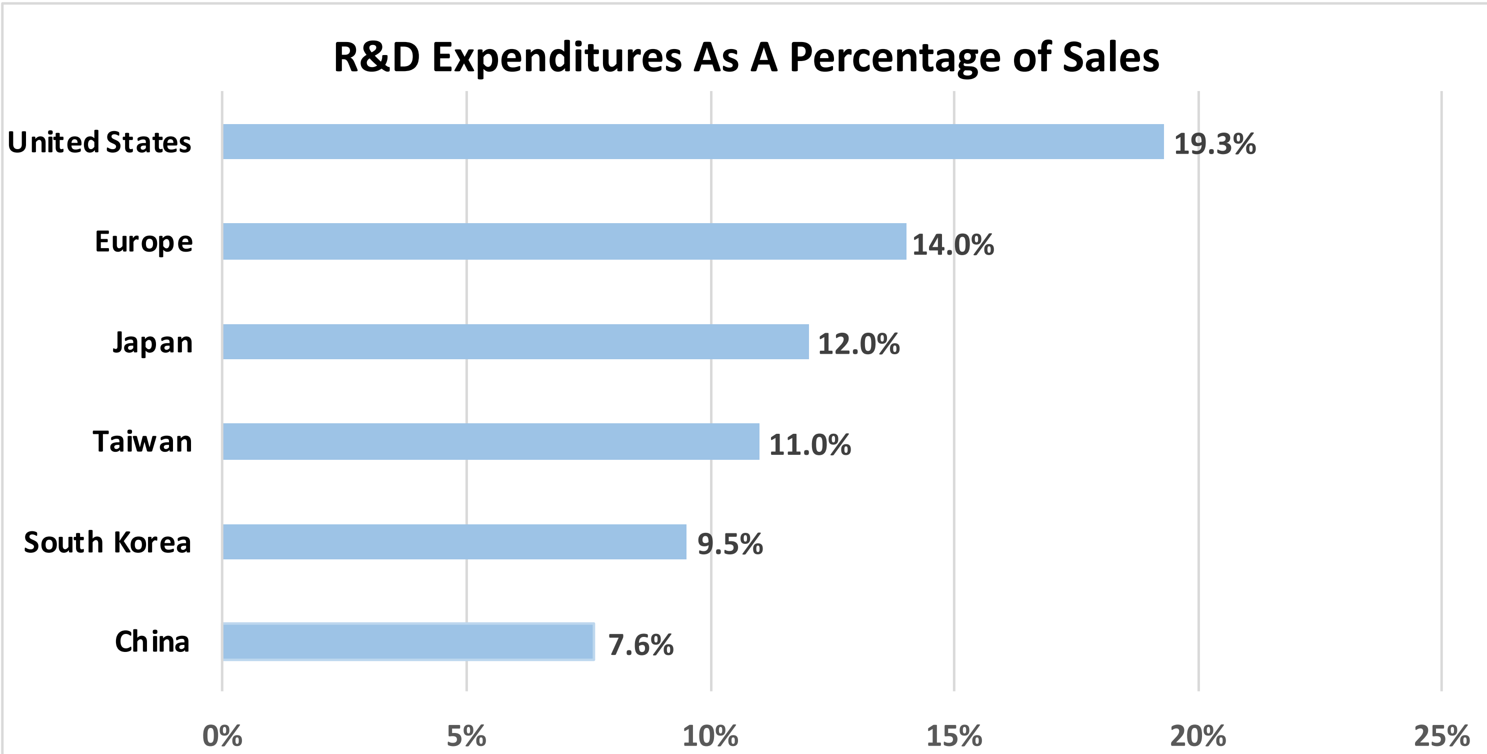
Figure 15. Overview of Semiconductor Manufacturing Process Technology

2. Research and Development

U.S. semiconductor firms continue to hold a global leadership position in research and development. In 2024, total R&D investment by the U.S. semiconductor industry reached US$ 62.7 billion, representing a 5.7% year-over-year increase and accounting for 17.7% of total industry revenue. This strong private-sector commitment is reinforced by public policy support. Under the CHIPS for America program—part of the broader CHIPS and Science Act enacted on August 9, 2022—US$ 11 billion has been earmarked specifically to advance semiconductor research and development.

In 2023, the United States led all major regions in R&D spending as a share of semiconductor sales, while China recorded the lowest ratio. R&D expenditures as a percentage of sales were 19.3% for the United States, 14.0% for Europe, 12.0% for Japan, 11.0% for Taiwan, 9.5% for South Korea, and 7.6% for China (see Figure 16).

Figure 16. Semiconductor Industry R&D Spending Across Regions: 2023



Source: Semiconductor Industry Association, State of the U.S. Semiconductor Industry 2024, September 17, 2024, p. 29.

3. Chip Design

Semiconductor chips can be broadly classified into three main categories, namely, logic, memory, and discrete, analog and other (DAO) chips. Each category of chips performs different functions and requires specialized design and manufacturing processes.

Logic chips are crucial for processing and executing instructions in electronic devices; memory chips, such as dynamic random-access memory (DRAM) and "not and" (NAND) flash memory, are essential for storing and retrieving data in devices; while DAO chips are used in the design and optimization of semiconductor manufacturing processes.

Chip design is carried out by fabless companies and IDMs. Fabless companies focus on designing semiconductor chips and partner with other companies (foundries) for the manufacturing phase while IDMs design and manufacture their own chips in their own fabs.

The U.S. leads in design automation software known as electronic design automation (EDA), and reusable pieces of intellectual property (IP), called core IP. The top three EDA companies, namely, U.S.-

based Cadence, Synopsys, and Mentor Graphics (a U.S.-based subsidiary of the German firm Siemens) control about 70% of the global EDA market.[4]

According to TrendForce, in 2024, the global IC design industry reached a total production value of US$ 249.8 billion. Benefiting from the surge in demand for generative AI–related chips, the combined revenue of the top 10 fabless IC design companies exceeded US$ 359.4 billion in 2025, representing a robust 44% year-on-year increase. This growth was largely driven by sustained capital expenditure on AI infrastructure by major cloud service providers (CSPs).

Among the world's top ten IC design companies, NVIDIA continued to dominate the rankings in 2025, underpinned by explosive demand for AI computing and the rapid expansion of AI servers and data-center processing capabilities. The company delivered another year of record performance, with full-year revenue rising 65.0% year-on-year to US$ 205.73 billion. Its share of total top-ten revenue further increased to 57%, reinforcing its unparalleled leadership in the industry. In other words, more than half of the top-tier IC design market now effectively speaks with a single accent—CUDA.

Broadcom advanced to second place, reflecting its deepening engagement in AI-related applications, with revenue reaching US$ 39.73 billion (up 30.0% year-on-year) and accounting for 11% of the top 10 market. Qualcomm slipped to third position, as its heavier reliance on consumer electronics moderated its growth, recording revenue of US$ 38.90 billion (up 12.0%) and likewise holding an 11% share.

AMD ranked fourth with revenue of US$ 34.64 billion, expanding 34.0% and maintaining a 10% share, supported by strong demand for high-performance computing. MediaTek placed fifth, driven by solid shipments of its flagship Dimensity 9500 chipset, achieving a record revenue of US$ 19.12 billion (up 16.0%) and capturing 5% of the market.

The remaining companies collectively account for only a small fraction of the total. Marvell generated US$ 8.06 billion (up 43.0%) with a 2% share, while Realtek (US$ 3.93 billion, up 11.0%), OmniVision (US$ 3.31 billion, up 10.0%), Novatek (US$ 3.23 billion, up 1.0%), and Monolithic Power Systems (US$ 2.79 billion, up 26.0%) each held approximately 1% of the market. This distribution underscores the increasing concentration of industry value, where scale—particularly in AI and data center applications—has become the defining competitive advantage.

A notable development is NVIDIA's recently announced US$ 2 billion investment in Marvell, targeting collaboration on customized XPUs, scale-up interconnect architectures based on NVLink Fusion, optical interconnects, and silicon photonics technologies. This partnership enables Marvell to develop platforms compatible with NVLink Fusion, signaling that competition in AI infrastructure is extending beyond GPU performance to encompass interconnect standards and system-level integration. In this context, AI networking is rapidly evolving from a supporting function into a critical foundation that determines the efficiency and scalability of AI clusters.

Structurally, the 2025 landscape is marked by an unprecedented concentration of revenue. NVIDIA

4 Zeyi Yang, "Inside the software that will become the next battle front in US-China chip war," MIT Technology Review, August 18, 2022.

alone accounts for 74.2% of total revenue among the top 10 firms, far exceeding all peers combined. The second tier—comprising Broadcom (8.3%) and AMD (8.1%)—remains significant but distant, followed by Qualcomm (3.7%), MediaTek (2.4%), and Marvell (2.2%). The remaining firms each contribute less than 1%, highlighting a pronounced long-tail structure in which technological leadership and ecosystem control increasingly outweigh traditional scale metrics.

From a national perspective, the United States overwhelmingly dominates the IC design sector, accounting for 97.3% of total revenue among the top 10 firms in 2025, with its share of the top 10 market rising to 93%. In contrast, Taiwan represents only 2.7% of revenue and 7% of market share, despite having multiple companies on the list (see Table 9).

Table 9. Top 10 Global IC Design Companies: 2025

Ranking		Company	Revenue		YoY	Contribution	Top 10 Share	
2025	2024		2024	2025			2024	2025
1	1	NVIDIA (US)	124,377	205,732	65.0%	74.2%	50%	57%
2	2	Broadcom (US)	30,644	39,727	30.0%	8.3%	12%	11%
3	3	Qualcomm (US)	34,857	38,896	12.0%	3.7%	14%	11%
4	4	AMD (US)	25,785	34,639	34.0%	8.1%	10%	10%
5	5	MediaTek (TW)	16,530	19,117	16.0%	2.4%	7%	5%
6	6	Marvell (US)	5,637	8,061	43.0%	2.2%	2%	2%
7	7	Realtek (TW)	3,530	3,930	11.0%	0.4%	1%	1%
8	8	OmniVision (CN)	3,011	3,312	10.0%	0.3%	1%	1%
9	9	Novatek (TW)	3,201	3,228	1.0%	0.0%	1%	1%
10	10	MPS (US)	2,207	2,790	26.0%	0.5%	1%	1%
Total of Top 10			249,780	359,432	44.0%	100.0%	100%	100%
US Share			223,507	329,845	48%	97.3%	90%	93%
TW Share			23,261	26,275	13%	2.7%	9%	7%
CN Share			3,011	3,312	10%	0.3%	1%	1%

Source: TrendForce, April 2026. "Contribution," "US Share," " TW Share" and "CN Share" are calculated by the author.

Among the world's top ten IC design companies in 2024, NVIDIA continued to dominate the rankings, driven by explosive demand for AI computing and the aggressive expansion of AI servers and data-center processing capabilities by cloud service providers.

NVIDIA achieved an astonishing 120.1% annual growth rate in 2024, reaching US$ 76.69 billion in revenue. This created a substantial gap with the second-ranked Qualcomm, whose revenue was only

US$ 32.98 billion, less than half of NVIDIA's. Broadcom ranked third with US$ 27.80 billion, followed by AMD with US$ 24.13 billion and Apple with US$ 20.51 billion. The sixth to tenth positions were held by MediaTek (US$ 15.93 billion), Marvell (US$ 5.64 billion), HiSilicon (US$ 4.79 billion), Realtek (US$ 3.52 billion) and Novatek (US$ 3.17 billion) respectively.

Notably, China's HiSilicon, Huawei's in-house chip design subsidiary, recorded a sharp surge in revenue in 2024, due to Huawei's rapid expansion in AI servers and automotive applications. Its new AI server, the CloudMatrix 384, which debuted in Shanghai in July 2025 and uses 384 of Huawei's Ascend 910C chips, competes with NVIDIA's own top-performing GB200 NVL72 AI server, which integrates 72 Nvidia Blackwell GPUs and 36 Nvidia Grace CPUs (Nvidia chips are individually more powerful than Ascend chips).

From a country-level perspective, among the top ten global IC design companies in 2024, the U.S., Taiwan and China dominates the world supply chain. United States accounted for six firms with a combined market share of 87.3%. Taiwan had three companies with a 10.5% share, while China had one company accounting for 2.2%. Looking at the overall industry, U.S.-based companies held approximately 69% of the global IC design market in 2024, while Taiwan accounted for about 17%, bringing the combined U.S.–Taiwan share to over 85%. China represented roughly 12%, still trailing significantly behind the United States and Taiwan **(see Table 10).**

Table 10. Top 10 Global IC Design Companies: 2024

Unit: US$ Billion

Rank	Company	Country	Main Products	Revenue	Growth Rate
1	NVIDIA	US	AI, HPC, Automotive Processors	76.69	120.1%
2	Qualcomm	US	5G (Mobile Processors, Base Stations), AI, HPC, Communication ICs	32.98	12.8%
3	Broadcom	US	5G (Base Stations), AI, HPC, Communication ICs	27.80	8.5%
4	AMD	US	AI, HPC	24.13	8.2%
5	Apple	US	5G (Mobile Processors), AI, CPU	20.51	13.6%
6	MediaTek	TWN	5G (Mobile Processors), AI, Communication ICs, IoT ICs	15.93	18.5%
7	Marvell	US	5G (Base Stations), AI, Communication ICs, Embedded Processors	5.64	3.4%
8	HiSilicon	CN	5G (Mobile Processors), AI, Communication ICs	4.79	105.2%

9	Realtek	TWN	Networking ICs, Multimedia ICs, PC Peripheral ICs, AI	3.52	15.7%
10	Novatek	TWN	Display Driver ICs, Digital TV ICs, AI	3.17	-10.0%
Total				**215.15**	**100.0%**
U.S. Share				**187.74**	**87.3%**
TWN Share				**22.623**	**10.5%**
China Share				**4.79**	**2.2%**

Source: Sayumi Chung, "Market and Technology Trends in AI Semiconductors and IC Design," ITRI, October 28, 2025, p. 12.

4. Wafer Fabrication

The precision and control required in wafer fabrication make it one of the most technology- and capital- intensive processes in manufacturing. In the wafer fabrication sector, Taiwan's TSMC holds the distinction of being both Taiwan's and the world's largest foundry.

In the first quarter of 2026, the global semiconductor foundry industry successfully defied its traditional seasonal slowdown, driven by continued growth in artificial intelligence (AI) demand and advance inventory buildup in consumer electronics. According to data from TrendForce[5], the combined revenue of the world's top ten foundries reached US$ 47.95 billion, representing a 3.7% quarter-on-quarter increase and 31.7% year-on-year growth, setting a new all-time quarterly record.

TSMC Captures Virtually All Industry Growth, Market Share Exceeds 72% for the First Time

TSMC reported first-quarter revenue of US$ 35.86 billion, up 6.3% from the previous quarter and more than 40% higher than a year earlier, significantly outperforming the industry average. In absolute terms, TSMC's quarterly revenue increased by approximately US$ 2.1 billion, while the combined revenue of the top ten foundries rose by only about US$ 1.7 billion. This indicates that nearly all incremental demand in the industry during the quarter was absorbed by TSMC.

Consequently, TSMC's global foundry revenue market share rose from 70.4% in the fourth quarter of 2025 to 72.3% in the first quarter of 2026, surpassing the 72% threshold for the first time and reaching a record high. In contrast, the market shares of most competitors stagnated or declined, reflecting an ongoing concentration of new demand toward technologically advanced industry leaders (see Table 11).

5 TrendForce is a global provider of market intelligence, in-depth analysis, and consulting services for the technology industry

Table 11. Global Top 10 Foundries by Revenue: Q1 2026

Unit: US$ Million

Ranking	Company	Q1 2026	Q4 2025	Quarterly Growth rate	Contribution	Q1 2025	Yearly Growth Rate	Contribution
1	TSMC (TW)	35,855	33,723	6.3%	125.3%	25,517	40.5%	89.5%
2	Samsung (KR)	3,201	3,399	-5.8%	-11.6%	2,893	10.6%	2.7%
3	SMIC (CN)	2,505	2,489	0.6%	0.9%	2,247	11.5%	2.2%
4	UMC (TW)	1,930	1,993	-3.2%	-3.7%	1,759	9.7%	1.5%
5	GlobalFoundries (USA)	1,634	1,830	-10.7%	-11.5%	1,575	3.7%	0.5%
6	Huahong Group (CN)	1,230	1,215	1.2%	0.9%	1,011	21.7%	1.9%
7	Tower (IL)	414	440	-6.0%	-1.5%	358	15.6%	0.5%
9	Nexchip (CN)	400	388	3.2%	0.7%	353	13.3%	0.4%
8	VIS (TW)	398	406	-2.1%	-0.5%	363	9.6%	0.3%
10	PSMC (TW)	386	370	4.4%	0.9%	327	18.0%	0.5%
Total of Top 10	47,953	46,252	3.7%	100.0%	36,403	31.7%	100.0%	100.0%

Source: Raw data are from TrendForce press releases; growth rates and "contribution" are calculated by the author.

Second-Tier Foundries Lag Behind as the Gap with TSMC Widens

Samsung, the world's second-largest foundry, generated approximately US$ 3.2 billion in revenue during the quarter, down 5.8% quarter-on-quarter. Its market share declined from 7.1% to 6.5%, widening the gap with TSMC to 65.8 percentage points and underscoring the increasingly dominant position of a single market leader.

SMIC maintained its position as the world's third-largest foundry, with revenue of US$ 2.51 billion, up 0.6% from the previous quarter, while its market share remained stable at 5.1%. Although the company continued to achieve double-digit year-on-year growth, its expansion lagged significantly behind that of TSMC, limiting any further improvement in its global standing.

UMC reported revenue of US$ 1.93 billion, down 3.2% quarter-on-quarter, with its market share declining from 4.2% to 3.9%. GlobalFoundries recorded revenue of US$ 1.63 billion, down approximately 11%, and saw its market share fall from 3.8% to 3.3%. Together, the two companies accounted for 7.2% of the global market, a notable decline from a year earlier.

Huahong Group posted revenue of US$ 1.23 billion, up 1.2% quarter-on-quarter, maintaining a 2.5% market share. Tower Semiconductor generated US$ 414 million, down 6%, while retaining its 0.8% market share and ranking.

Among the eighth- to tenth-ranked foundries, Nexchip recorded revenue growth of 3.2% to US$ 400 million, rising from ninth to eighth place and achieving its highest ranking to date. Vanguard International Semiconductor (VIS) saw revenue decline 2.1% to nearly US$ 400 million, slipping to ninth place. Powerchip Semiconductor Manufacturing Corporation (PSMC) posted foundry revenue of US$ 386 million, up 4.4%, ranking tenth globally (see Table 12).

Table 12. Global Market Shares of the Top 10 Semiconductor Foundries: 2023–2026

Ranking	Company	Market Share												
		2026Q1	2025Q4	2025Q3	2025Q2	2025Q1	2024Q4	2024Q3	2024Q2	2024Q1	2023Q4	2023Q3	2023Q2	2023Q1
1	TSMC (TW)	72.3%	70.4%	71.0%	70.2%	67.6%	67.1%	64.7%	62.3%	61.7%	61.2%	57.9%	56.4%	60.1%
2	Samsung (KR)	6.5%	7.1%	6.8%	7.3%	7.7%	8.1%	9.1%	11.5%	11.0%	11.3%	12.4%	11.7%	12.4%
3	SMIC (CN)	5.1%	5.2%	5.1%	5.1%	6.0%	5.5%	6.0%	5.7%	5.7%	5.2%	5.4%	5.6%	5.3%
4	UMC (TW)	3.9%	4.2%	4.2%	4.4%	4.7%	4.7%	5.1%	5.3%	5.7%	5.4%	6.0%	6.6%	6.4%
5	GlobalFoundries (USA)	3.3%	3.8%	3.6%	3.9%	4.2%	4.6%	4.8%	4.9%	5.1%	5.8%	6.2%	6.7%	6.6%
6	Huahong Group (CN)	2.5%	2.5%	2.6%	2.5%	2.7%	2.6%	2.7%	2.1%	2.2%	2.0%	2.6%	3.0%	3.0%
7	Tower (IL)	0.8%	0.9%	0.9%	0.9%	0.9%	1.0%	1.0%	1.1%	1.1%	1.1%	1.2%	1.3%	1.3%
8	Nexchip (CN)	0.8%	0.8%	0.9%	0.9%	1.0%	0.9%	1.0%	1.0%	1.0%	1.0%	1.1%	1.2%	1.0%
9	VIS (TW)	0.8%	0.8%	0.9%	0.8%	0.9%	0.9%	0.9%	0.9%	1.0%	1.0%	1.0%	n.a.	n.a.
10	PSMC (TW)	0.8%	0.8%	0.8%	0.8%	0.9%	0.8%	0.9%	1.0%	1.0%	1.0%	1.0%	1.2%	1.2%
Total of Top 10		96.8%	96.5%	97.0%	96.8%	96.8%	97.0%	96.2%	96.2%	96.0%	96.0%	95.0%	95.0%	94.0%

Source: Trendforce, Press Releases.

Market Concentration Reaches a New High as the Leading Firms Pull Further Ahead

From a structural perspective, the global foundry industry became increasingly concentrated in the first quarter of 2026. The world's top ten foundries collectively accounted for 96.8% of the market, while TSMC alone captured 72.3%. Combined, the top three foundries—TSMC, Samsung, and SMIC—held 83.9% of the global market, while the top five controlled more than 90%.

Compared with a year earlier, TSMC's market share increased by approximately five percentage points, whereas major competitors including Samsung, UMC, and GlobalFoundries generally lost market share. This trend highlights how new demand in the global foundry industry is increasingly concentrated among a small number of technologically leading firms (see Table 13).

Table 13. Market Share of Global Top 10 Foundries by Revenue: 2022-2025

Ranking	Company	Revenue					Market Share			
		2025	2024	Difference	Growth Rate (YoY)	Contribution	2025	2024	2023	2022
1	TSMC	122,543	90,047	32,496	36.1%	92.1%	69.9%	64.4%	58.9%	55.4%
2	Samsung	12,634	13,152	-518	-3.9%	-1.5%	7.2%	9.4%	12.0%	16.0%
3	SMIC	9,327	8,030	1,297	16.2%	3.7%	5.3%	5.7%	5.4%	5.3%
4	UMC	7,629	7,234	395	5.5%	1.1%	4.4%	5.2%	6.1%	6.8%
5	GlobalFoundries	6,791	6,750	41	0.6%	0.1%	3.9%	4.8%	6.3%	6.0%
6	HuaHong Group	4,500	3,595	905	25.2%	2.6%	2.6%	2.6%	2.7%	3.1%
7	Tower	1,566	1,436	130	9.1%	0.4%	0.9%	1.0%	1.2%	1.3%
8	VIS	1,561	1,371	190	13.8%	0.5%	0.9%	1.0%	1.1%	1.3%
9	Nexchip	1,514	1,286	228	17.7%	0.6%	0.9%	0.9%	1.0%	1.3%
10	PSMC	1,404	1,304	100	7.7%	0.3%	0.8%	0.9%	1.1%	1.7%
Total of Top 10		169,469	134,204	35,265	26.3%	100.0%	97.0%	96.0%	95.8%	98.2%

Source: Raw data are from TrendForce press releases; growth rates and "contribution" are calculated by the author.

5. Packaging and Testing

After front-end fabrication of the chips, wafers are typically sent to other facilities for back-end manufacturing activities such as assembly, testing, and packaging (collectively known as ATP). Semiconductor packaging and testing is largely a labor-intensive process involving precise handling, assembly, and inspection of tiny and delicate semiconductor devices. The global semiconductor packaging and testing industry is largely dominated by outsourced semiconductor assembly and test (OSAT) companies. These firms specialize in providing third-party IC packaging and testing services, including wafer bumping, wafer probing, IC packaging, and IC testing. To take advantage of lower wages and input costs, a significant portion of the world's ATP production is located in Asia. The global top two OSAT companies are Taiwan's ASEH and US-headquartered Amkor Technology.[6]

In this book, the term "global packaging and testing industry" primarily refers to the output value of third-party OSAT services. Because the packaging and testing divisions of IDMs or foundries typically do not disclose standalone revenue, estimates of the global IC packaging and testing market are largely based on OSAT revenue figures. As third-party service providers, OSAT firms offer packaging and testing outsourcing services to fabless companies as well as IDMs/foundries, forming an indispensable link in the semiconductor supply chain.

6 News, "Chinese Semiconductor Design Industry Diverts to Malaysia to Evade U.S. Controls; Potential Advanced Packaging Orders Surge for ASE," TrendForce, December 19, 2023.

Based on changes in global IC packaging and testing output value shown in Figure 17, the industry experienced strong growth from 2021 to 2022. Supported by demand generated during and after the pandemic—particularly remote-work–driven needs—the global semiconductor market continued expanding, propelling synchronous growth in the packaging and testing sector. In 2022, the industry's output value reached US$ 42.61 billion, marking a five-year high.

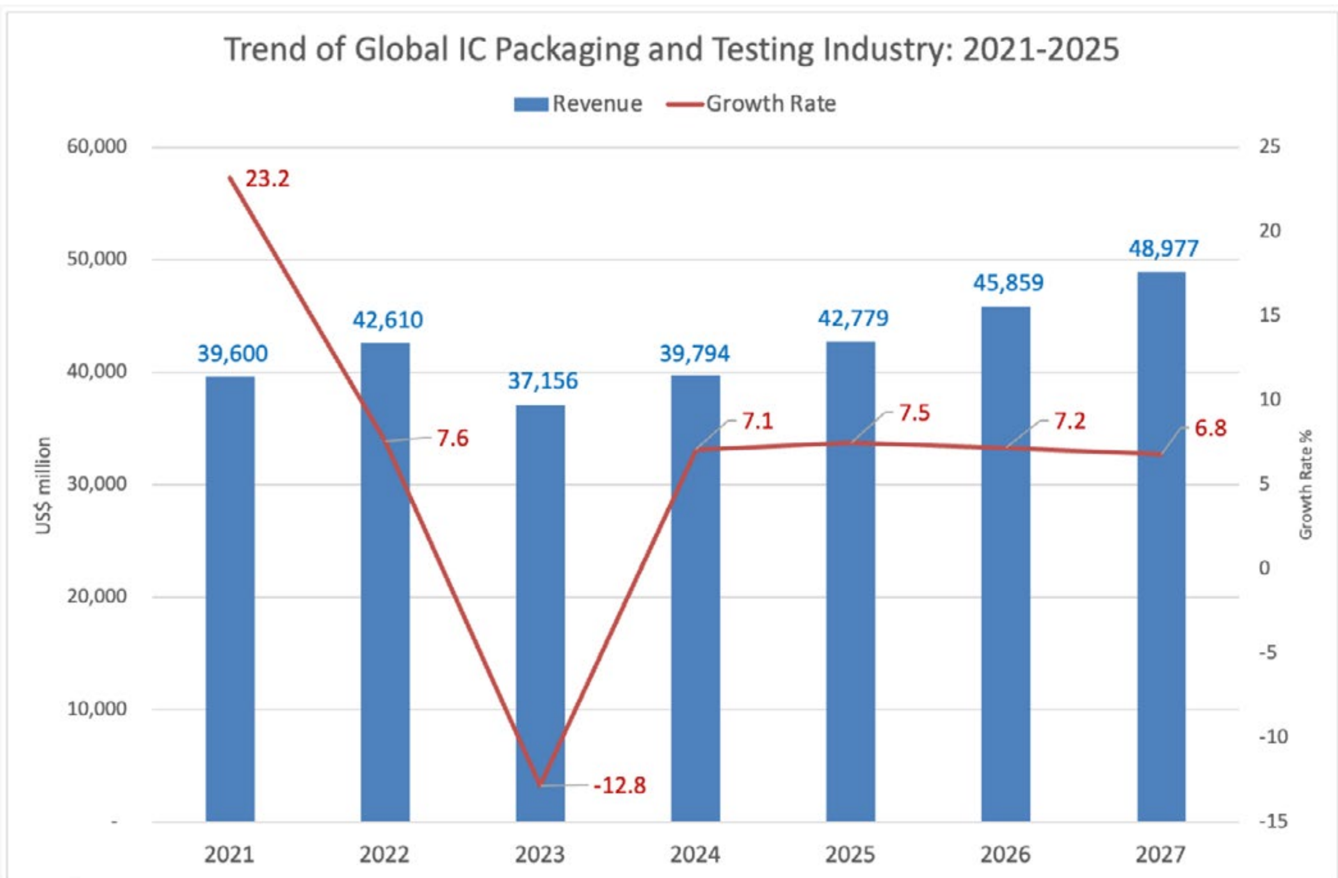
However, at the beginning in the second half of 2022, the global economy began to cool significantly. Central banks in major economies raised interest rates to curb inflation, leading to a contraction in both corporate capital expenditure and consumer electronics demand. The sharp slowdown in end-market demand elevated chip inventory levels, which in turn further suppressed packaging and testing requirements.

Under these multiple headwinds, the global IC packaging and testing industry saw a substantial decline in 2023. The annual output value fell by 12.8% from the previous year to US$ 37.16 billion. Nevertheless, 2023 also marked the low point of the inventory correction cycle.

Starting in 2024, as inventory digestion concluded and market demand gradually recovered, the sector rebounded to US$ 39.79 billion, representing year-over-year growth of 7.1%.

Looking ahead to 2025, with improving global economic conditions and strong momentum from high-end applications such as AI servers and data centers, the packaging and testing industry is poised for more stable growth. According to forecasts by the IEK of ITRI, industry revenue is expected to grow an additional 7.5% in 2025, reaching US$ 42.78 billion—potentially setting a new historical high (see Figure 17).

Figure 17. Trend of Global IC Packaging and Testing Industry: 2021-2025



Source: Jing-Han Chen, "Development Trends and Technological Innovations in the Advanced Semiconductor

Packaging Industry," IEK, ITRI, October 28, 2025, p.2.

The global OSAT industry in 2024 experienced a year of mild recovery accompanied by a noticeable redistribution of growth and market share across both companies and countries. The top 10 OSAT companies generated US$ 41.56 billion in revenue, compared with US$ 40.34 billion in 2023, representing an absolute increase of US$ 1.22 billion, or 3.0% year on year. While total industry revenue expanded, this growth was unevenly distributed, with leading incumbents showing modest contraction and mid-tier players driving most of the incremental gains.

At the company level, ASE Holdings of Taiwan remained the dominant global OSAT player, but its revenue declined from US$ 18.68 billion to US$ 18.54 billion, a decrease of US$ 0.14 billion, while its global market share fell from 46.3% to 44.6%. Amkor of the United States, the second-largest player, followed a similar trajectory, with revenue slipping by US$ 0.18 billion to US$ 6.32 billion and market share declining from 16.1% to 15.2%. In contrast, JCET of China recorded a significant expansion, increasing revenue by US$ 0.81 billion to US$ 5.0 billion, and raising its global market share from 10.4% to 12.0%, thereby reinforcing its position as the world's third-largest OSAT provider. Other Chinese firms also posted solid gains: Tongfu Microelectronics (TFME) increased revenue by US$ 0.18 billion to US$ 3.32 billion, while Tianshui Huatian (TSHT) achieved the fastest growth among the top 10, expanding revenue by US$ 0.42 billion to US$ 2.01 billion, accompanied by a rise in market share from 4.0% to 4.8%.

In Asia, Hana Micron of Korea strengthened its position by increasing revenue from US$ 0.74 billion to US$ 0.92 billion, lifting its global market share from 1.8% to 2.2%. Among Taiwanese mid-sized players, PTI (Powertech Technology) and ChipMOS recorded small but positive revenue growth, while KYEC (King Yuan Electronics) experienced a notable downturn, with revenue falling by US$ 0.15 billion to US$ 0.91 billion and market share declining from 2.6% to 2.2%. WiseRoad of China remained broadly stable, with modest revenue growth and an unchanged market share of 3.7%.

The redistribution of growth becomes even clearer at country level. Taiwan continued to be the largest OSAT base globally, but its combined revenue among the top 10 declined from US$ 22.69 billion to US$ 22.44 billion, and its global market share fell from 56.2% to 54.0%, reflecting revenue pressure at ASE and KYEC. China, by contrast, emerged as the main growth engine, with total revenue rising from US$ 10.4 billion to US$ 11.89 billion, an absolute increase of US$ 1.49 billion, and market share expanding significantly from 25.9% to 28.5%. The United States, represented solely by Amkor, saw its share of the top 10 market ease from 16.1% to 15.2%, while Korea modestly increased its presence, with revenue rising from US$ 0.74 billion to US$ 0.92 billion and market share moving from 1.8% to 2.2%.

Overall, the 2024 data indicate that while the global OSAT industry has returned to growth in absolute terms, competitive dynamics are shifting. Scale leaders remain firmly in place, but incremental growth and rising market share are increasingly concentrated among Chinese and select Korean firms, pointing to a gradual rebalancing of global OSAT capacity and influence rather than a sudden structural break (see Table 14).

Table 14. Global Top10 OSAT Company Revenue Rankings: 2024

Ranking	Company	Revenue			Top10 Market Share	
		2023	2024	YoY	2023	2024
1	ASE Holdings (TW)	18.68	18.54	-0.7%	46.3%	44.6%
2	Amkor (US)	6.5	6.32	-2.8%	16.1%	15.2%
3	JCET (CN)	4.19	5	19.3%	10.4%	12.0%
4	TFME (Tongfu Microelectronics, CN)	3.14	3.32	5.6%	7.8%	8.0%
5	PTI (Powertech Technology Inc., TW)	2.26	2.28	1.0%	5.6%	5.5%
6	TSHT (Tianshui Huatian Technology, CN)	1.59	2.01	26.0%	4.0%	4.8%
7	WiseRoad (CN)	1.48	1.56	5.0%	3.7%	3.7%
8	Hana Micron (KR)	0.74	0.92	23.7%	1.8%	2.2%
9	KYEC (King Yuan Electronics, TW)	1.06	0.91	-14.5%	2.6%	2.2%
10	ChipMOS (TW)	0.69	0.71	3.1%	1.7%	1.7%
Taiwan total		**22.69**	**22.44**	**-1.1%**	**56.2%**	**54.0%**
U.S. total		**6.5**	**6.32**	**-2.8%**	**16.1%**	**15.2%**
China total		**10.4**	**11.89**	**14.3%**	**25.9%**	**28.5%**
Korea total		**0.74**	**0.92**	**24.3%**	**1.8%**	**2.2%**
Top 10 total		**40.34**	**41.56**	**3.0%**	**100.0%**	**100.0%**

Source: Press release, "Top 10 OSAT Companies of 2024 Revealed—China Players See Double-Digit Growth, Reshaping the Global Market Landscape, Says TrendForce," TrendForce, May 13, 2025.

6. Semiconductor Materials and Equipment

Semiconductor production depends on a highly specialized ecosystem spanning materials, manufacturing equipment, design software, and core intellectual property. Among these, equipment suppliers are central, providing the tools that enable chip fabrication. US-headquartered firms dominate most categories of semiconductor manufacturing equipment, with the main exceptions being photolithography and wafer handling. Leading companies such as Applied Materials, Lam Research, and KLA collectively control about 35% of the global market, reflecting US strengths in deposition, etching, and process control technologies.[7]

7 Lauly Li, "U.S. chip tool makers eye Southeast Asia as China business shrinks," Nikkei Asia, February 10, 2023.

Within the broader equipment market, key semiconductor equipment modules represent a critical and rapidly growing segment. According to a January 2026 ITRI report, the global market size for key semiconductor equipment modules reached US$ 22.57 billion in 2025 and is projected to grow at a compound annual growth rate (CAGR) of 7.9% to reach US$ 32.94 billion by 2030.[8]

Driven by the increasing complexity of advanced packaging (such as 3D stacking for AI chips) and the growing number of etching and deposition steps in high-aspect-ratio structures, the fastest-growing sub-segments from 2025 to 2030 are expected to be vacuum modules (12.2% CAGR), thermal management modules (11.3% CAGR), and power and reactive gas modules (10.5% CAGR). To secure technological advantages and supply chain resilience, leading module suppliers and equipment manufacturers are increasingly engaging in global mergers and acquisitions.

A critical exception to US dominance lies in photolithography. The Netherlands' ASML is the world's sole supplier of extreme ultraviolet (EUV) lithography systems, a prerequisite for manufacturing the most advanced chips. Upstream materials are similarly concentrated in Japan: JSR, Tokyo Ohka Kogyo, Shin-Etsu Chemical, and Fujifilm Electronic Materials together account for roughly three-quarters of the global market for high-end photoresists and hold a near-monopoly in EUV photoresists.

The supply of silicon wafers is also controlled by a small number of firms, led by Japan's Shin-Etsu Chemical and Sumco, alongside Taiwan's GlobalWafers. This concentration underscores the structural importance of materials suppliers, whose reliability and technological depth directly shape the resilience of the entire semiconductor value chain.[9]

In 2024, global semiconductor equipment sales reached approximately ¥19.8 trillion (about US$ 137 billion), marking 19.5% year-over-year growth. The United States accounted for 43.3% of global sales (around US$ 59 billion), driven by its leading equipment firms. The Netherlands followed with 25.7% (about US$ 35 billion), largely due to ASML and ASM International, while Japan contributed 20.8% (around US$ 29 billion) through a broad range of lithography-related and inspection tools. China represented 3.5% (about US$ 4.8 billion), reflecting rapid growth from a low base, and Singapore, at 0.7% (about US$ 1.0 billion), participated mainly through ASMPT's role in advanced packaging equipment (see Table 15).

Table 15. Top 20 Global Semiconductor Equipment Manufacturers: 2024

Unit: Yen 100 Million

Rank	Company name	Headquarters country	2024 Sales	2023 Sales	Year-over-year Growth Rate	Share
1	ASML	Netherlands	46,069	41,613	10.7%	23.2%
2	Applied Materials	United States	40,319	35,398	13.9%	20.3%

8 Wen-Chi Chang, "Market Trend Analysis of Key Semiconductor Equipment Modules," ITRI, January 28, 2026.
9 Yole Group, Press Release: "Globalwafers to mass produce advanced SiC wafers by 2025," October 27, 2023.

3	Lam Research	United States	24,476	20,040	22.1%	12.3%
4	Tokyo Electron	Japan	23,232	18,264	27.2%	11.7%
5	KLA	United States	16,379	12,786	28.1%	8.3%
6	Advantest	Japan	6,832	4,981	37.2%	3.4%
7	SCREEN	Japan	5,157	3,881	32.9%	2.6%
8	NAURA	China	4,977	3,205	55.3%	2.5%
9	ASM International	Netherlands	4,781	3,977	20.2%	2.4%
10	Disco	Japan	4,040	2,954	36.8%	2.0%
11	Teradyne	United States	3,207	2,547	25.9%	1.6%
12	Canon	Japan	2,813	2,250	25.0%	1.4%
13	SEMS	Japan	2,698	2,714	-0.6%	1.4%
14	Lasertec	Japan	2,420	1,899	27.4%	1.2%
15	Hitachi High-Tech	Japan	2,250	2,082	8.1%	1.1%
16	Kokusai Electric	Japan	2,238	1,918	16.7%	1.1%
17	AMEC	China	1,903	1,241	53.3%	1.0%
18	Ebara	Japan	1,571	1,447	8.6%	0.8%
19	Axcelis	United States	1,537	1,583	-2.9%	0.8%
20	ASMPT	Singapore	1,317	1,138	15.7%	0.7%
Netherlands total			50,850	45,590	11.5%	25.7%
U.S. total			85,918	72,354	18.7%	43.3%
Japan total			41,262	33,528	23.1%	20.8%
Singapore total			1,317	1,138	15.7%	0.7%
China total			6,880	4,446	54.7%	3.5%
Total			198,216	165,918	19.5%	100.0%

Source: "Top 10 Global Semiconductor Equipment Manufacturers for 2024 Revealed," Tonarism, April 3, 2025.

In the third quarter of 2025, the global semiconductor equipment market remained highly concentrated among a small number of leading suppliers. The top ten companies generated a combined revenue of about US$ 35.1 billion, reflecting continued investment by semiconductor manufacturers in advanced fabrication technologies driven by demand for artificial intelligence, high-performance computing, and data centers. ASML of the Netherlands remained the largest supplier, with a market share of 25.1%, largely due to its dominance in extreme ultraviolet (EUV) lithography systems. It was followed by major U.S. firms such as Applied Materials, Lam Research, and KLA, as well as Japanese companies including Tokyo Electron and Advantest, which together form the technological backbone of the global semiconductor manufacturing ecosystem.

From a national perspective, the semiconductor equipment industry is dominated by a few advanced economies. U.S. companies accounted for about 43.7% of the market among the top suppliers, reflecting the strong position of American firms in deposition, etching, and process control technologies. The Netherlands held 27.7%, primarily due to ASML's leadership in lithography equipment, while Japan represented 24.1%, supported by several major equipment manufacturers. In comparison, China accounted for about 4.4%, although companies such as Naura have been expanding rapidly as China seeks to strengthen its domestic semiconductor equipment capabilities (see Table 16).

Table 16. Top 10 Global Semiconductor Equipment Suppliers by Revenue in 3Q 2025

Unit: US$ Million

Rank	Vendor	2Q 2025	3Q 2025	QoQ Change	Share
1	ASML (Netherlands)	8,722.8	8,782.8	0.7%	25.1%
2	Applied Materials (USA)	7,302.0	6,800.0	-6.9%	19.4%
3	Lam Research (USA)	5,171.0	5,324.0	3.0%	15.2%
4	Tokyo Electron (Japan)	3,803.6	4,270.9	12.3%	12.2%
5	KLA Corp (USA)	3,063.0	3,209.7	4.8%	9.2%
6	Advantest (Japan)	1,825.7	1,782.3	-2.4%	5.1%
7	Naura (China)	1,097.0	1,559.3	42.1%	4.4%
8	Ebara (Japan)	1,634.1	1,456.1	-10.9%	4.2%
9	Screen Holdings (Japan)	939.8	938.9	-0.1%	2.7%
10	ASM International (Netherlands)	948.2	934.8	-1.4%	2.7%
Total		34,507.2	35,058.8	1.6%	
Netherlands' share			27.7%		
USA's share			43.7%		
Japan's share			24.1%		
China's share			4.4%		

Source: TrendForce, "ASML EUV Dominance & China's Semiconductor Equipment Push," Dec. 23, 2025.

Record quarterly billings were driven by continued AI-related investment, including capacity expansion and technology upgrades supporting leading-edge logic, DRAM, and advanced packaging. According to the Worldwide Semiconductor Equipment Market Statistics (WWSEMS) report recently announced by SEMI, global semiconductor equipment billings increased 14% year-over-year to US$ 36.55 billion in the first quarter of 2026, registering a 1% quarter-over-quarter growth.

From a regional perspective, the growth momentum in the first quarter of 2026 was primarily driven by Korea and Taiwan. China remained the largest global semiconductor equipment market with US$ 10.99 billion (a 7% YoY increase), despite experiencing a 16% QoQ decline. Korea surged to the second position with US$ 8.93 billion, demonstrating strong growth of 26% QoQ and 16% YoY. Taiwan followed closely in third place at US$ 8.77 billion, expanding 18% QoQ and an impressive 24% YoY. Meanwhile, North America (US$ 3.28 billion, up 12% YoY) and Europe (US$ 0.95 billion, up 9% YoY) also maintained positive growth trends. Japan was the only major region to experience a notable decline, with its billings dropping to US$ 2.16 billion (-24% QoQ, -1% YoY) (see Table 17).

Table 17. Semiconductor Equipment Market Revenue by Region: 2025-2026

Unit: US$ Billion

Region	1Q 2026	4Q 2025	1Q 2025	1Q (QoQ)	1Q (YoY)
Europe	0.95	0.74	0.87	28%	9%
Japan	2.16	2.82	2.18	-24%	-1%
North America	3.28	3.09	2.93	6%	12%
Korea	8.93	7.08	7.69	26%	16%
Taiwan	8.77	7.44	7.09	18%	24%
China	10.99	13.13	10.26	-16%	7%
Rest of the World	1.48	1.97	1.03	-25%	43%
Total	36.55	36.27	32.05	1%	14%

Sources: SEMI, "Record Quarterly Equipment Billings Reflect Continued AI-Driven Investment," June 4, 2026
Note: Summed subtotals may not equal total due to rounding.

7. Value-Added Share

Different regions have strengths in different areas. A Boston Consulting Group (BCG) report in May 2024 highlights the U.S.'s strong position in design, core IP, and EDA; the U.S., EU, and Japan jointly lead in equipment; companies headquartered in China, Japan, Taiwan, and South Korea lead in materials; South Korea- and Taiwan-headquartered companies lead the world in advanced node fabrication (sub-10 nanometer chips); and the assembly, test and packaging (ATP) segment is concentrated in Taiwan and China.

The U.S. dominates virtually all precompetitive research and design activities. In 2022, the U.S. accounting for 68% of value-added in the EDA & Core IP segment, followed by the EU (25%), Taiwan (3%), South Korea (1%), China (1%), and others contribute minimally. The U.S. also leads at 65% value-added in the logic chip design and 41% value-added in the design of discrete, analog, and other (DAO) chips segments. In the memory chip design segment, South Korea accounted for 60% of value-added in 2022, far surpassing other regions.

In 2022, the U.S. leads with 47% value-added in the semiconductor manufacturing equipment segment, with Japan and South Korea also playing important roles (18% and 25%, respectively).

Semiconductor manufacturing is a multi-stage process that can be broadly divided into two key segments, namely, frontend wafer fabrication and backend assembly, testing and packaging (ATP). In the wafer fabrication segment, in 2022 China accounted for 24% value-added, followed by Taiwan (18%) and South Korea (17%). The U.S. and Japan contribute modestly. In the ATP segment, China accounted for 30% value-added and is closely followed by Taiwan (28%) in 2022.

Overall, the U.S. is the largest contributor to the global semiconductor value chain (38%), followed by Japan (12%), South Korea (12%), Taiwan (11%) and China (11%) in 2022 (see Table 18).

Table 18. Semiconductor Industry Value Added by Activity and Region: 2022 (%)

Precompetitive Research		Segment Value Added		U.S.	EU	Japan	South Korea	Taiwan	China	RoW
EDA Core IP	**Design** • Logic • DAO • Memory	EDA & Core IP	3%	68%	25%	<1%	<1%	3%	<1%	3%
		Design-Logic	30%	65%	9%	4%	3%	11%	5%	4%
		Design-DAO	17%	41%	17%	18%	4%	5%	9%	6%
		Design-Memory	9%	25%	<1%	7%	60%	4%	3%	<1%
Equipment Materials	Manufacturing • Wafer fabrication • Assembly, test and packaging	Mfg equipment	12%	47%	18%	25%	3%	<1%	3%	2%
		Materials	5%	9%	6%	12%	18%	28%	18%	10%
		Wafer fabrication	19%	10%	8%	17%	17%	18%	24%	7%
		ATP	6%	3%	3%	6%	9%	28%	30%	20%
		Overall value chain	100%	38%	11%	12%	12%	11%	11%	5%

Notes on regional breakdown:

- EDA, design, manufacturing equipment, and raw materials based on company revenues and company headquarters location.
- Wafer fabrication and assembly & testing based on installed capacity and geographic location of the facilities.
- RoW includes Singapore, Israel, India and the rest of the world.

Source: Raj Varadarajan, Iacob Koch-Weser, Chris Richard, Joseph Fitzgerald, Jaskaran Singh, Mary Thornton, Robert Casanova and David Isaacs, “Emerging Resilience in The Semiconductor Supply Chain,” Boston Consulting Group, May 2024, p. 10.

III. Taiwan's Semiconductor Industry

1. Output Value and Growth

Taiwan's IC industry can be divided into four major segments: IC design, IC manufacturing, IC packaging, and IC testing. From a structural perspective, Taiwan's industrial landscape has shifted toward IC manufacturing, reflecting the gradual concentration of the global semiconductor supply chain around Taiwan's production capabilities.

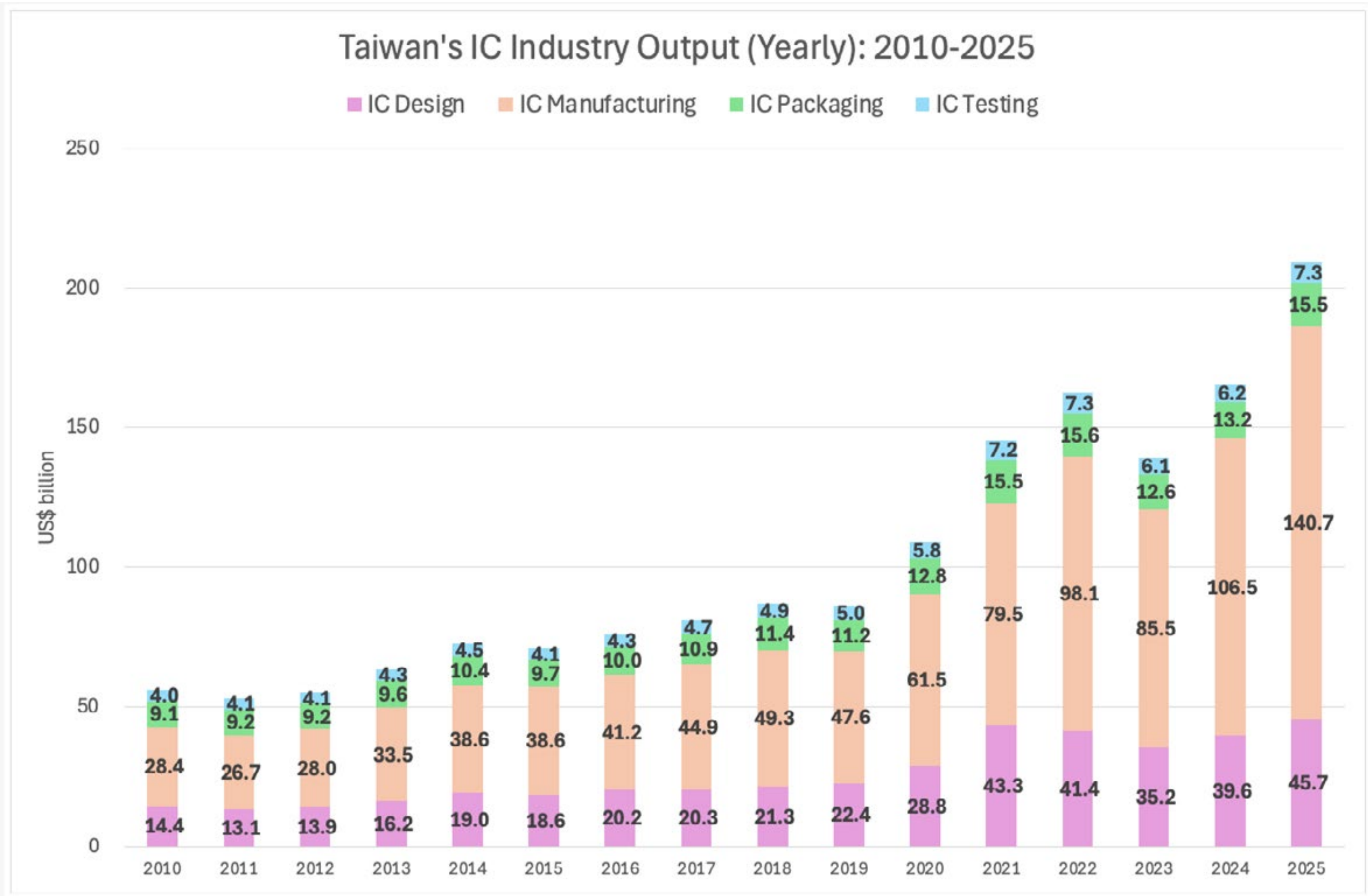
Taiwan's IC design industry, a key component of innovation in the semiconductor supply chain currently anchored by top-performing firms such as MediaTek, Novatek and Realtek, has experienced steady growth since 2010, with output increasing from US$ 14.4 billion to US$ 22.4 billion in 2019. Following the pandemic-driven surge in global demand, output jumped to US$ 28.8 billion in 2020 and further to US$ 43.4 billion in 2021. In the following years, production levels stabilized at around US$ 40 billion. However, output in 2025 reached US$ 45.7 billion, representing a 12.0% year-over-year growth, setting a new record high and indicating that growth momentum in this segment has firmly re-emerged.

IC manufacturing represents Taiwan's core competitive strength in semiconductors, as seen in leading wafer foundries such as TSMC. Output rose from US$ 28.4 billion in 2010 to US$ 47.6 billion in 2019. From the start of the pandemic in 2020, soaring global chip demand pushed output steadily to US$ 98.1 billion in 2022 over the short period of 3 years. Although output slightly declined to US$ 85.5 billion in 2023, it rebounded sharply to a record US$ 106.5 billion in 2024. With US$ 140.7 billion achieved in 2025, representing a 28.3% year-over-year growth, another historic high has been set in the age of AI. Within this segment, wafer foundry reached US$ 133.8 billion, growing 28.5%, while memory and other manufacturing reached US$ 7.0 billion, growing 23.8%.

Growth in IC packaging, helmed by some of Taiwan's leading companies – ASEH, PTI and KYEC has been moderate. Output rose steadily through the 2010s, climbing from just over US$ 9 billion to around US$ 11 billion before the pandemic. It reached its surge, reaching its peak at roughly US$ 15.5 billion in 2021–2022. A market adjustment brought the number down the following year, though it has since begun to recover, rising back above US$ 13 billion in 2024. With US$ 15.5 billion generated in 2025, growing by 14.0% year-over-year, the sector has successfully returned to its early-2020s highs.

The IC testing segment, similar to IC packaging, is smaller in scale and has shown more limited growth. Output increased from US$ 4.0 billion in 2010 to US$ 5.0 billion in 2019. A pandemic-surge lifted production to US$ 5.8 billion in 2020, US$ 7.2 billion in 2021, and US$ 7.3 billion in 2022 as lockdowns increased demand for personal computing, leading to an increase in workload for OSAT providers in Taiwan. However, in 2023, output fell to US$ 6.1 billion in 2023 only to inch slightly to US$ 6.2 billion in 2024. With US$ 7.3 billion achieved in 2025, growing by 14.2% year-over-year, the full-year number has once again approached the 2021–2022 peak (see Figure 18).

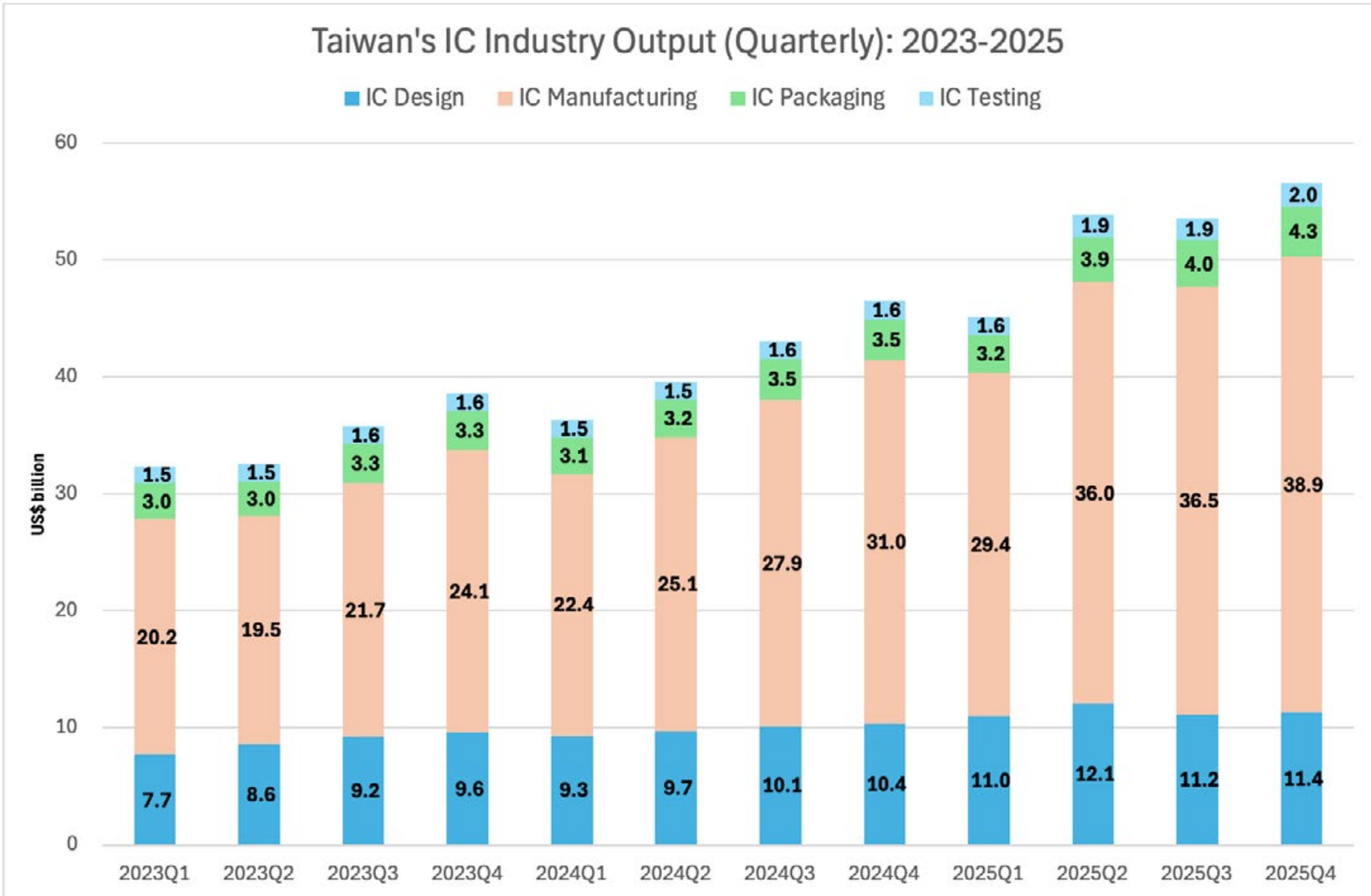
Figure 18. Taiwan's IC Industry Output (Yearly): 2010-2025



Source: Chia-Chen Lee, "Taiwan IC Industry Development in 20254Q," IEK, ITRI, March 4, 2026.

Based on full-year 2025 data, Taiwan's overall IC industry output value reached a record US$ 209.2 billion, representing a robust 22.7% growth from 2024. In the fourth quarter of 2025 alone, the industry output reached US$ 56.6 billion, a quarter-on-quarter increase of 5.7% and a year-over-year increase of 18.1%. Looking ahead, driven by the continuous expansion of AI applications, Taiwan's IC industry output is forecasted to reach NT$ 7.71 trillion (about US$ 246 billion) in 2026, achieving an annual growth of 18.3% (see Figure 19).

Figure 19. Taiwan's IC Industry Output (Quarterly): 2023-2025



Source: Chia-Chen Lee, "Taiwan IC Industry Development in 20254Q," IEK, ITRI, March 4, 2026.

Table 15 shows the quarterly growth rates of Taiwan's IC industry output in 2025 across four major segments: IC design, manufacturing, packaging, and testing. Overall, IC manufacturing recorded the strongest expansion, with annual growth reaching 28.3%, driven by particularly strong performance in the first half of the year, including 34.6% in 1Q and 32.4% in 2Q, before moderating toward the end of the year. IC design grew by 12.0% for the year, but its growth slowed gradually from 20.6% in 1Q to 6.1% in 4Q. In contrast, IC packaging and testing showed a strengthening trend in the latter half of the year. Packaging growth increased from 8.3% in 1Q to 21.5% in 4Q, while testing rose from 6.3% in 1Q to 19.1% in 4Q. These patterns suggest that while front-end manufacturing led overall industry growth in 2025, back-end activities such as packaging and testing gained momentum as the year progressed (see Table 19).

Table 19. Growth of Taiwan's IC Industry Output (Quarterly): 2025

	2025	1Q	2Q	3Q	4Q
IC Design	12.0%	20.6%	15.0%	7.2%	6.1%
IC Manufacturing	28.3%	34.6%	32.4%	26.8%	21.7%
IC Packaging	14.0%	8.3%	13.0%	12.4%	21.5%
IC Testing	14.2%	6.3%	15.3%	15.4%	19.1%

Source: Chia-Chen Lee, "Taiwan IC Industry Development in 20254Q," IEK, ITRI, March 4, 2026.

An examination of the sectoral shares within Taiwan's IC industry reveals a continued consolidation toward manufacturing, reflecting a long-term pattern of expanding production, stagnant design growth, and contraction in back-end processes.

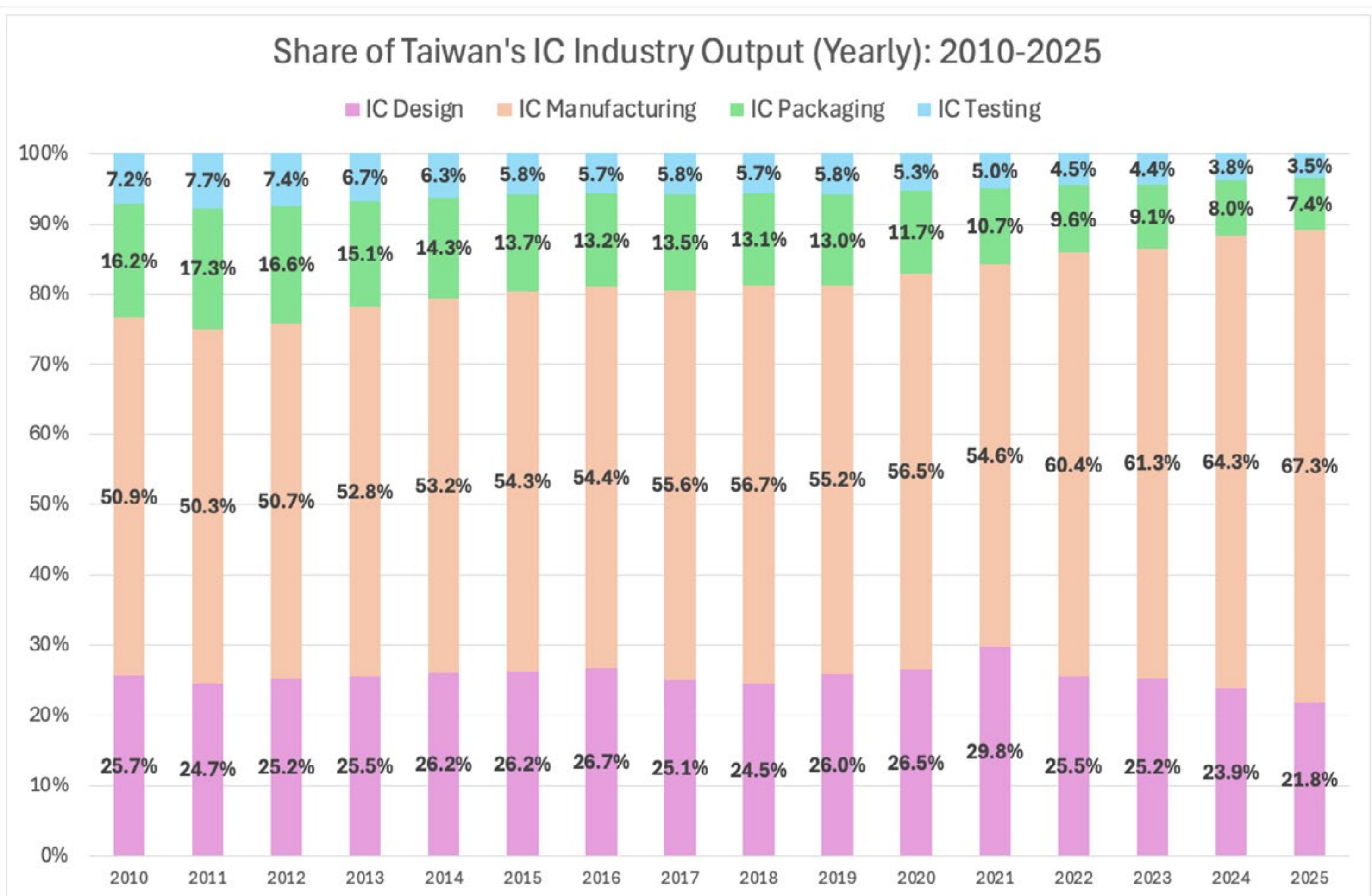
From 2010 to 2020, IC design consistently accounted for roughly 25–27% of total IC industry output. In 2021, surging demand briefly pushed its share to 29.8%, but the proportion has declined steadily since then—falling to 23.9% in 2024 and further to 21.8% for the full year of 2025.

The share of IC manufacturing has risen steadily, from around 50% in 2010 to 56% in 2019. It climbed to 60.4% in 2022 and expanded to 64.3% in 2024, 67.2% (including 63.9% for foundry and 3.3% for memory) for the full year of 2025—an all-time high. Manufacturing has thus become the undeniable backbone of Taiwan's semiconductor structure.

IC packaging has experienced a long-term decline in its share of the industry. Its proportion dropped from 16.2% in 2010 to 13.0% in 2019, fell further to 9.6% in 2022, and declined again to 8.0% in 2024. The share fell to 7.4% for the full year of 2025.

The share of IC testing has also trended downward, falling from 7.2% in 2010 to 5.8% in 2019, then to 4.5% in 2022. It reached 3.8% in 2024 and further declined to 3.5% for the full year of 2025 (see Figure 20).

Figure 20. Share of Taiwan's IC Industry Output (Yearly): 2010-2025



Source: Chia-Chen Lee, "Taiwan IC Industry Development in 20254Q," IEK, ITRI, March 4, 2026.

2. Taiwan in the Global Semiconductor Supply Chain

Based on the statistics and the estimates from the ITRI, Taiwan's global semiconductor market share shows three distinct trajectories across wafer foundry, IC packaging and testing, and IC design from 2011 to 2025.

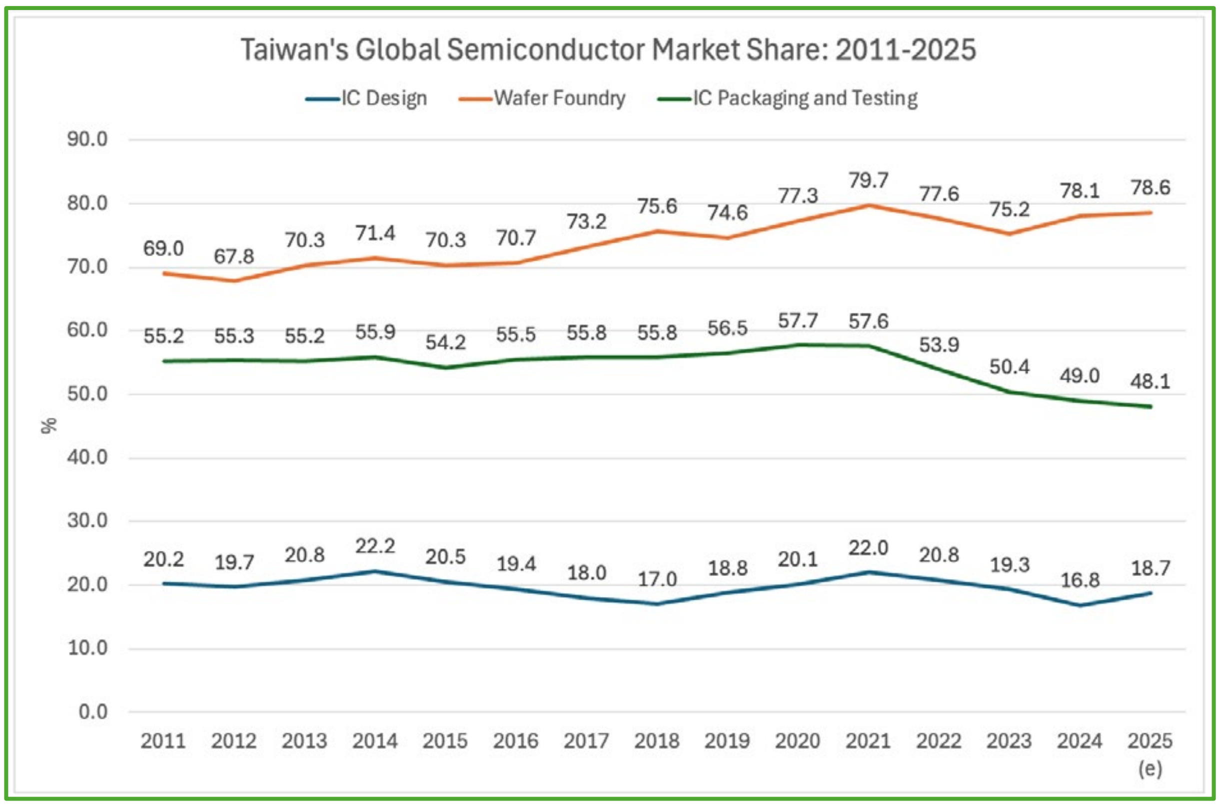
In wafer foundry, Taiwan's share rose steadily from 69.0% in 2011 to a peak of 79.7% in 2021, reflecting the island's continued dominance in advanced manufacturing. The share then dipped to 75.2% in 2023, before rebounding to 78.1% in 2024; ITRI projects a further uptick to 78.6% in 2025.

By contrast, Taiwan's share in IC packaging and testing remained relatively stable between 55% and 58% from 2011 through 2021, but then entered a noticeable decline: 53.9% in 2022, 50.4% in 2023, and 49.0% in 2024. ITRI forecasts an additional drop to 48.1% in 2025, suggesting mounting competitive pressures.

IC design shows a more cyclical pattern. Taiwan's share climbed from 20.2% in 2011 to a historical high of 22.2% in 2014, followed by a gradual slide to 17.0% in 2018. It recovered to 22.0% in 2021, then fell again to a low of 16.8% in 2024. ITRI expects a modest rebound to 18.7% in 2025.

Collectively, these trends reveal a foundry sector that remains robust, a packaging and testing segment facing sustained headwinds, and a design industry navigating cyclical fluctuations while remaining globally competitive (see Figure 21).

Figure 21. Taiwan's Global Semiconductor Market Share: 2011-2025

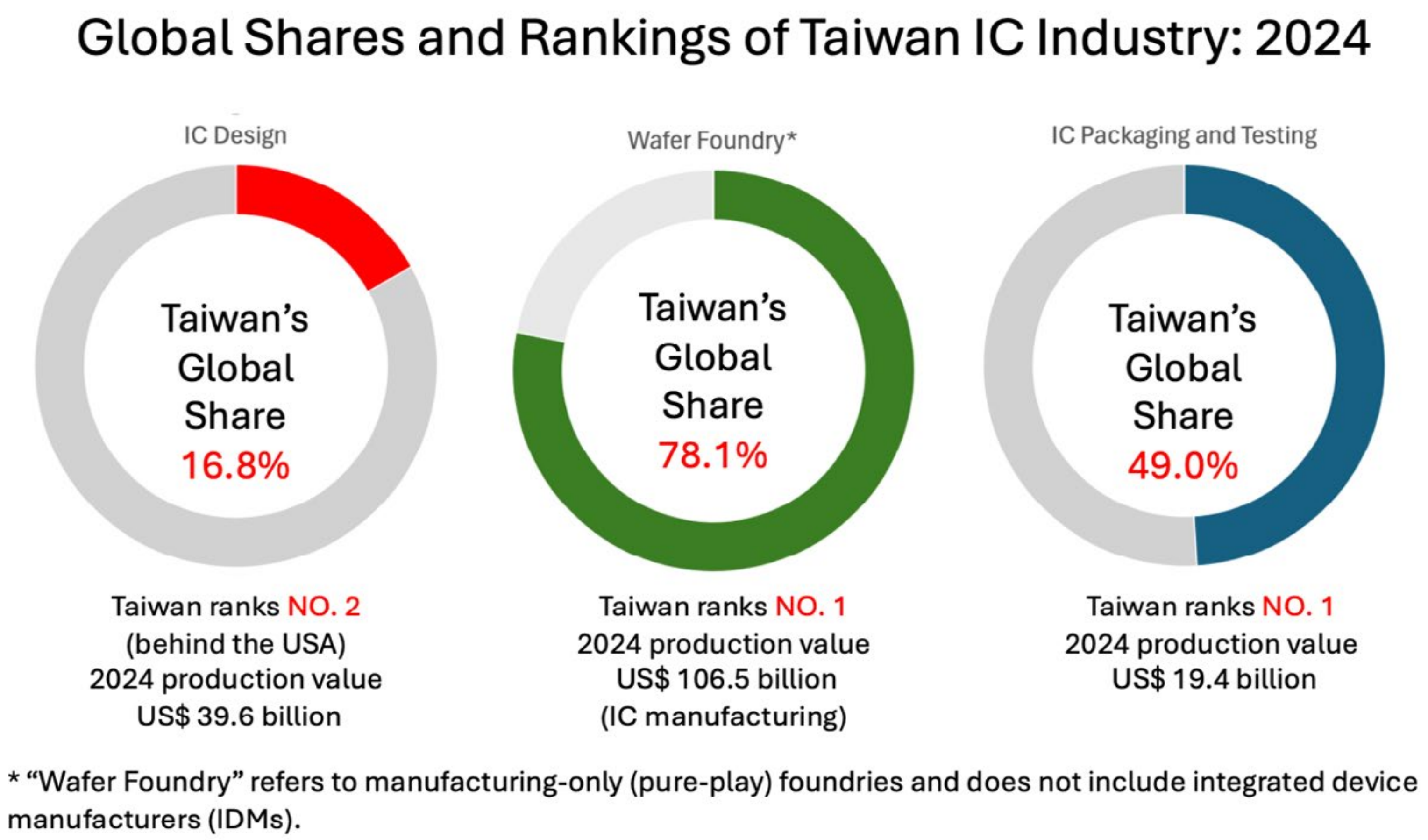


Source: IRTI, accessed November 23, 2025.

According to statistics from the ITRI, Taiwan's IC design industry reached a production value of US$ 39.6 billion in 2024, accounting for 16.8% of the global market and ranking second only to the United

States. The IC manufacturing industry recorded a production value of US$ 106.5 billion, with wafer foundries achieving a global market share of 78.1%, the highest in the world. The IC packaging and testing industry generated US$ 19.4 billion, representing 49.0% of the global market, also ranking first worldwide (see Figure 22).

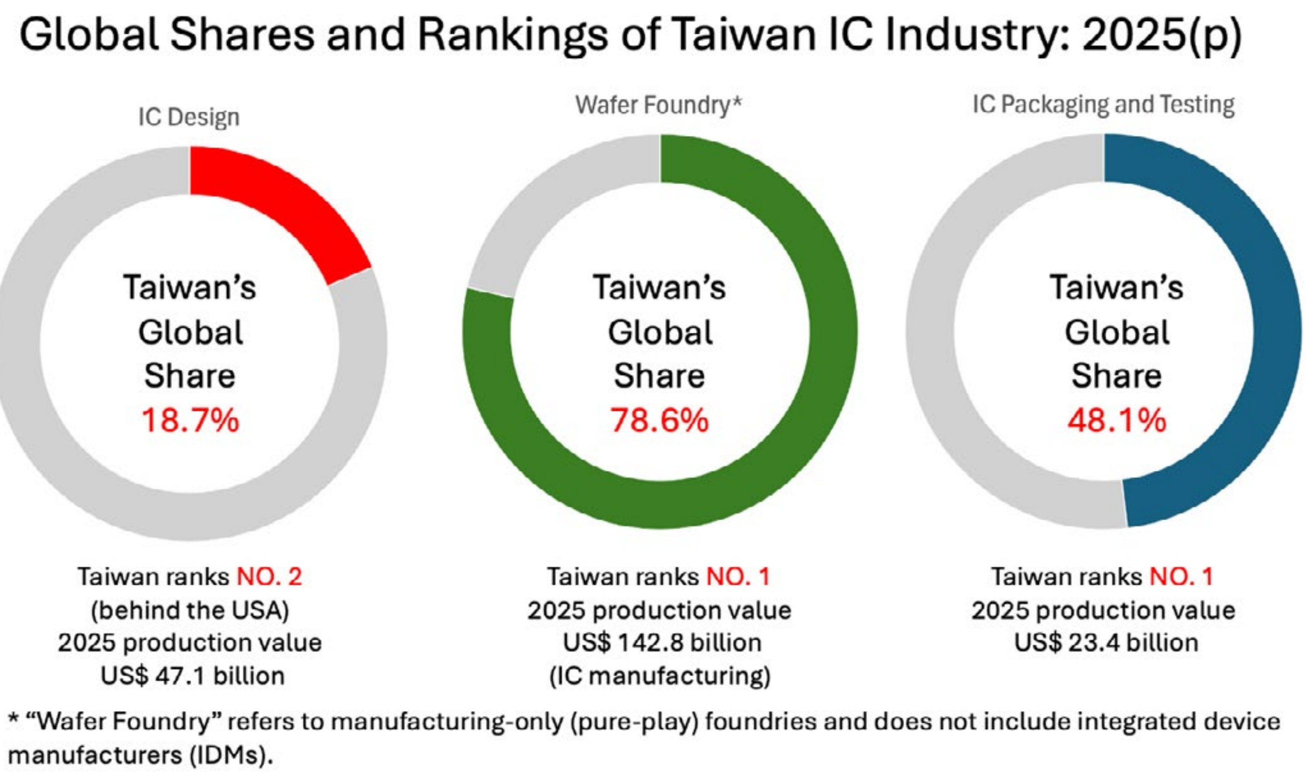
Figure 22. Global Shares and Rankings of Taiwan IC Industry: 2024



Source: ITRI, November 29, 2025.

ITRI forecasts that by 2025, Taiwan's IC design industry will expand to a production value of US$ 47.1 billion, with its global market share rising to 18.7%, remaining second only to the United States. The IC manufacturing industry is expected to grow to US$ 142.8 billion, with wafer foundries increasing their global share to 78.6%, maintaining their global leadership. The IC packaging and testing industry is projected to reach US$ 23.4 billion, representing 48.1% of the global market and continuing to hold the top global position (see Figure 23).

Figure 23. Global Shares and Rankings of Taiwan IC Industry: 2025(p)



Source: ITRI, November 29, 2025.

Taiwan's role in the semiconductor equipment supply chain is undergoing a significant strategic upgrade. Taiwanese companies are successfully transitioning from simple parts suppliers to core module designers and system integrators. Supported by a comprehensive domestic precision machinery and automation ecosystem, Taiwan has achieved high levels of manufacturing autonomy in critical areas such as vacuum modules, fluid management, and wafer handling systems.[10]

Notably, Taiwanese firms have successfully broken the long-standing technological barriers previously monopolized by Western and Japanese giants in core technologies like power and reactive gas modules. This localized supply chain capability, reinforced by recent strategic acquisitions and investments by Taiwanese firms, not only enhances the resilience of Taiwan's semiconductor equipment ecosystem but also solidifies long-term partnerships with leading global wafer foundries and international equipment giants.

In the memory segment, Taiwan-based DRAM suppliers have also demonstrated strong momentum by capitalizing on the supply gaps created as leading global suppliers transition their production to advanced nodes. In the first quarter of 2026 (1Q 2026), Taiwan-based suppliers Nanya, Winbond, and PSMC continue to focus on mature-node DRAM products to fill market gaps left by the top three suppliers as they transition toward advanced process technologies.

Nanya significantly reduced inventory during the quarter, while sharp increases in DDR4 and DDR3 contract prices drove revenue up 60% QoQ to US$ 1.55 billion. Winbond expanded shipments of DDR4 and LPDDR4 products in 1Q 2026, lifting quarterly revenue 91.4% QoQ to nearly US$ 568 million. PSMC's revenue from its internally produced consumer DRAM products rose 29.9% QoQ to US$ 43 million, while total revenue, which includes foundry operations, increased 19.3% QoQ. Following its

10 Wen-Chi Chang, "Market Trend Analysis of Key Semiconductor Equipment Modules," ITRI, January 28, 2026.

licensing agreement for Micron's process technology, PSMC is expected to aggressively expand supply capacity going forward.

While Taiwan does not possess a homegrown HBM brand, it has substantively established itself as the indispensable core hub for global HBM manufacturing and integration. This position is anchored by TSMC's unparalleled capabilities in advanced packaging (such as CoWoS) and the manufacturing of logic base-dies, which are critical for integrating HBM from SK hynix, Samsung, and Micron with logic chips.

Moreover, foreign memory giants continue to deepen their footprint in Taiwan. Micron, adopting a multi-country diversification strategy, treats Taiwan as a core base for its HBM production. In January 2026, Micron accelerated its capacity expansion by acquiring PSMC's Tongluo P5 fab for US$ 1.8 billion, aiming to begin mass production by 2027 to satisfy the urgent AI-driven demand. Through these global and local expansions, Micron's HBM monthly capacity will increase from roughly 55,000 wafers in 2025 to 85,000 in 2026.

3. Taiwan Extends Lead in Advanced Nodes

TSMC's Global Footprint with Taiwan at the Core

Taiwan Semiconductor Manufacturing Company (TSMC) pioneered the pure-play foundry business model when it was founded in 1987, and has been the world's leading dedicated semiconductor foundry ever since. TSMC deployed 288 distinct process technologies, and manufactured 11,878 products for 522 customers in 2024 by providing the broadest range of advanced, specialty and advanced packaging technology services. The company is headquartered in Hsinchu, Taiwan.

Despite its increasingly global footprint, Taiwan remains the immovable center of TSMC's manufacturing gravity. This irreplaceability is built on three pillars. First, the most advanced manufacturing processes are in Taiwan. TSMC's most advanced nodes, such as the 2-nanometer (N2) and subsequent 1.4-nanometer-class (A14) technologies, always initiate their R&D, pilot runs, and mass production locally.

Second, the vast majority of advanced production capacity is in Taiwan. As of late 2025, more than 90% of TSMC's total capacity—and an even larger share of its advanced-node output—continues to be concentrated in Taiwan. Even after massive investments in the U.S., Taiwan will still account for approximately 85% of TSMC's total advanced-node capacity by 2030, and is expected to remain close to 80% by 2036.

Third, the high-end technology R&D centers are in Taiwan. TSMC has established its global R&D center in Taiwan as the primary hub for cutting-edge processes and frontier technologies, bringing together nearly 7,000 R&D personnel rather than shifting them overseas. This dominance underpins the company's historic 71.0% share of the global foundry market in the third quarter of 2025.

On the front-end, 3nm advanced process capacity—currently dominated by TSMC—has become even more constrained, turning into a scarce resource fiercely contested by global tech giants. TrendForce notes that AI compute chips are rapidly transitioning from 4 nm to 3 nm between late 2025 and 2026. At the same time, high-end smartphone and PC processors have yet to migrate en masse to the next-generation 2 nm node, resulting in a short-term concentration of high-performance demand on 3 nm.

From a supply perspective, Samsung and Intel remain behind TSMC in 3 nm foundry progress. Combined with the fact that most chip designs are finalized one to three years in advance, this has led to a temporary single-supplier dynamic dominated by TSMC. The company is accelerating the construction of new 3 nm fabs to alleviate the imbalance. As additional capacity comes online, global 3 nm capacity is expected to surpass 5/4 nm by the end of 2026 and become the second-largest process node after 28 nm by 2027.

Compared to its rivals, although Samsung's first-generation 2nm (SF2) began mass production in December 2025, its disclosed performance gains (8% energy efficiency improvement and 5% performance boost) still lag behind TSMC's claimed double-digit growth, indicating an ongoing technological gap. Meanwhile, Intel only showcased its first 18A-based Panther Lake processor in early 2026. With its high-yield 2nm technology, early preparations for the A16 process, and the continuous construction of four strategic bases (Hsinchu, Taichung, Chiayi, and Kaohsiung) to seamlessly integrate front-end wafer fabrication with back-end advanced packaging, TSMC maintains a steady and unshakeable leadership position in the future advanced node competition.

Furthermore, A14 development is progressing smoothly with yield performance ahead of schedule, with the A14 Process Fab at the Central Taiwan Science Park estimated to reach mass production in the second half of 2028. In addition, the Chiayi Science Park CoWoS Advanced Packaging Fab began its first phase of construction in May 2024 and is slated for production in 2028. Taiwan thus remains the world's primary hub for cutting-edge logic R&D and volume production, anchoring TSMC's technological leadership even as the company expands abroad (see Table 20).

Table 20. TSMC Fabs Overview: As of Dec 2025

Location/Fab types	12-inch	8-inch	6-inch	Advanced Packaging
Taiwan	Fab 12, 14, 15, 18, 20, 22, 25	Fab 3, 5, 6, 8	Fab 2	AP 1, 2, 3, 5, 6, 7, 8
China	Fab 16	Fab 10	-	-
U.S.	Fab 21	Fab 11	-	-
Japan	Fab 23	-	-	-
Germany	Fab 24	-	-	-

Source: Dylan Patel, Steven Lee, and Jeff Koch, "TSMC Overseas Fabs – A Success? ," SemiAnalysis, December 1, 2025.

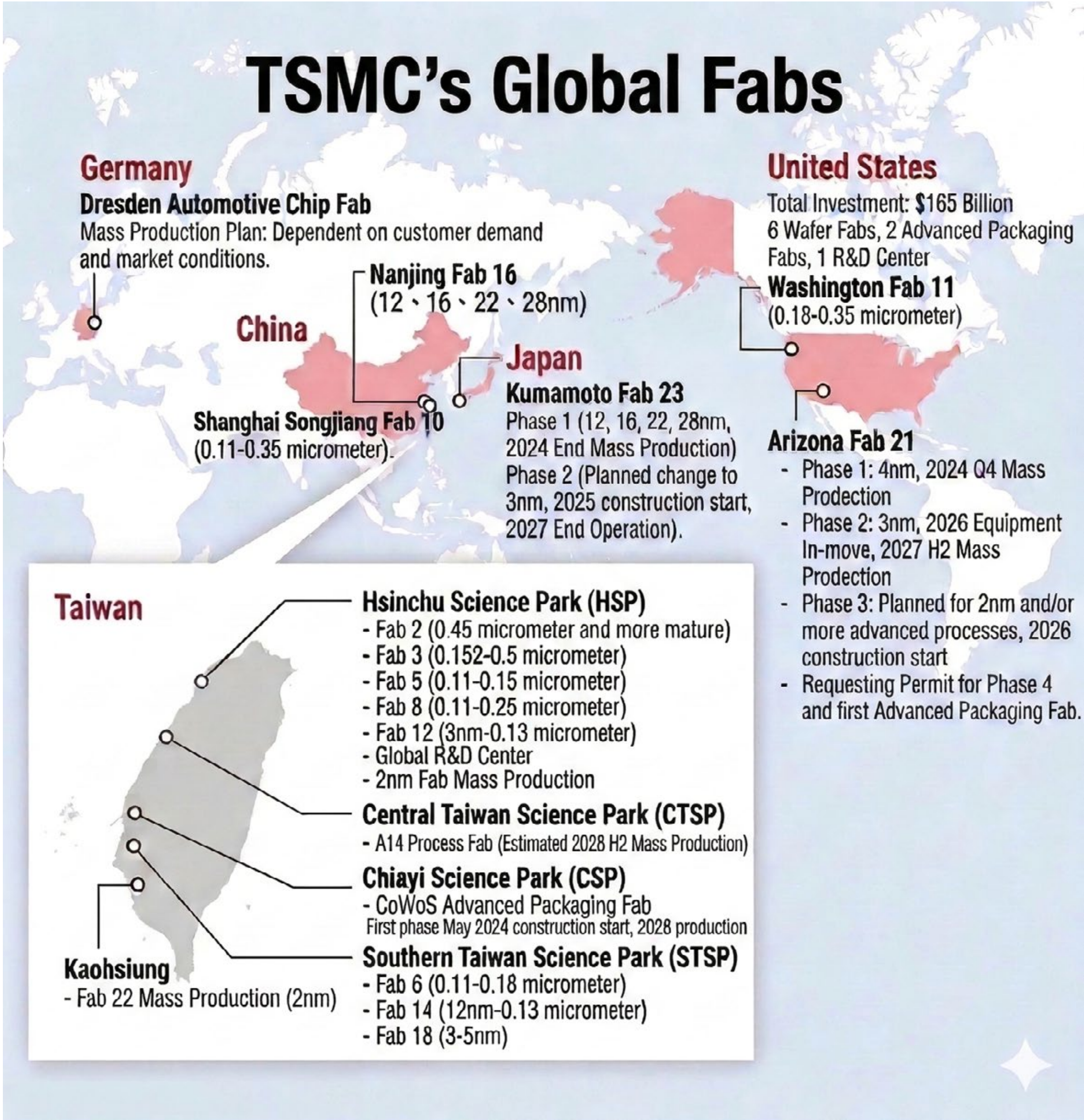
In the United States, TSMC has elevated its commitment to an unprecedented US$165 billion investment aimed at localizing critical supply chains. Originally planned as a US$ 40 billion project, the Arizona campus has expanded to include 6 Wafer Fabs, 2 Advanced Packaging Fabs, and 1 R&D Center, positioning it as one of the largest chipmaking complexes globally. The first fab began equipment installation in 2022 and achieved initial volume production of 4nm chips for key clients like Apple and NVIDIA by late 2024, with Phase 1 achieving 4nm mass production in 4Q 2024. Meanwhile, the second fab is under construction to produce 3nm chips, with equipment in-move scheduled for 2026 and mass production in the second half of 2027. Phase 3 is planned for 2nm and/or more advanced processes with construction starting in 2026, and TSMC is currently requesting permits for Phase 4 and its first Advanced Packaging Fab..

In Japan, TSMC's expansion is driven by a strategic partnership with Sony, Denso, and Toyota through the Japan Advanced Semiconductor Manufacturing (JASM) joint venture. This Kumamoto facility (Fab 23), which entered high-volume production in 2024, is TSMC's first new overseas fab to come online in decades. It utilizes legacy 28nm planar and 16/12nm FinFET technologies to meet the demand for image sensors and automotive ICs, with a capacity of approximately 55,000 wafers per month. A Phase 2 expansion has been approved and is slated to begin construction in 2025, targeting a planned change to 3nm technology, with operations (mass production) in 2027 to further deepen ties with Japan's industrial sector.

Europe's semiconductor ecosystem is being bolstered by the European Semiconductor Manufacturing Company (ESMC) in Dresden, Germany, a joint venture between TSMC, Bosch, Infineon, and NXP. Construction of this € 10 billion facility began in late 2024, with cleanroom shell work currently underway. Unlike the multi-phase projects in other regions, the Dresden fab is a focused, single-phase initiative targeting a capacity of 40,000 wafers per month using 28/22nm and 16/12nm process technologies. Production is scheduled to begin by late 2027, aligning with the European Chips Act to provide a resilient local supply of automotive and industrial chips.

TSMC's global layout is thus evolving along two parallel tracks: ultra-advanced nodes remain firmly rooted in Taiwan, while strategic overseas fabs deliver supply-chain resilience and regional alignment. The result is a diversified yet asymmetrical manufacturing network—one that extends TSMC's reach across three continents while keeping the technological frontier at home (see Figure 24).

Figure 24. TSMC's Global Fabs: As of Feb. 2026



Source: Central News Agency, March 5, 2026, https://www.cna.com.tw/news/afe/202603040043.aspx .

In the Foundry Race, TSMC Takes the Profits

Global competition in the foundry market intensified in the third quarter of 2025, with the four dominant players delivering sharply divergent performances that underscore their differing strategic trajectories. TSMC further solidified its lead through unmatched execution in advanced manufacturing; Samsung Electronics reported a strong profit recovery powered by the scale-up of its 2 nm gate-all-around (GAA) process; Intel accelerated its pivot toward Intel Foundry and strengthened its AI supply chain position with substantial government backing; and SMIC—despite logging record-high revenue—adopted a more cautious stance on near-term prospects.

TSMC posted consolidated third-quarter revenue of US$ 33.1 billion, setting a new historical high. Revenue rose 40.8% year-over-year, supported by robust demand across its high-performance computing

(HPC) and smartphone platforms. Leading-edge technologies at 7 nm and below accounted for 74% of total wafer revenue, with 3 nm contributing 23% and 5 nm contributing 37%. Gross profit reached US$ 19.68 billion, with a 59.5% gross margin, while net profit was US$ 15.1 billion, yielding an impressive 45.6% net margin. TSMC earned a fourth-quarter revenue of US$ 33.73 billion, with gross margins holding at a strong 62.3% and a net margin of 48.3%.

Samsung Electronics reported US$ 59.4 billion in consolidated revenue for the quarter, up 9% from the previous year. Its semiconductor division generated US$ 22.8 billion, increasing 13% year-over-year. Operating profit surged to US$ 8.37 billion, marking a significant turnaround. Management highlighted that the foundry segment achieved record-high advanced-node order volumes and commenced large-scale production of its 2 nm GAA process—a milestone seen as a key catalyst for Samsung's improving profitability and competitive momentum.

Intel reported third-quarter revenue of US$ 13.7 billion, growing 2.8% year-over-year. Gross profit reached US$ 5.2 billion, and net profit stood at US$ 4.3 billion. CEO Lip-Bu Tan emphasized during the earnings call that accelerating AI workloads are expanding compute demand, creating opportunities across Intel's x86 portfolio, ASIC operations, and Intel Foundry Services. The quarterly report also confirmed the sale of a majority stake in Altera, the securing of US$ 5.7 billion in accelerated U.S. government funding, and strategic equity investments from NVIDIA and SoftBank Group. These moves strengthen Intel's balance sheet and reinforce its focus on long-term Intel Foundry development.

SMIC reported third-quarter revenue of US$ 2.3818 billion, up 9.7% year-over-year and marking the second-highest level in its history. Revenue growth was driven by increased wafer shipments and a more favorable product mix, lifting gross margin to 22.0%—still far behind TSMC's 59.5%—and pushing capacity utilization to 95.8%. Net profit reached US$ 0.315 billion, yielding a 13.2% net margin (compared with TSMC's 45.6%). However, management adopted a more cautious outlook for the fourth quarter, guiding for flat to mildly positive revenue growth of 0–2% and a gross margin decline to 18–20%, citing ongoing geopolitical uncertainties and global trade headwinds (see Table 21).

Table 21. Income Statements of Four Major Semiconductor Companies: 3Q 2025

Unit: US$ Billion

Company	Revenue	Growth Rtae	Gross Profit	Operating Profit	Net Income
Intel	13.7	2.8%	5.2	-0.7	4.3
Samsung	59.4	9.0%	23.1	8.37	8.37
SMIC	2.38	9.7%	0.523	0.351	0.315
TSMC	33.1	40.8%	19.68	16.74	15.1

Note:

1 US$ ≈ 1,449 Korean won (KRW) as of November 15, 2025.

Samsung Electronics' figures cover both semiconductors and other electronics products.

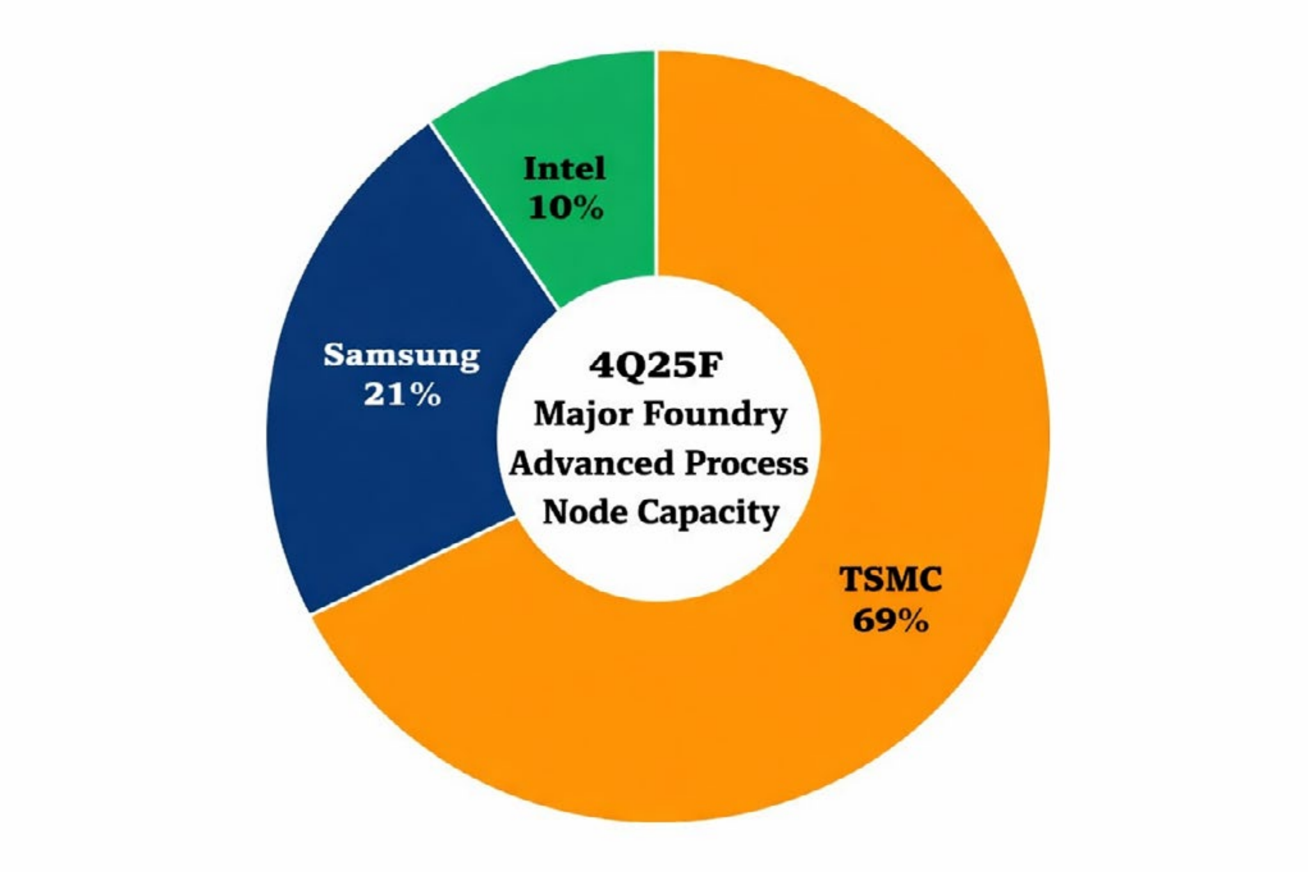
Source: TrendForce, https://x.com/trendforce/status/1989206648284664028, November 15, 2025.

Overall, TSMC continues to consolidate its dominance in the global foundry market through sustained technological leadership, heavy investment in advanced nodes, and disciplined yet expansive capacity planning. In revenue terms, Samsung's market share has declined markedly in recent years, while China's three leading foundries—despite substantial subsidies and strong policy backing—remain collectively capped at around 9% of the global market. The foundry sector is thus not only highly concentrated but increasingly unipolar, evolving from a multi-player competitive landscape into an era of TSMC's near-overwhelming supremacy.

TrendForce Analysis

According to TrendForce's forecast, the distribution of advanced-process manufacturing capacity among the three major foundries in the fourth quarter of 2025 remains highly concentrated. TSMC is projected to account for 69% of total advanced-node capacity, underscoring its continued dominance in leading-edge manufacturing. Samsung is expected to hold approximately 21%, reflecting its role as a contender in advanced nodes as it strives to close the gap with the industry leader, while Intel's share is estimated at around 10%, indicating a more limited but gradually expanding presence in advanced-process production (see Figure 25).

Figure 25. Advanced Process Capacity Shares of Major Foundries: 4Q 2025F



Source: TrendForce, January 7, 2026.

According to TrendForce, advanced processes are defined as those based on non-planar transistor architectures, such as FinFET and GAA, corresponding to the 16 nm node and more advanced technologies. Matured processes, by contrast, refer to planar transistor architectures, encompassing 28 nm and more mature nodes.

The evolution of global semiconductor manufacturing capacity between 2021 and 2030 reveals a clear structural divergence between advanced and matured processes. Rather than converging, national specializations become more pronounced, reflecting fundamental differences in demand patterns, technological capabilities, and industrial policy priorities across major economies.

For advanced processes, Taiwan starts from an overwhelmingly dominant position in 2021, accounting for approximately 68% of global capacity. By 2030, its share is projected to decline to around 56%, not as a result of technological retreat, but due to partial geographic diversification of capacity. Over the same period, the United States increases its share from roughly 18% to 24%, while China rises modestly from 5% to 7%. South Korea edges down slightly from 8% to 7%, and Japan remains marginal at about 2%.

This redistribution is closely linked to demand dynamics. Advanced-process demand is primarily driven by US-based customers such as Apple, Nvidia, AMD, and Qualcomm. To reduce exposure to overseas production risks and to meet domestic manufacturing objectives, the United States has actively promoted the localization of advanced-node capacity. As a result, the US share of advanced processes is expected to reach 24% by 2030. However, driven by customer demand, the primary contributors to this new capacity will remain non-U.S. suppliers, most notably TSMC and Samsung.

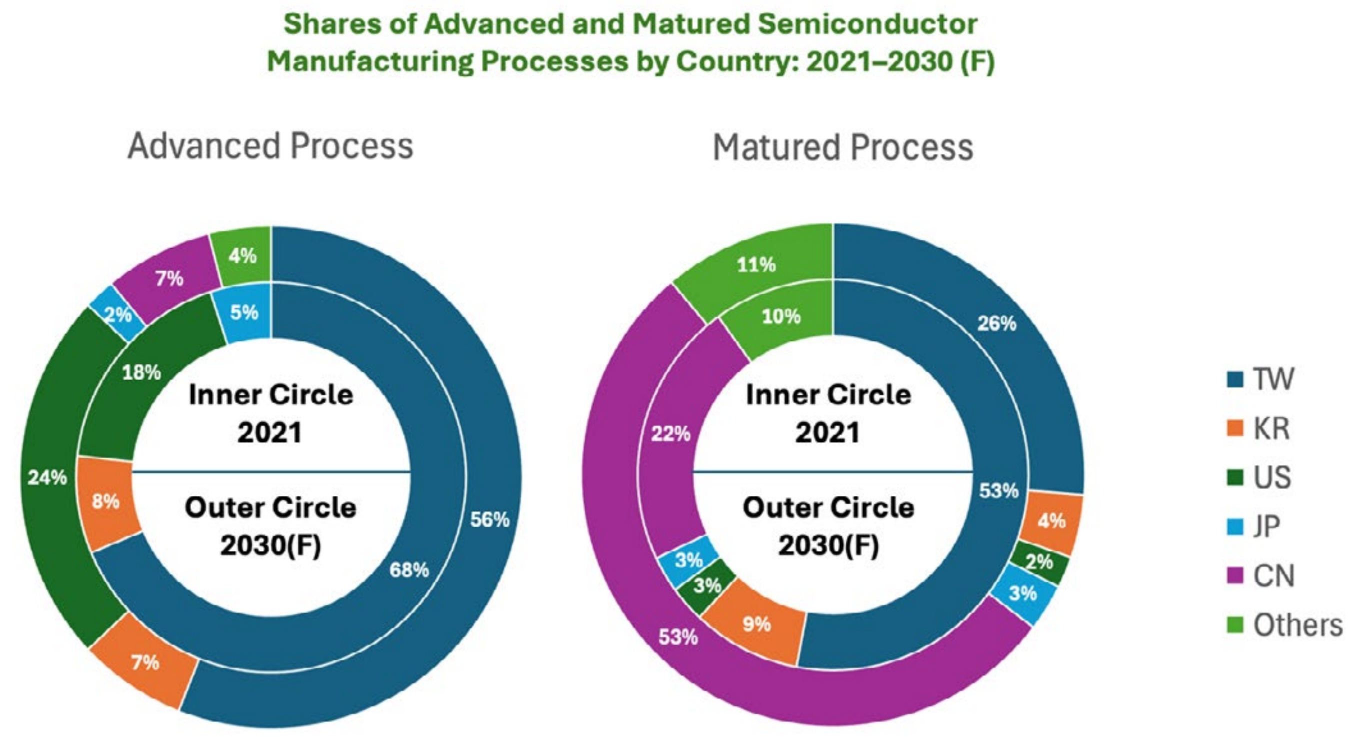
At the company level within the United States, Intel is projected to hold the largest share of US-based advanced manufacturing capacity by 2030 at around 38%, although execution risks remain, including delays at facilities such as the Ohio fab. Samsung follows closely with approximately 34%, reflecting its aggressive expansion strategy in the US. TSMC accounts for about 16%, indicating a selective presence focused on technological leadership rather than scale, while GlobalFoundries holds roughly 11%, consistent with its emphasis on specialty and non-leading-edge processes.

The trajectory for matured processes follows a markedly different path. In 2021, Taiwan still leads with around 53% of global capacity, while China accounts for approximately 22%. By 2030, China is projected to expand dramatically to about 53%, emerging as the dominant global producer. This growth is driven primarily by China's emphasis on supply-chain autonomy and domestic demand, rather than participation in export-oriented leading-edge competition.

Over the same period, Taiwan's share of matured processes is projected to decline sharply to around 26%, reflecting a strategic reallocation of resources toward advanced nodes. The United States remains a marginal participant, with its share slipping slightly from about 3% to 2%, while South Korea and Japan continue to occupy relatively small positions. With additional Chinese and emerging foundries entering the market, China's share of matured-process capacity still has potential for further upward revision.

Taken together, the semiconductor landscape becomes increasingly segmented. The United States strengthens advanced manufacturing primarily to support its own design ecosystem, China consolidates dominance in matured processes to serve domestic industrial demand, and Taiwan remains the critical anchor at the technological frontier (see Figure 26).

Figure 26. Shares of Advanced and Matured Semiconductor Manufacturing Processes by Country: 2021–2030



Source: TrendForce, January 2026.

ITRI's Estimates for 2029

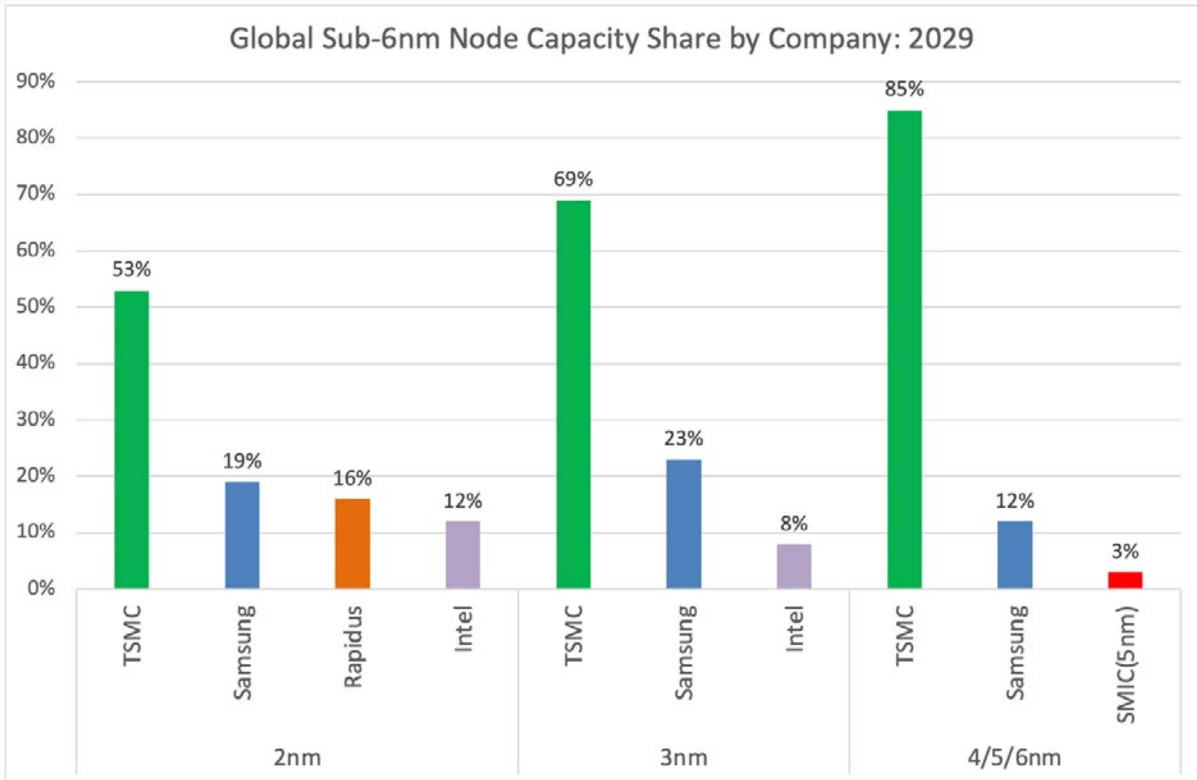
This dominance is even more pronounced in advanced manufacturing below the 7-nanometer threshold. Based on ITRI 's estimates using publicly announced construction schedules and planned production capacities—and projecting effective 2nm–6nm output at the point of full-scale mass production in 2029 (excluding R&D lines and unannounced capacity)—TSMC is expected to control 53% of global 2-nanometer capacity, followed by Samsung (19%), Japan's Rapidus (16%), and Intel (12%). At 3 nanometers, TSMC's lead widens further to 69%, compared with Samsung's 23% and Intel's 8%. Even in the relatively more competitive 4–6 nanometer range, TSMC maintains a commanding 85% share, far ahead of Samsung (12%) and SMIC (3%), underscoring a persistent and measurable performance gap.

At the 2-nanometer node, global capacity deployment is concentrated on next-generation AI accelerators, GPUs, AIPC processors, and premium smartphone SoCs. TSMC remains the largest and fastest-moving producer, with mass production primarily based in Taiwan. Samsung's SF2 process, built on a GAAFET (MBCFET) architecture and incorporating BSPDN technology, has made technical progress, though yield stability remains a challenge; its 2-nanometer capacity is mainly located in Texas. Intel has begun mass production of its 18A process at Fab 52 in Arizona and plans to launch the Panther Lake CPU in 2025, marking a critical step in reestablishing US capabilities at the leading edge.

In the 3-nanometer segment, capacity is oriented toward flagship smartphone SoCs, AI and HPC GPUs, high-performance server CPUs, and data center inference chips. TSMC again leads with the largest and most stable output base, centered in Taiwan with an additional presence in Arizona. Samsung ranks second, operating capacity in South Korea and Texas, while Intel has initiated 3-nanometer chip production in Ireland, successfully reaching high-volume output by late 2025.

For 4-, 5-, and 6-nanometer processes, key applications include mainstream AI accelerators, high-end mobile processors, and advanced server CPUs. TSMC remains the world's largest supplier, with geographically diversified capacity across Tainan and Hsinchu in Taiwan, Kumamoto in Japan, and Arizona in the United States—reflecting a deliberate balance between scale efficiency and geopolitical risk management. Samsung's 6-nanometer node represents an optimized extension of its 7-nanometer technology, while SMIC aims to move its 5-nanometer process into mass production in 2025. However, without access to EUV lithography, SMIC must rely solely on DUV-based techniques, imposing structural constraints on yields, costs, and long-term competitiveness (see Figure 27).

Figure 27. Global Sub-6nm Node Capacity Share by Company: 2029



Source: Nancy Liu, "AI and Innovative Applications Are Driving a Strategic Re-Evolution in the Global IC Manufacturing Industry," ITRI, October 28, 2025, p. 10.

Furthermore, according to estimates by ITRI's IEK, in 2029 Taiwan's global market share is expected to reach 61%. The United States would account for 16%, South Korea 11%, Japan 7%, Ireland 4%, and China only 1%. This uneven distribution indicates that advanced semiconductor manufacturing capacity will remain highly concentrated globally and remain malleable to geopolitics and national industrial policy instruments.

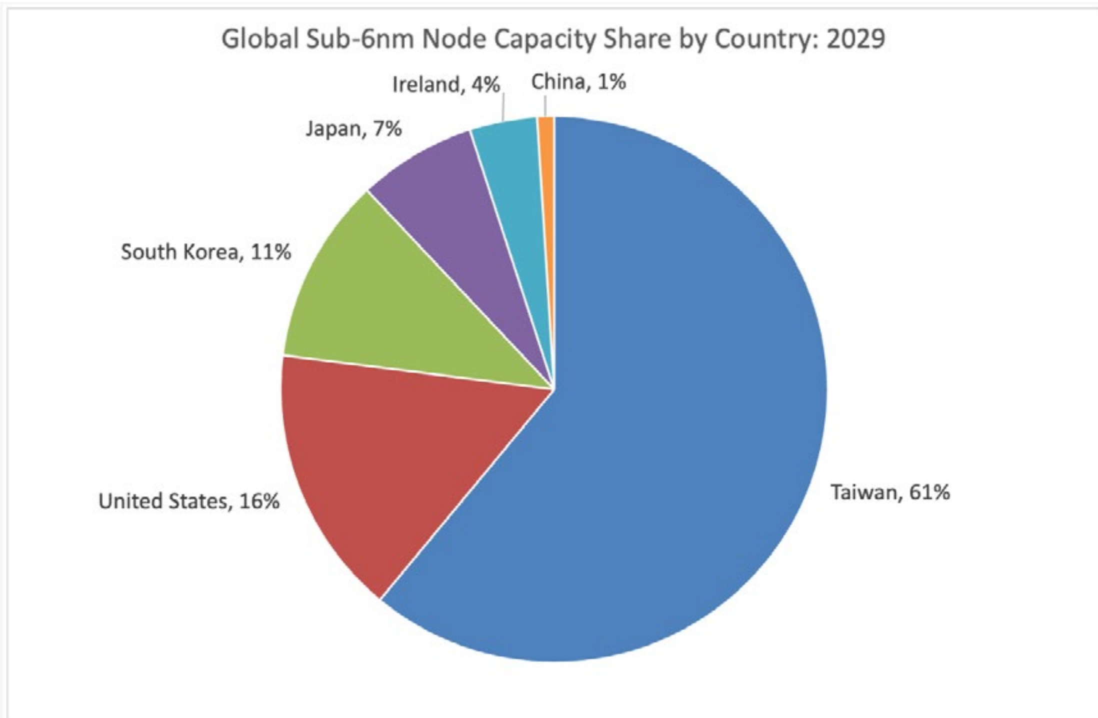
From a policy perspective, the U.S. government has leveraged the CHIPS and Science Act to provide substantial subsidies to companies targeting the 7nm and more advanced technology nodes, aiming to rebuild leading-edge semiconductor manufacturing capabilities on American soil. Among U.S. domestic companies, Intel is primarily positioned with its Intel 20A (now discontinued) and Intel 18A processes. Foreign companies operating in the U.S. include TSMC with its N4X, N3, and N2 nodes, and Samsung with its SF3 and SF2 technologies— forming the core of advanced manufacturing capacity in the United States.

Intel remains behind at nodes below 3nm and is attempting to regain competitiveness in foundry services through Intel 18A and even more advanced process technologies. Its Fab 52 and Fab 62 facilities in Arizona continue to expand, with a focus on building advanced capacity centered on 18A. As a U.S. company, Intel is also more likely to receive priority access to government and defense-related orders, strengthening its prospects for reestablishing technological leadership.

TSMC's U.S. investment is projected to exceed US$ 40 billion by 2029, making it one of the largest foreign direct investment projects in American history. The company's Arizona campus is set to introduce the N4X, N3, and N2 process nodes, with a target of beginning 3nm mass production in 2026—a development that underscores the deepening supply chain complementarities between Taiwan and the United States.

Samsung, meanwhile, plans to invest more than US$ 17 billion in Texas to produce its SF4 and SF3 nodes. Its U.S. presence provides the American market with an additional source of advanced manufacturing beyond TSMC, supporting Washington's goal of achieving greater supply chain diversification and reducing reliance on any single supplier (see Figure 28).

Figure 28. Global Sub-6nm Node Capacity Share by Country: 2029



Source: Nancy Liu, "AI and Innovative Applications Are Driving a Strategic Re-Evolution in the Global IC Manufacturing Industry," ITRI, October 28, 2025, p. 11.

However, the relevant estimates by the ITRI are based on several underlying assumptions. Specifically, they draw on publicly announced construction schedules and planned production capacities, and assume that projected capacity for 2-nanometer to 6-nanometer process technologies will be realized as planned when full-scale mass production begins around 2029. In practice, the realization of these assumptions may be influenced by a range of operational and market factors. Based on current developments, Intel and Samsung continue to navigate challenges related to manufacturing yields, production costs, and customer demand, which have contributed to adjustments in construction and mass-production timelines at facilities in the United States and Europe.

Furthermore, as TSMC, Intel, and Samsung progress toward sub-2-nanometer process technologies, variations in technological readiness, execution capability, and scaling efficiency may shape each firm's production trajectory. Over time, these factors could introduce changes to their respective positions within the global advanced-node market.

In addition, the estimation of national market shares in advanced process technologies is conducted on a country-based basis and does not differentiate among major semiconductor foundries in terms of their individual production capacities and technological capabilities. As a result, such estimates reflect a high-level analytical perspective and may not fully capture the evolving dynamics or relative leadership of individual semiconductor companies—and, by extension, their home countries—in advanced semiconductor manufacturing.

4. Taiwan-U.S. Semiconductor Cooperation and Progress

From 2021 through early 2026, Taiwan–U.S. semiconductor relations evolved from a largely transactional buyer–supplier dynamic into a deeply integrated strategic partnership. This transition was driven by sustained capital investment, deliberate supply-chain restructuring, and intensified policy coordination, particularly as geopolitical risk and AI-driven demand reshaped global semiconductor strategies. While commercial considerations remain central, the partnership has increasingly reflected shared objectives in supply-chain resilience, advanced manufacturing security, and long-term technological competitiveness.

A defining feature of this period has been sustained bilateral dialogue on adapting elements of Taiwan's science park and industrial cluster experience to the U.S. context. Policymakers on both sides have recognized that overseas fabrication facilities operating in isolation face structural disadvantages in cost efficiency, coordination, and scalability. Consequently, discussions have focused on how Taiwan's accumulated expertise in supplier co-location, infrastructure planning, and administrative coordination—developed through decades of science park development—could inform U.S. efforts to build more integrated semiconductor manufacturing ecosystems.

Within this broader strategic vision, the so-called "Taiwan Model" emphasizes ecosystem formation over single-plant investment. Through ongoing bilateral exchanges, both sides have converged on the understanding that semiconductor competitiveness depends not only on fabs, but also on the density and integration of surrounding suppliers, service providers, research institutions, and workforce pipelines. These dialogues have reinforced the idea that advanced manufacturing efficiency is ultimately a systems problem rather than a purely firm-level challenge.

Looking ahead, Taiwan is expected to support the development of innovation-oriented industrial clusters in Arizona and Texas. In Arizona, TSMC and key segments of its supply chain will be anchored in the Phoenix area. Several Taiwanese chemical and materials firms have announced U.S. investment plans linked to electronic-grade chemicals and specialty inputs, though most remain partial relocations rather than full-scale duplication of Taiwan's supplier base. Even so, these early moves signal a gradual extension of Taiwan's supply-chain logic into the U.S. manufacturing environment.

Texas, in turn, is projected to center on GlobalWafers, complemented by AI server and related supply chains led by Foxconn, Wistron, Pegatron, and Inventec, relocating from the U.S.–Mexico border region. GlobalWafers has raised its U.S. investment plan to approximately US$ 7.5 billion, making it one of the most significant silicon wafer investments in the United States in decades and an important pillar of upstream localization.

Together, these efforts aim to form globally competitive AI technology industrial park clusters. To facilitate this expansion, the Taiwan government will provide one-stop support services for Taiwanese semiconductor companies operating in Arizona and Texas.

The Taiwan–U.S. Economic Prosperity Partnership Dialogue (EPPD) has emerged as a critical institutional platform underpinning this cooperation. Through the EPPD, both sides are advancing discussions on the implementation of resilient AI industry clusters and deepening collaboration in AI-related innovation, infrastructure development, energy security, and critical minerals.

At the operational level, TSMC's investment in Arizona has begun to generate tangible localized clustering effects. The Arizona expansion—widely regarded as the largest greenfield manufacturing investment by a foreign firm in U.S. history—stands at the core of Taiwan–U.S. semiconductor cooperation. TSMC's initial US$ 12 billion commitment was expanded to US$ 40 billion, and subsequently to a long-term plan of up to US$ 165 billion, encompassing multiple advanced logic fabs, advanced packaging facilities, and a research and development presence. Crucially, TSMC's first Arizona fab has transitioned from construction and pilot production to actual volume output of 4-nanometer chips as of late 2024 to early 2025, validating the feasibility of advanced logic manufacturing in the United States.

Beyond manufacturing, the bilateral relationship has been reshaped by a landmark trade and investment consensus. In 2024, Taiwan's exports to the U.S. reached approximately US$ 111.4 billion, setting a record high and accounting for about 23.4% of Taiwan's total exports for the year. Taiwan is the sixth-largest trade deficit partner of the United States, with up to 90% of the deficit attributable to semiconductors, ICT products, and electronic components—sectors subject to Section 232 investigations of the U.S. Trade Expansion Act of 1962.[11] Against this backdrop, Taiwan engaged the United States in multiple rounds of consultations focused on reciprocal tariffs and potential Section 232 measures.

Equally important is the reverse flow: Taiwan's continued reliance on U.S. semiconductor manufacturing equipment. Taiwanese fabs remain among the world's largest purchasers of U.S.-made process tools, including deposition, etching, and other critical systems. In the first half of 2025 alone, Taiwan imported more than US$ 2.3 billion worth of semiconductor manufacturing equipment from the United States, while industry estimates place Taiwan's total semiconductor equipment market at around US$ 16–17 billion in 2024.

On January 15, 2026, Taiwan and the United States reached a comprehensive consensus, including:

11 "Summary of Taiwan–U.S. Tariff Negotiations," Department of Information Services, Executive Yuan, January 15, 2026

reducing reciprocal tariffs to 15% without stacking MFN rates, securing most-favored treatment under any future Section 232 tariffs on semiconductors and semiconductor derivatives, expanding supply-chain investment cooperation, and deepening the Taiwan–U.S. AI strategic partnership.

The Resulting Outcomes Were Substantial

First, reciprocal tariffs were reduced to 15% without being layered onto existing MFN rates, effectively granting Taiwan "most favored ally" status among major U.S. trade deficit partners, on par with Japan, South Korea, and the European Union.

Second, Taiwan became the first country globally to secure a commitment to most-favored treatment under potential Section 232 tariffs on semiconductors and semiconductor derivatives for its domestic investors in the United States. As formal Section 232 measures had not yet been announced at the time of negotiation, both sides adopted a pre-set scenario approach. Under this arrangement, the United States committed that, should such tariffs be enacted, Taiwan would receive the most favorable treatment available.

Taiwan also secured tax-exempt conditions for a designated quota of U.S.-based investments by semiconductor and semiconductor-derivative firms, while retaining the most favorable rates beyond that quota. In addition, raw materials, equipment, and components required by Taiwanese firms for U.S. manufacturing and operations are exempted from relevant reciprocal and Section 232 tariffs.

Third, Taiwan will leverage the "Taiwan Model" to guide Taiwanese firms into the U.S. supply chain, fostering industrial clusters and extending the global competitiveness of Taiwan's technology sector. Under firms' autonomous investment planning, Taiwan committed to two categories of capital engagement.

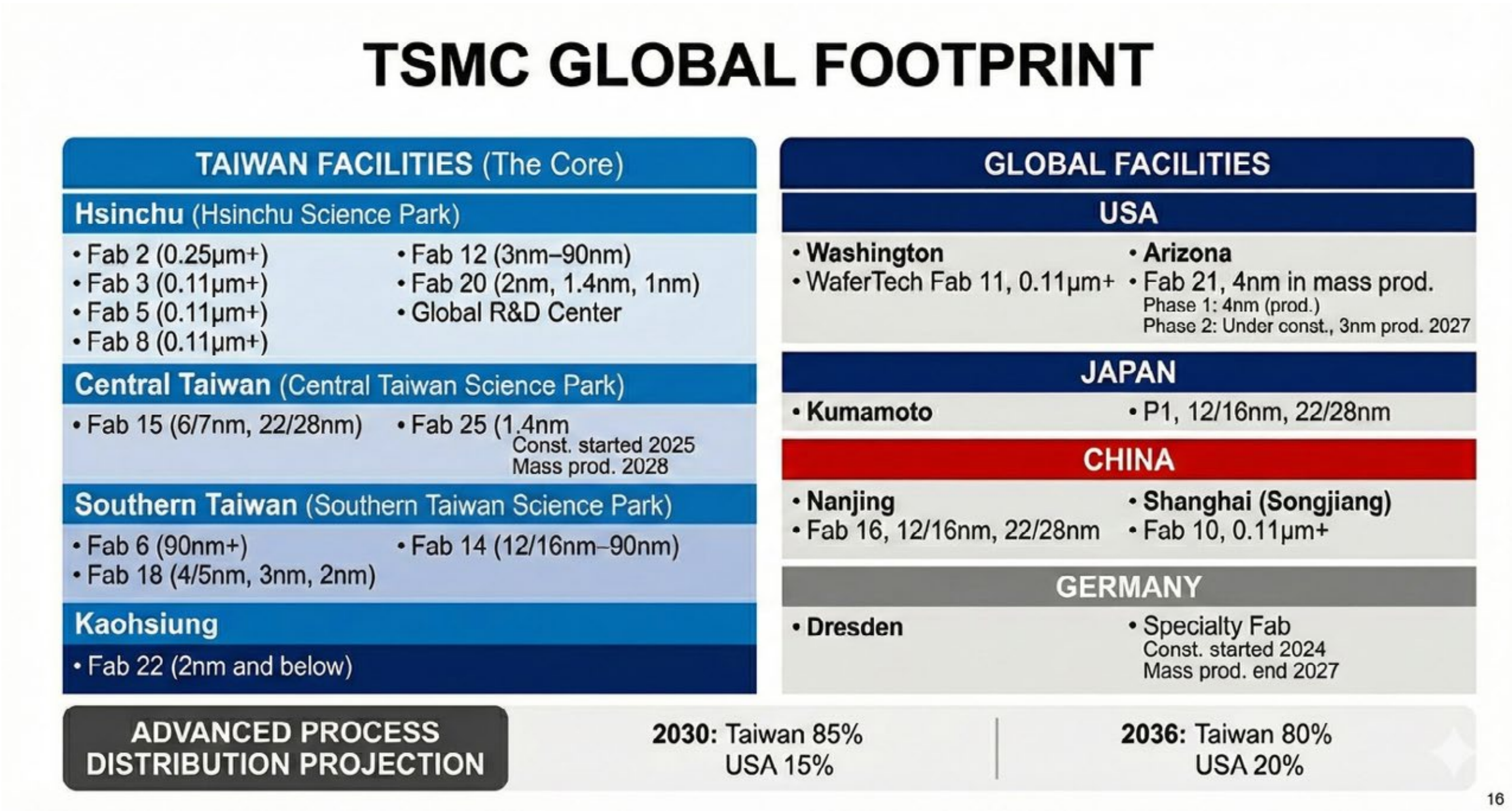
The first involves up to US$ 250 billion in private-sector investment by Taiwanese enterprises across semiconductors, AI-related electronic manufacturing services, energy, and related industries. The second entails government-backed credit guarantees enabling financial institutions to provide up to US$ 250 billion in corporate credit lines for investments in semiconductors and the broader ICT supply chain. To ensure a favorable investment environment, the United States committed to assisting Taiwanese firms in securing land, utilities, infrastructure, tax incentives, and access to relevant visa programs.

Fourth, the agreement facilitates mutual investment in high-technology sectors and establishes a Taiwan–U.S. global AI supply chain strategic partnership. By combining Taiwan's world-class manufacturing capabilities with U.S. strengths in innovative R&D, talent, and market access, both sides are positioned to serve as each other's most critical high-tech strategic partners, jointly reinforcing global leadership in advanced technologies.

In parallel with expanded Taiwanese investment in the United States, both sides agreed to establish a "two-way investment mechanism." With Taiwan's encouragement, the United States will expand investment in Taiwan's semiconductor, artificial intelligence, defense technology, security and surveillance, next-generation communications, and biotechnology sectors. U.S. financial institutions, including the Export-Import Bank of the United States and the U.S. International Development Finance Corporation, will cooperate with Taiwan, as appropriate, to support private-sector investment and financing in Taiwan's key industries.

Building on these consensus outcomes and investment commitments between Taiwan and the United States, estimates by Taiwan's Ministry of Economic Affairs indicate that TSMC's global capacity allocation is structured to preserve its leadership in advanced process technologies. By 2030, Taiwan is projected to account for approximately 85% of TSMC's capacity, with the United States comprising the remaining 15%. By 2036, this distribution is expected to adjust to roughly 80% in Taiwan and 20% in the United States (see Figure 29).

Figure 29. TSMC Global Footprint: 2026



Source: Ministry of Economic Affairs (Taiwan), January 17, 2026.

In sum, the period from 2021 to early 2026 marked the consolidation of a structurally deeper Taiwan–U.S. semiconductor partnership. Through large-scale project-based investments led by TSMC and its supply-chain partners, sustained bilateral dialogue on ecosystem development, and the comprehensive consensus reached in January 2026, the two economies have become increasingly interlinked. Rather than decoupling, this phase has produced a form of strategic coupling—binding U.S. market demand and equipment suppliers with Taiwan's manufacturing expertise into a shared AI and semiconductor ecosystem that is both resilient and globally competitive.

5. Global Expansion, Taiwan at the Core

At a time when countries around the world are competing to localize advanced semiconductor manufacturing, TSMC has in recent years significantly expanded its investments in the United States, Japan, and Europe. This has inevitably sparked concerns that its industrial center of gravity may be shifting overseas, even being simplistically labeled as so-called "de-Taiwanization." However, (1) the most advanced manufacturing processes are first brought into volume production in Taiwan; (2) the vast majority of advanced-node production capacity is securely located in Taiwan; and (3) the high-end technology R&D centers are firmly established in Taiwan. A comprehensive examination of capacity structure, process nodes, and R&D deployment makes one point clear: while TSMC is extending its global manufacturing network and capabilities, the R&D core, technology development, and advanced-node production capacity that truly determine competitiveness remain firmly anchored in Taiwan.

Overall, TSMC's global manufacturing system exhibits a pattern of "diversification without symmetry." The establishment of overseas fabs primarily responds to supply-chain resilience, geopolitical considerations, and regional customer demand. In contrast, the core capabilities related to advanced process R&D are deliberately and highly concentrated in Taiwan, making the island the undisputed center of technology and capacity.

From the perspective of capacity distribution, this structure is unlikely to be fundamentally shaken for more than a decade. According to estimates by Taiwan's Ministry of Economic Affairs, even after investing up to US$ 165 billion in Arizona to build three advanced fabs, Taiwan will still account for about 85% of TSMC's total advanced-node capacity by 2030, with the United States at around 15%. Even by 2036, Taiwan's share is expected to remain close to 80%. This indicates that overseas investment is essentially a form of "strategic extension," not a replacement of Taiwan's core position.

Taiwan's leading role is equally evident in the global allocation of advanced capacity. The Industrial Technology Research Institute estimates that by 2029, Taiwan will account for 61% of global capacity at 6-nanometer and below nodes—well ahead of the United States at 16%, South Korea at 11%, and Japan at 7%, while China is projected to hold only 1%. TrendForce likewise forecasts that Taiwan's share of global advanced-node capacity will be around 56% in 2030, maintaining its leading position.

Behind these figures lies not merely the scale of capacity, but the ability to set the pace of technological evolution. TSMC's most advanced process nodes are always first brought into volume production in Taiwan. The 2-nanometer (N2) process is scheduled for mass production in Hsinchu and Kaohsiung in the fourth quarter of 2025, while subsequent A16 and A14 (1.4-nanometer-class) technologies will likewise see their R&D, pilot runs, and initial mass production start in Taiwan.

By contrast, even if TSMC's Arizona fabs introduce advanced logic processes, their mass-production timelines will still lag Taiwan's significantly, with 2-nanometer or A16 production not expected until around 2030. This deliberate gap of roughly one to two technology generations is a key design through which TSMC preserves technological sovereignty and long-term competitive advantage.

The concentration of R&D resources further underscores Taiwan's central role. TSMC has established its global R&D center in Taiwan as the hub for cutting-edge processes and frontier technologies, focusing on nodes below 2 nanometers, new materials, and new transistor architectures, and is expected to bring together nearly 7,000 R&D personnel. This demonstrates that R&D activities have not shifted overseas with fab expansion; instead, the most critical talent and innovation capacity are being further concentrated in Taiwan.

This R&D configuration is built upon Taiwan's highly mature and difficult-to-replicate industrial ecosystem. The close integration of R&D, pilot production, and large-scale manufacturing enables rapid accumulation along the yield-learning curve and continues to attract leading global equipment and materials suppliers to establish R&D and technical support bases in Taiwan. Even as overseas fabs gradually mature, they remain heavily dependent on process experience and management models that are transplanted from—and repeatedly validated in—Taiwan.

By contrast, TSMC's investments in Japan and Europe have been assigned different roles from the outset. The Japanese fabs primarily serve image sensors, automotive, and industrial applications, focusing on specialty processes in the 12- to 28-nanometer range. Even with the introduction of 6- to 7-nanometer processes at a second fab in 2027, these will still not represent TSMC's most advanced nodes.

The European fab, meanwhile, concentrates on 28-, 22-, 16-, and 12-nanometer processes, deeply embedded in local automotive and industrial supply chains, and does not participate in the competition for leading-edge logic chips. The main function of overseas sites is to enhance local supply-chain resilience, not to replace Taiwan's role at the apex of the technology chain.

Taken together—capacity structure, the cadence of advanced processes, and R&D deployment—TSMC's global footprint is not a story of "de-Taiwanization," but rather a Taiwan-centric global expansion strategy. Overseas fabs provide supply-chain resilience and proximity to markets, while Taiwan continues to command the R&D leadership and the vast majority of capacity at 2-nanometer and more advanced nodes, making Taiwan an even more solid—and increasingly irreplaceable—core of the global semiconductor landscape.

IV. The U.S. Semiconductor Industry

1. The U.S. in the Global Semiconductor Supply Chain

The United States plays a crucial role in various segments of the semiconductor value chain, from research and development, electronic design automation, core intellectual property, and design to manufacturing equipment. Nevertheless, over the years, the U.S.'s global share of semiconductor manufacturing capacity located on its shore has declined.

The U.S., Japan and Europe used to virtually dominate the entire global semiconductor production in 1990. Europe led with 44%, the U.S. followed with 37%, and Japan accounted for 19% of the global fabrication capacity. The U.S. share of global semiconductor manufacturing capacity, however, slipped to 12% in 2020, and fell further to about 10% in 2022.

When U.S.'s share of global capacity dropped from 37.0% in 1990 to 19.0% in 2000, its CAGR[12] stood at 12.8%, while the world's CAGR was 20.2% in 2000. In 2010, as the U.S. share of global capacity further decreased to 13.0%, its CAGR stood at 5.0%, compared to the global CAGR of 9.6%. In 2020, the U.S. share slightly declined to 12.0%, and its CAGR was reduced to 4.0%, with the global rate at 4.9%. The U.S. CAGR has thus been significantly lower than the global CAGR in semiconductor production from 2000 to 2020 (see Table 22).

Table 22. U.S. Share and CAGR of Production Capacity

Year	U.S. Share of Global Capacity	Compound Annual Growth Rate	
		U.S.	World
1990	37.0%	n.a.	n.a.
2000	19.0%	12.8%	20.2%
2010	13.0%	5.0%	9.6%
2020	12.0%	4.0%	4.9%
2022	10.0%	n.a.	n.a.

Source: Douglas Thomas, "Annual Report on the U.S. Manufacturing Economy: 2023," NIST Advanced Manufacturing Series, National Institute of Standards and Technology (NIST).

This trend suggests that other regions expanded their semiconductor manufacturing capabilities far more rapidly than the United States, particularly in Northeast Asia. Economies such as Taiwan, South Korea, and China invested aggressively in their semiconductor sectors through strong government incentives and coordinated industrial policies. As a result, by 2022, the combined production share of the United States, Europe, and Japan had declined to 35%, while Northeast Asia's share rose to 59%.

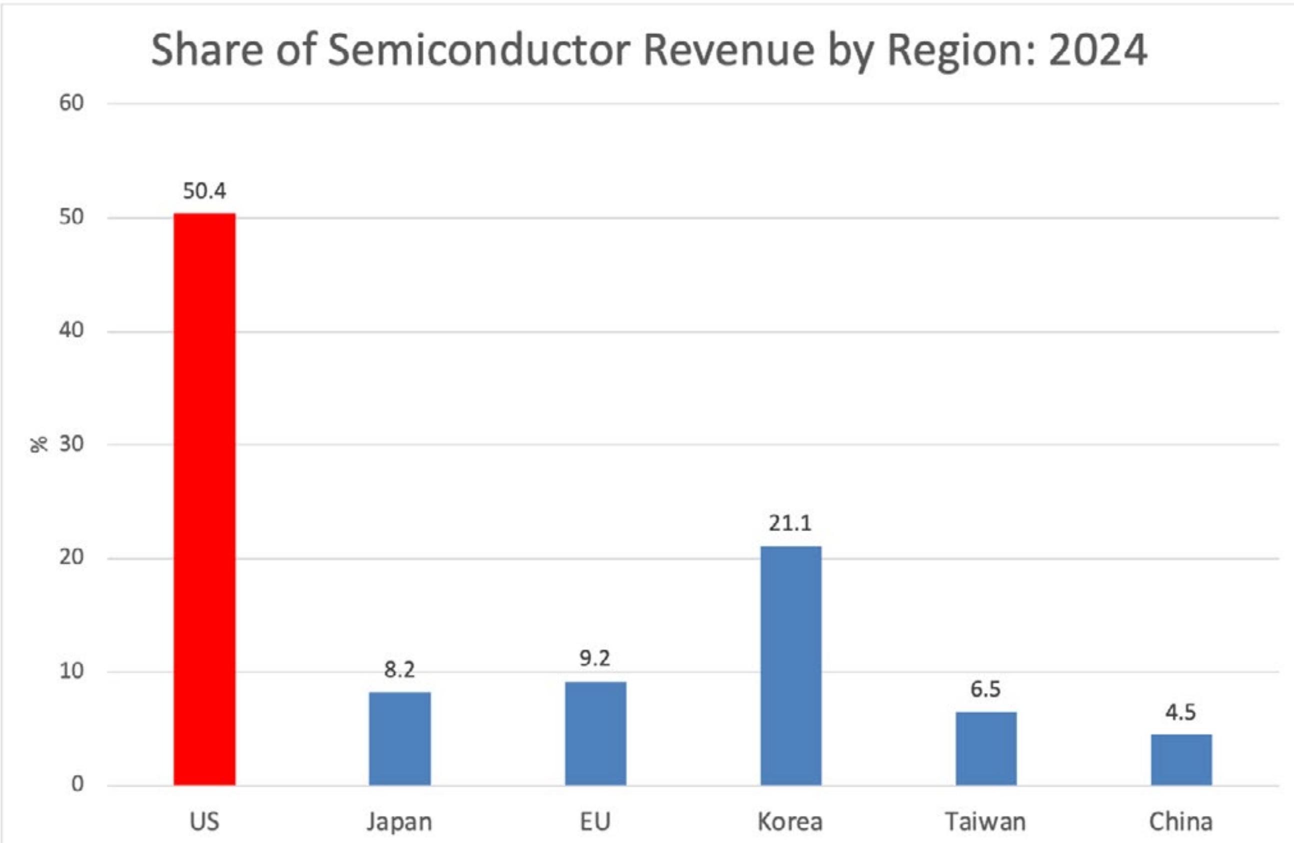
12 The CAGR of the semiconductor industry represents the annualized average rate of revenue growth over a specific period, assuming the growth happens at an exponentially compounded rate.

Moreover, a joint report by BCG and the Semiconductor Industry Association (SIA)[13] warned that, absent policy intervention, the US share of global semiconductor manufacturing capacity could fall further to 8% by 2032.[14]

These shifts have triggered growing concern within the US Congress over the heavy concentration of semiconductor manufacturing in East Asia. Lawmakers have underscored the resulting exposure of global supply chains to risks such as trade frictions, geopolitical tensions, and potential military conflict. Such concerns have directly shaped policy responses, most notably the passage of the CHIPS and Science Act, aimed at rebuilding domestic manufacturing capacity and strengthening supply-chain resilience.[15]

Nevertheless, the United States has continued to dominate global semiconductor industry since the late 1990s.[16] According to WSTS and SIA data, global semiconductor revenues expanded from US$ 139.0 billion in 2001 to US$ 630.5 billion in 2024, while revenues of US-based semiconductor firms grew in parallel, from US$ 71.1 billion to US$ 318.2 billion. As a result, US companies remain the industry's leaders in non-manufacturing, accounting for 50.4% of global semiconductor revenues despite their declining share in manufacturing (see Figure 30).

Figure 30. Share of Semiconductor Revenue by Region: 2024



Source: Semiconductor Industry Association, SIA 2025 Factbook, May 27, 2025.

In contrast, the semiconductor industry of other countries has between 4.5% and 21.1% of global market share, a distribution expected to remain stable in the foreseeable future. The U.S. semiconductor industry, with its leading position in the market, is able to heavily invest in R&D, keeping it at the forefront of global tech advancements and reinforcing its sales leadership.

13 The Semiconductor Industry Association is a U.S.-based trade organization that represents the interests of the semiconductor industry and its global supply chain.
14 Raj Varadarajan, et al., "Emerging Resilience in the Semiconductor Supply Chain," Boston Consulting Group and Semiconductor Industry Association, May 2024.
15 "Semiconductors and the CHIPS Act: The Global Context," Congressional Research Service, May 18, 2023.
16 State of the U.S. Semiconductor Industry Report 2024, Semiconductor Industry Association, September 9, 2024.

A report from the U.S. Department of Commerce (DOC)'s Bureau of Industry and Security (BIS) in December 2023 highlighted the strength of U.S. companies in chip design and IDMs. U.S.- based companies are particularly strong in design processes, accounting for 72% of all fabless revenue, 42% of IDM revenue among companies that do both design and manufacturing, and 53% of global semiconductor revenue in 2022.[17] However, the U.S. has a relatively lower share in the foundry segment (6%) and the OSAT segment (15%) (see Table 23).

Table 23. Market Share of Process Roles by Location of Company Headquarters: 2022

	Fabless	IDM	Total Semiconductor Providers	Foundry	OSAT	Total Outsourced Manufacturing
Total (US$ billion)	248	412	660*	139	50	190
United States	72%	42%	53%	6%	15%	8%
Taiwan	14%	2%	6%	65%	58%	63%
South Korea	1%	22%	14%	16%	1%	12%
Japan	1%	17%	11%	1%	0%	0%
China	12%	2%	6%	9%	20%	12%
Germany	0%	5%	3%	1%	0%	0%
Switzerland	0%	4%	3%	0%	0%	0%
Netherlands	0%	4%	2%	0%	0%	0%
BIS's data is based on publicly reported sales and estimates of the revenues of major non-public companies						
* The BIS estimates may exceed those of the Semiconductor Industry Association (US$ 574 billion, via SIA 2023 Factbook) and Gartner (US$ 600 billion, April 26 2023 press release) in part because it is revenue focused, and thus may not have fully accounted for non-semiconductor revenue or integration of semiconductors into other semiconductor devices. Foundry and ATP revenue are not part of these vendor-specific reports.						

Source: Office of Technology Evaluation, Bureau of Industry and Security, U.S. Department of Commerce, "Assessment of the Status of the Microelectronics Industrial Base in the United States," December 2023.

Wafer manufacturing, encompassing production by both wafer foundries and integrated device manufacturers (IDMs), represents a core pillar of the semiconductor supply chain. In 2022, the output value of the IDM segment reached US$ 412 billion, nearly three times that of the foundry segment, which stood at US$ 139 billion. The United States, anchored by major IDMs such as Intel and Texas Instruments, led global integrated device manufacturing with 42% of worldwide IDM output value. When combining the total market revenue of US semiconductor companies (US$ 349.8 billion) with outsourced manufacturing revenue (US$ 15.2 billion), the US semiconductor market generated US$ 365 billion, equivalent to 42.9% of global market revenue.

By contrast, Taiwan dominated the wafer foundry segment. Led by Taiwan Semiconductor Manufacturing Company (TSMC), Taiwan accounted for 65% of global foundry output value in 2022, underscoring its central role in outsourced manufacturing, particularly at advanced process nodes.

17 Office of Technology Evaluation, Bureau of Industry and Security, U.S. Department of Commerce, "Assessment of the Status of the Microelectronics Industrial Base in the United States," December 2023.

According to a US Bureau of Industry and Security (BIS) report, the world's 30 largest semiconductor companies in 2022 together generated approximately US$ 684.5 billion, or 75% of total global semiconductor revenue. Among them, 16 US-based firms—spanning fabless companies, IDMs, and foundries—accounted for 51.2% of the combined revenue of the top 30, totaling US$ 350.4 billion. This places the overall output value of the US semiconductor industry well ahead of all other major players. Taiwan, ranking second, recorded a total output value of US$ 125.7 billion, roughly one-third of that of the United States (see Table 24).

Table 24. U.S. Share of World's 30 Largest Semiconductor Companies: 2022

Unit: US$ Billion

Company	Primary Segment	Process Role	Country of Headquarters	Revenue
Samsung*	Memory	IDM	South Korea	76.2
TSMC	Foundry	Foundry	Taiwan	75.9
Intel	Micro	IDM	U.S.	63.1
Qualcomm	Logic	Fabless	U.S.	43.0
Apple**	Logic	Fabless	U.S.	40.0
SK Hynix	Memory	IDM	South Korea	34.0
Broadcom	Logic	Fabless	U.S.	33.2
NVIDIA	Logic	Fabless	U.S.	29.6
Micron Technology	Memory	IDM	U.S.	27.2
Advanced Micro Devices	Micro	Fabless	U.S.	23.6
Advanced Semiconductor Engineering	AT&P	AT&P	Taiwan	22.2
Texas Instruments	Analog	IDM	U.S.	19.6
MediaTek	Logic	Fabless	Taiwan	18.4
Western Digital	Memory	IDM	U.S.	16.4
STMicroelectronics	Analog	IDM	Switzerland	16.1
Infineon	Discretes	IDM	Germany	15.8
Murata	Sensors	IDM	Japan	14.0
NXP Semiconductors***	Micro	IDM	Netherlands	13.2
Analog Devices	Analog	IDM	U.S.	12.0
Kioxia	Memory	IDM	Japan	11.7
Renesas	Analog	IDM	Japan	11.3
United Microelectronics Corporation	Foundry	Foundry	Taiwan	9.2
Sony-Imaging and Sensing Solutions****	Optoelectronics	IDM	Japan	9.1
onsemi	Discretes	IDM	U.S.	8.3
GlobalFoundries	Foundry	Foundry	U.S.	8.1
Microchip Technology Incorporated	Micro	IDM	U.S.	8.1
Semiconductor Manufacturing International Corporation (SMIC)	Foundry	Foundry	China	7.2
Amkor Technology	AT&P	AT&P	U.S.	7.1

Marvell Semiconductor, Inc.	Logic	Fabless	U.S.	5.8
Skyworks Solutions	Analog	IDM	U.S.	5.3
U.S. Total				**350.4**
Top 30 Total				**684.5**
U.S. Share (%)				**51.2%**
Data is based on annual and quarterly financial filings via company websites and U.S. Securities and Exchange Commission. *Data is for Samsung's Semiconductor (DS) segment. **Estimated value of Apple's semiconductor production based on publicly reported share of TSMC's revenue. ***NXP Semiconductors is spun off from Philips in 2006. Philips Semiconductors became NXP Semiconductors, a separate, stand-alone company.18 ****Data is for Sony's Imaging and Sensing Solutions segment.				

Source: Office of Technology Evaluation, Bureau of Industry and Security, U.S. Department of Commerce, "Assessment of the Status of the Microelectronics Industrial Base in the United States," December 2023, p. 15.

Semiconductors significantly boost the U.S. economy. In 2024, U.S. exports of semiconductors were worth US$ 57.0 billion, making semiconductors the sixth highest among U.S. exports. The industry also directly employs 345,000 Americans and indirectly accounts for 2 million additional jobs.[19]

2. The U.S. CHIPS and Science Act

On August 9, 2022, then U.S. President Biden signed the bipartisan Creating Helpful Incentives to Produce Semiconductors (CHIPS) and Science Act (hereinafter "the CHIPS Act") into law. The CHIPS Act, a cornerstone of the CHIPS for America initiative, aims to reestablish the United States' leadership in semiconductor manufacturing, bolster global supply chains, and enhance both national and economic security.

The four strategic goals for the CHIPS for America Fund as spelt out by the DOC are as follows:

1. Invest in U.S. production of strategically important semiconductor chips, focusing on leading-edge technologies.
2. Assure a sufficient, sustainable, and secure supply of older and current generation chips for national security purposes and for critical manufacturing industries.
3. Strengthen U.S. semiconductor R&D leadership to catalyze and capture the next set of critical technologies, applications, and industries.
4. Grow a diverse semiconductor workforce and build strong communities that participate in the prosperity of the semiconductor industry.[20]

18 NXP Semiconductors, Annual Report 2006, NXP Semiconductors, 2006.
19 Semiconductor Industry Association, SIA 2025 Factbook, May 27, 2025.
20 The U.S. Department of Commerce, Press Release: "A Strategy for the Chips for America Fund", September 6, 2022.

Correspondingly, DOC aims to reach the following goals by 2030 in order to advance U.S. economic and national security:

1. make the U.S. home to at least two, new large-scale clusters of leading-edge logic chip fabs,
2. make the U.S. home to multiple, high-volume advanced packaging facilities,
3. produce high-volume leading-edge memory chips, and
4. increase production capacity for current-generation and mature-node chips, especially for critical domestic industries.[21]

Financial Incentives

The CHIPS Act provides US$ 52.7 billion over five years (2022 to 2027) for American semiconductor research, development, manufacturing, and workforce development. This includes US$ 39 billion in manufacturing incentives, US$ 11 billion for R&D, and US$ 2.7 billion for defense, technology security and workforce development (see Table 25).

Table 25. U.S. CHIPS and Science Act

Semiconductor Manufacturing and Research & Development
US$ 39 Billion Manufacturing Incentives: • Build, expand, or modernize domestic facilities and equipment for semiconductor fabrication, assembly, testing, advanced packaging, or research and development, including US$ 2 billion specifically for mature semiconductors.
US$ 11 Billion for Research and Development: • **DOC National Semiconductor Technology Center (NSTC):** ◊ A public-private partnership to conduct advanced semiconductor manufacturing R&D and prototyping; invest in new technologies; and expand workforce training and development opportunities. • **DOC National Advanced Packaging Manufacturing Program:** ◊ A Federal R&D program to strengthen advanced assembly, test, and packaging (ATP) capabilities, in coordination with the NSTC. ◊ DOC Manufacturing USA Semiconductor Institute: ◊ A partnership between government, industry, and academia to research virtualization of semiconductor machinery, develop ATP capabilities, and design and disseminate training. • **DOC Microelectronics Metrology R&D:** ◊ A National Institute of Standards and Technology research program to advance measurement science, standards, material characterization, instrumentation, testing, and manufacturing capabilities. • **DOC Economic Development Administration's Tech Hub Program** ◊ Designation of Tech Hubs in regions across the country to drive regional innovation and job creation. ◊ Award of Strategy Development Grants to help communities significantly increase local coordination and planning activities.
Defense, Technology Security and Workforce Development

21 The U.S. Department of Commerce, Press Release: "Biden-Harris Administration Launches First CHIPS for America Funding Opportunity", February 28, 2023.

- **CHIPS for America Defense Fund:**
  - ◊ US$ 2 billion for the DOD to implement the Microelectronics Commons, a national network for onshore, university-based prototyping, lab-to-fab transition of semiconductor technologies—including DOD-unique applications—and semiconductor workforce training.
- **CHIPS for America International Technology Security and Innovation Fund:**
  - ◊ US$ 500 million for the Department of State, in coordination with the U.S. Agency for International Development, the Export-Import Bank, and the U.S. International Development Finance Corporation, to support international information and communications technology security and semiconductor supply chain activities, including supporting the development and adoption of secure and trusted telecommunications technologies, semiconductors, and other emerging technologies.
- **CHIPS for America Workforce and Education Fund:**
  - ◊ US$ 200 million to kick start development of the domestic semiconductor workforce, which faces near-term labor shortages, by leveraging activities of the National Science Foundation.

Source: U.S. Department of Commerce, "CHIPS and Science Act of 2022: Division A Summary - CHIPS and ORAN Investment," July 2022, and U.S. Economic Development Administration's Press Release, "Biden-Harris Administration Designates 31 Tech Hubs Across America," October 23, 2023.

The CHIPS Program Office, responsible for manufacturing incentives, and the CHIPS Research and Development Office, responsible for the R&D programs, both sit within the National Institute of Standards and Technology (NIST) at the DOC. The CHIPS Program Office gives preference to applicants that commit to making long-term investments in the United States. By providing substantial financial incentives and supporting cutting-edge research and development through programs administered by the NIST, the CHIPS Act aims to restore the United States as a leader in semiconductor technology and innovation.

The CHIPS Act also provides a 25% investment tax credit for capital expenses for manufacturing of semiconductors and related equipment. The tax credit is available for projects that start construction between January 1, 2023, and December 31, 2026.[22] Semiconductor firms that build new plants or extend existing plants, including foreign-owned firms such as TSMC and Samsung, can claim a tax credit equal to 25% of the cost for plant and equipment placed in service after December 31, 2022 or for which construction starts before January 1, 2027.

The U.S. Congressional Budget Office originally estimated in 2022 that investment tax credit for capital expenses for manufacturing of semiconductors and related equipment would cost US$ 24.3 billion in forgone revenue.[23] However, according to a June 2024 report by the Peterson Institute for International Economics that used "very conservative assumptions based on the current investment trends," the true cost could be more than US$ 85 billion.[24]

In fact, tax credits are expected to account for the greatest share of CHIPS Act incentives going to any one company. Micron Technology Inc., for example, expects to get around US$ 11.3 billion in tax credits

22 The White House, Fact Sheet: CHIPS and Science Act Will Lower Costs, Create Jobs, Strengthen Supply Chains, and Counter China, August 9, 2021.

23 Congressional Budget Office, Cost Estimates: Table 2. Estimated Budgetary Effects of Divisions A and B of H.R. 4346, as Amended by the Senate and as Posted by the Senate Committee on Commerce, Science, & Transportation on July 20, 2022.

24 Martin Chorzempa, "The US and Korean CHIPS Acts are spurring investment but at a high cost," Peterson Institute for International Economics, June 10, 2024.

for two chip factories in New York, compared to the sums of US$ 6.1 billion in grants and US$ 7.5 billion in loans that it is receiving to support those two facilities and another plant in Idaho. Texas Instruments Inc. anticipates US$ 6 billion to US$ 8 billion in tax credits — as much as five times the size of its Chips Act grant.

Tax credits could also go to the many companies that were not awarded CHIPS grant money — like Applied Materials — but are still building factories for chips, equipment or wafers. Businesses can get refunds for construction that starts by the end of 2026 and is continuous after that point.

3. Guardrails

The DOC highlighted that the funds under the CHIPS Act come with strong guardrails "to ensure technology and innovation funded by the CHIPS and Science Act is not used for malign purposes by adversarial countries against the United States or its allies and partners" and also "to prevent CHIPS funds from being used to directly or indirectly benefit foreign countries of concern."[25]

The CHIPS Act identifies a "foreign country of concern" as one that falls under 10 U.S.C. § 4872(d) and any other country that the Secretary of Commerce, in consultation with other key government officials, determines poses a threat to U.S. national security or foreign policy.[26] In addition, a person is considered under the jurisdiction or direction of a government of concern if the person or their organization has a connection to that government through citizenship or residence, place of establishment, or direct or indirect control amounting to 25% or more, whether held individually or in aggregate.

The CHIPS Act establishes two separate guardrails, namely the expansion guardrail and the technology guardrail, and includes clawbacks to prevent the beneficiaries of CHIPS funds from supporting the semiconductor manufacturing and technology development of foreign countries of concern. Both guardrails permit the U.S. DOC to recover the entire award if violated (see Table 26).

Table 26. U.S. Chips Act Guardrails

Expansion Guardrail
• Companies receiving CHIPS funding, as well as members of their affiliated group, may not build new facilities or expand existing facilities in foreign countries of concern for 10 years. ◊ They may upgrade manufacturing capacity by 5% for the purpose of allowing existing facilities to continue ordinary operations (such as tool upgrades and replacements). • Existing facilities manufacturing legacy semiconductors are excepted; however, such a facility may not increase capacity by 10% or more. • Existing facilities may upgrade their technology, but export controls may still apply. • The exception for new legacy facilities that predominantly serve the country of concern requires that 85% of the final products containing the chips be used or consumed in that country.

25 The U.S. Department of Commerce, Press Release: "Commerce Department Outlines Proposed National Security Guardrails for CHIPS for America Incentives Program", March 21, 2023; "Frequently Asked Questions: Preventing the Improper Use of CHIPS Act Funding," National Institute of Standards and Technology.

26 10 U.S.C. § 4872(d) defines the terms used in Section 4872, which pertains to the acquisition of sensitive materials from non-allied foreign nations. Specifically, it includes definitions for "covered material" and "covered nation" (North Korea, China, Russia and Iran).

Technology Guardrail
• Companies may not generally engage in joint research or technology licensing related to technology or products that raise national security concerns (i.e., certain export-controlled semiconductors or semiconductors critical to national security as determined by the Secretary) with foreign entities of concern. ◊ The Technology Guardrail does not apply to joint research or technology licensing that was ongoing prior to the issuance of the final rule on September 22, 2023.

Source: National Institute of Standards and Technology, US Department of Commerce, CHIPS for America: Preventing the Improper Use of CHIPS Act Funding, September 22, 2023.

The CHIPS Act classifies semiconductors as critical to national security and places limits on the expansion and new construction of legacy facilities in foreign countries of concern. Under the rules, "legacy semiconductor" means (1) a digital or analog chip of the 28nm generation or older; (2) a DRAM memory device with a half-pitch greater than 18nm or a NAND flash memory device that is less than 128 layers and does not use emerging memory technologies; or (3) any other device designated by DOC. Only semiconductors utilizing advanced 3D integration packaging such as by directly attaching one or more die or wafer, through silicon vias, or through mold vias are not considered to be legacy semiconductors and would be subject to the guardrails.[27]

The rules do provide two exceptions to the prohibition for legacy semiconductors. The first applies to a recipient's existing facilities or equipment for manufacturing "legacy semiconductors" that exist on the date of the award so long as the facility does not undergo a "significant renovation" (capacity is increased by 10% or more). The second applies to new facilities so long as at least 85% of its output is incorporated in end products used or consumed in the host country.[28]

Violations of these guardrails allow the DOC to take remedial measures, including recovering up to the full amount of the award.

Export Controls

In addition to statutory measures, the U.S. Department of Commerce's Bureau of Industry and Security (BIS) issued major updates to the Export Administration Regulations (EAR) on October 7, 2022, targeting the semiconductor sector. The rules expanded controls on advanced computing chips, supercomputer-related end uses, semiconductor manufacturing equipment, and transactions involving Entity List parties, citing U.S. national security and foreign policy concerns.

These controls are designed to limit countries of concern—particularly China—from accessing advanced chips, developing supercomputers, and producing leading-edge semiconductors, which are critical to modern military systems, AI-enabled warfare, and autonomous decision-making. BIS also warned that foreign government interference with compliance reviews could result in Entity List

27 "Preventing the Improper Use of CHIPS Act Funding," Federal Register, September 25, 2023, https://www.govinfo.gov/content/pkg/FR-2023-09-25/pdf/2023-20471.pdf, Accessed on November 20, 2024.
28 National Institute of Standards and Technology, "CHIPS for America- Preventing the Improper Use of CHIPS Act Funding- Final Rule", September 22, 2023.

designations, restricting access to U.S. technology.

Subsequent rules tightened restrictions on high-performance computing chips and manufacturing equipment, including measures to prevent circumvention through aggregation of lower-end AI chips. Controls were also extended to chip exports and manufacturing equipment involving countries under U.S. arms embargoes, beyond China alone.

By April 2024, 319 Chinese firms had been added to the Entity List under the Biden administration. On December 2, 2024, BIS further expanded the list by 140 Chinese semiconductor-related entities and announced new controls on high-bandwidth memory chips, additional chipmaking tools and software, and certain foreign-made equipment to close third-country loopholes.

4. Domestic Outcomes of the CHIPS Act

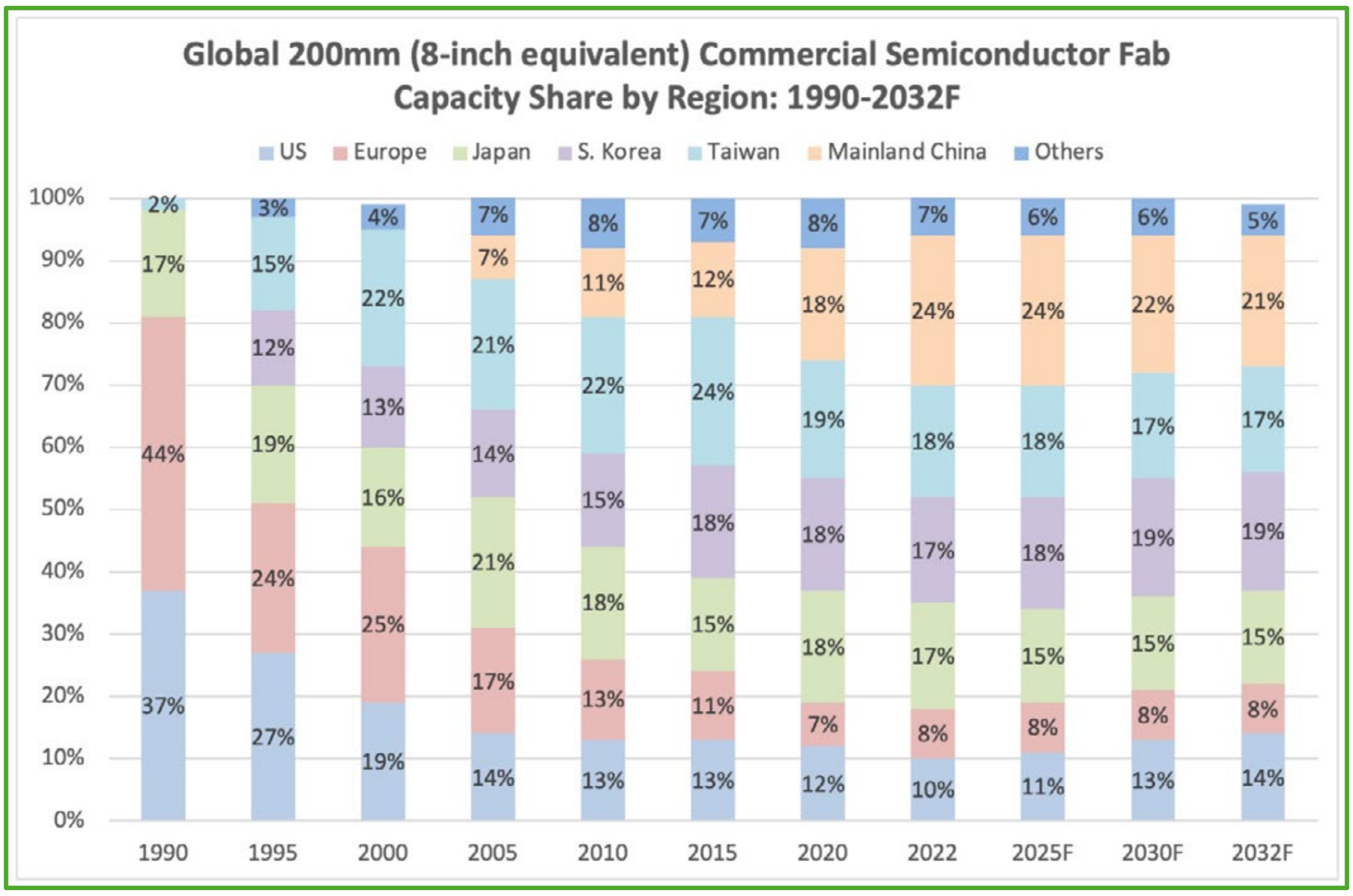
The CHIPS Act has had a significant impact across several key areas, including chip production, R&D, employment, and talent cultivation.

Chip Production

A BCG-SIA report released in May 2024 projected the United States will see a tripling of its domestic semiconductor manufacturing capacity from 2022—when CHIPS was enacted—to 2032. The report also projected the U.S. will capture over one-quarter (28%) of total global capital expenditures from 2024-2032. In fact, the U.S. share of global semiconductor production capacity is projected to increase from 10% in 2022 to 14% 2032.

South Korea, too, is expected to see an increase in its share of global semiconductor fab capacity. On the other hand, regions like China, Taiwan, Japan, and the "Others" category are anticipated to experience a decline in their share of global semiconductor fab capacity. These shifts underscore the dynamic nature of the semiconductor industry and the strategic moves by countries to bolster their positions in this critical sector (see Figure 31).

Figure 31. Global 200mm (8-inch equivalent) Commercial Semiconductor Fab Capacity Share by Region: 1990-2032F



Note: "Others" includes Malaysia, Singapore, India, and the rest of the world.
Source: Raj Varadarajan, Iacob Koch-Weser, Christopher Richard, Joseph Fitzgerald, Jaskaran Singh, Mary Thornton, and Robert Casanova, "Emerging Resilience In The Semiconductor Supply Chain," Semiconductor Industry Association and Boston Consulting Group, May 8, 2024, p. 1

When the CHIPS and Science Act of 2022 was signed into law, it provided the Department of Commerce with US$ 50 billion for a suite of programs to strengthen and revitalize the U.S. position in semiconductor research, development, and manufacturing — while also investing in American workers. CHIPS for America encompasses two offices responsible for implementing the law: The CHIPS Research and Development Office is investing US$ 11 billion into developing a robust domestic R&D ecosystem, while the CHIPS Program Office is dedicating US$ 39 billion to provide incentives for investment in facilities and equipment in the United States.

As of October 6, 2025, the DOC has awarded 35 companies. This funding initiative allocates approximately US$ 30.9 billion across the semiconductor supply chain, with the vast majority of resources concentrated in multi-billion dollar grants to industry giants to bolster large-scale manufacturing. The strategy is heavily anchored by six major recipients: Intel leads with US$ 7.8 billion, followed closely by TSMC Arizona (US$ 6.6 billion), Micron (US$ 6.165 billion), and Samsung Electronics (US$ 4.745 billion), alongside significant awards to GlobalFoundries and Texas Instruments; together, these massive subsidies overshadow the numerous smaller grants provided to supply chain and research partners, signaling a clear priority on expanding advanced fabrication capacity (see Table 27).

Table 27. Finalized CHIPS for America Awards

Company	Award Amount	Locations
Intel Corporation	US$ 7.8 billion	Rio Rancho, NM New Albany, OH Chandler, AZ Hillsboro, OR
Micron	US$ 6.165 billion	Manassas, VA Boise, ID Clay, NY
BAE Systems, Inc.	US$ 35 million	Nashua, NH
GlobalFoundries	US$ 1.975 billion	Burlington, VT Malta, NY Sherman, TX St. Peters, MO
TSMC Arizona	US$ 6.6 billion	Phoenix, Arizona
Polar Semiconductor	US$ 123 million	Bloomington, MN
Edwards Vacuum	US$ 18 million	Genesee County, NY
Infinera	US$ 186 million	San Jose, CA Bethlehem, PA
Corning	US$ 32 million	Canton, NY
Absolics Inc.	US$ 175 million	Covington, GA
Applied Materials	US$ 100 million	Santa Clara, CA
Arizona State University	US$ 100 million	Tempe, AZ
HP Inc.	US$ 53 million	Corvallis, OR
Hemlock Semiconductor	US$ 325 million	Hemlock, MI
Semiconductor Research Corporation Manufacturing Consortium Corporation	US$ 285 million	Durham, NC
Texas Instruments	US$ 1.61 billion	Sherman, TX Lehi, UT
Samsung Electronics	US$ 4.745 billion	Austin, TX Taylor, TX
SK hynix	US$ 458 million	West Lafayette, IN
Entegris	US$ 77 million	Colorado Springs, CO
Rocket Lab	US$ 23.9 million	Albuquerque, NM
Activate	US$ 5 million	Berkeley, CA
Total	US$ 30.8953 billion	

Note: List of direct funding as of Oct. 6, 2025. Out of a total of 35 subsidy awards, this Table lists only the 21 awards exceeding US$ 5 million, while the total amount reflects the full value of all subsidy awards.
Source: "CHIPS for America Awards," NIST, https://www.nist.gov/chips/chips-america-awards, Accessed on November 30, 2025.

The CHIPS Act award will be finalized only if the semiconductor fabrication company meets key milestones and satisfies DOC's due diligence requirements. The purpose of due diligence is "to validate material facts of the application", "address critical risks", and "uncover any new information that may impact the size, nature, or timing of the proposed award."[29] This process, which applies to all CHIPS Act applicants, has been clear from the outset and aims to ensure that companies receive taxpayer dollars only after they have met their commitments.

Research and Development

The CHIPS Research and Development Office is responsible for administering US$ 11 billion to advance U.S. leadership in semiconductor R&D through four programs:

The CHIPS National Semiconductor Technology Center (NSTC) Program

This program focuses on fostering innovation and collaboration in semiconductor technology, aiming to drive cutting-edge advancements and create a robust semiconductor ecosystem.

The CHIPS National Advanced Packaging Manufacturing Program (NAPMP)

This program emphasizes the development of advanced packaging technologies, which are crucial for integrating different semiconductor components and enhancing their performance and efficiency.

The CHIPS Metrology Program

This program aims to develop and implement advanced measurement technologies and standards to ensure the quality and reliability of semiconductor manufacturing processes.

The CHIPS Manufacturing USA Program

This program supports the establishment of up to three Manufacturing USA institutes, focusing on semiconductor manufacturing and advanced packaging, promoting collaboration between industry, academia, and government to drive technological progress.

Employment

The CHIPS fund initiatives will create over 115,000 direct jobs in construction and manufacturing, with additional investments in workforce development and training.[30] TSMC's investment in Arizona, for example, is expected to generate over 6,000 direct manufacturing jobs, more than 20,000 unique accumulated construction jobs, and tens of thousands of indirect jobs over the next five years.[31] This highlights the immediate and localized economic benefits of such investments.

Talent cultivation

Under the CHIPS for America Workforce and Education Fund, US$ 200 million is set aside to kick start development of the domestic semiconductor workforce, which faces near-term labor shortages,

29 NIST, "Due Diligence Process Fact Sheet," July 2024, Accessed November 25, 2024.
30 The White House, Fact Sheet: "Two Years after the CHIPS and Science Act, Biden- Harris Administration Celebrates Historic Achievements in Bringing Semiconductor Supply Chains Home, Creating Jobs, Supporting Innovation, and Protecting National Security," August 9, 2024.
31 National Institute of Standards and Technology, Press Release: "TSMC Arizona Community Impact Report," November 15, 2024.

by leveraging activities of the National Science Foundation (NSF). The NSF launched its Future of Semiconductors initiative, a US$ 45.6 million investment to conduct frontier research and develop the future microelectronics workforce.

The NSTC's Workforce Center of Excellence (WCoE), with a US$ 250 million investment from the DOC, focuses on addressing critical job and skill gaps in the semiconductor industry.[32] It will collaborate with industry, academia, labor unions, the Departments of Labor and Education, the NSF, and local government partners to develop innovative solutions and best practices.

5. Updates in 2025-2026 and Prospects

Between 2025 and 2026, the U.S. semiconductor industry entered a decisive turning point. Policy implementation began to shift from broad-based subsidy deployment toward a phase emphasizing performance evaluation, institutional adjustment, and a more explicitly "transaction-driven" investment strategy. More than three years after the CHIPS and Science Act came into force, Washington's ambition to rebuild domestic supply chains and advanced manufacturing capacity has reached a stage where concrete outcomes can be observed and strategic recalibration is underway.

According to projections by the World Semiconductor Trade Statistics (WSTS), the global semiconductor market is expected to reach a record-breaking US$ 1.51 trillion in 2026, representing 89.9 percent year-over-year growth and surpassing the historic US$ 1 trillion threshold. The Americas region—often used as a proxy for U.S. domestic semiconductor demand—is projected to expand to US$ 543.6 billion, reflecting an exceptional 112.0 percent annual growth rate. This surge is driven overwhelmingly by the demand for logic and memory chips supporting AI training, large-scale inference, and data center infrastructure.

Diverging Progress in U.S. Capacity Expansion

As the CHIPS Act entered its implementation phase, physical construction and pilot production accelerated across multiple projects. However, the pace of expansion among major industry players diverged significantly.

TSMC has emerged as the most visible symbol of progress. In early 2025, the first facility of Fab 21 in Phoenix, Arizona, officially began volume production using the 4-nanometer process, with yield rates reportedly comparable to those of its fabs in Taiwan. Strong demand from U.S. customers such as Apple and Nvidia prompted TSMC to accelerate its second phase. The 3-nanometer production schedule has been moved forward from 2028 to the second half of 2027.

At the same time, TSMC expanded its long-term U.S. investment commitment to approximately US$ 165 billion, planning a large-scale "Gigafab" or Megafab cluster consisting of six advanced wafer fabs alongside advanced packaging facilities. If completed as planned, the Arizona complex could account for a

32 "NSTC Workforce Center of Excellence," National Center for the Advancement of Semiconductor Technology.

substantial share of TSMC's global capacity for nodes at 2 nanometers and below.

Intel, by contrast, has faced greater financial and operational constraints. Its flagship project in New Albany, Ohio, once envisioned as a centerpiece of the revival of American chip manufacturing, has experienced multiple delays. Volume production at the site is now expected around 2030 or later. Intel intends to position the Ohio complex as a key manufacturing base for its future 14A process node (roughly the 1.4-nanometer class), deploying highly expensive High-NA EUV lithography equipment.

Meanwhile, Intel's advanced packaging operations in New Mexico have made more visible progress. Facilities such as Fab 9 and Fab 11x have become the core production base for Intel's Foveros 3D packaging technology, representing the only large-scale 3D packaging capacity currently operating in the United States.

Corporate financing structures have also evolved under Washington's new industrial policy approach. In August 2025, the U.S. Department of Commerce converted US$ 8.9 billion in previously allocated subsidies into a 9.9 percent equity stake in Intel, effectively transforming the federal government from a traditional grant provider into a passive shareholder. This shift reflects a broader policy trend toward linking industrial subsidies with financial returns for taxpayers.

Other semiconductor firms have adjusted their strategies in response to market conditions.

Samsung Electronics has delayed the mass production timeline of its Taylor, Texas fab, originally intended to produce 4-nanometer logic chips. Although construction is largely completed, uncertainties regarding major customer orders—particularly from firms such as Nvidia and Apple—have pushed the start of production back to 2026 or later.

Micron Technology, meanwhile, has recalibrated its long-term plan for a massive DRAM manufacturing campus in Clay, New York, which could involve investments of up to US$ 100 billion over twenty years. Construction of the first fab has been postponed to 2026, with production expected around 2030. At the same time, Micron has shifted its product focus toward high-bandwidth memory (HBM), a key component for AI computing. Rapid growth in HBM sales indicates that AI-related demand is becoming the company's primary growth driver.

In the broader ecosystem, GlobalFoundries continues to emphasize its "differentiated foundry" strategy by focusing on mature and specialty nodes, particularly for automotive electronics and power management applications.

Meanwhile, advanced packaging capacity—an emerging bottleneck in the AI era—is gradually being localized in the United States. Amkor Technology, the world's second-largest outsourced semiconductor assembly and test (OSAT) provider, has launched a US$ 7 billion investment in Peoria, Arizona, to build a facility specializing in 2.5D advanced packaging technologies. Scheduled to begin production in 2028, the plant will be located adjacent to TSMC's Arizona fabs, forming a localized "wafer-to-packaging" supply chain cluster (see Table 28).

Table 28. Progress of Semiconductor Investment and Production in the U.S. : 2025

Company	U.S. Location	Investment Scale	Technology / Product Focus	Production Timeline & Status
TSMC	Phoenix, Arizona	Approx. US$ 165 billion (planned, 6 fabs)	4nm (in production); 3nm, 2nm, A16-class (planned)	Fab 21 Phase 1 began volume production in early 2025; Fab 2 in 2027; Fab 3 around 2030
Intel	Ohio (front-end); New Mexico (back-end)	Approx. US$ 28 billion + equity investments	18A (≈1.8nm); Foveros 3D advanced packaging	Ohio fabs delayed to 2030 or later; 18A ramp-up from 2026; NM packaging fabs operational
Samsung	Taylor, Texas	Approx. US$ 44 billion	4nm logic (planned)	Construction largely completed; production delayed to 2026 or later
Micron	Clay, New York	Up to US$ 100 billion (over 20 years)	DRAM; High-Bandwidth Memory (HBM)	First fab construction delayed to 2026; production expected around 2030
GlobalFoundries	New York	Not disclosed (incremental expansion)	Mature & specialty nodes	Ongoing expansion
Amkor	Peoria, Arizona	Approx. US$ 7 billion	Advanced 2.5D packaging	Construction started in 2025; production begins in 2028

By 2026, demand from artificial intelligence applications had begun to shift from model training toward large-scale inference, fundamentally reshaping server architectures and semiconductor design priorities.

One notable beneficiary of this transition has been Broadcom, which has emerged as a leading supplier of custom AI accelerators (ASICs). The company reportedly secured orders exceeding US$ 10 billion from OpenAI and other major cloud computing firms. Broadcom has also challenged Nvidia's proprietary InfiniBand networking standard by promoting its high-performance 102.4 Tbps Ethernet switching platforms for AI data center interconnects.

Policy Transformation and Trade Defense Tools

U.S. semiconductor policy is also undergoing a structural shift. Government tools have expanded beyond traditional industrial subsidies to include export controls, outbound investment screening, and trade defense mechanisms.

A key development is the ongoing Section 232 investigation into semiconductors and their supply chains, initiated by the Department of Commerce in April 2025. The investigation covers not only chips themselves but also manufacturing equipment and downstream products. Possible policy outcomes include tariffs on semiconductor imports or preferential treatment for companies that manufacture within the United States.

In parallel, export control policies toward China continue to evolve. Since October 2022, the United States has repeatedly tightened restrictions on exports of advanced GPUs, semiconductor manufacturing equipment, and electronic design automation (EDA) software.

In January 2026, the Bureau of Industry and Security revised its licensing policy for advanced semiconductor exports. Under the new rules, exports of high-performance AI chips—such as Nvidia's H200 and AMD's MI325X—to approved Chinese customers will be reviewed on a case-by-case basis, provided that exporters demonstrate compliance with several conditions. These include ensuring that shipments do not reduce supply available to U.S. customers, verifying that Chinese purchasers have established internal export compliance procedures, and subjecting the products to independent third-party testing within the United States to verify performance and security.

More broadly, the focus of U.S. policy is gradually shifting from sanctions targeting individual companies toward a comprehensive regulatory framework that establishes performance thresholds and technological boundaries. Measures such as the expansion of the Foreign Direct Product Rule effectively extend U.S. jurisdiction to semiconductor products manufactured worldwide using American technology.

Infrastructure Bottlenecks: Power, Water, and Talent

By 2026, the principal constraint on semiconductor and AI expansion in the United States was no longer fabrication capacity alone but the availability of supporting infrastructure and skilled labor.

The explosive growth of AI data centers has placed enormous pressure on the power grid. In some regions, grid connection waiting times have stretched to as long as five years. In response, major technology companies—including Amazon and Google—have begun adopting a "Bring Your Own Power" (BYOP) model, constructing dedicated natural gas power plants or small modular nuclear reactors (SMRs) to ensure stable energy supply.

Water management has also become a critical factor. Semiconductor manufacturing requires large volumes of ultra-pure water, prompting fabs to invest heavily in recycling technologies. For example, TSMC's Arizona facilities aim to achieve a water recycling rate of around 90 percent.

The industry also faces a severe shortage of skilled workers. With multiple mega-projects under construction simultaneously, the shortage rate of technical labor reached approximately 58 percent in early 2026, contributing to project delays and rising costs.

To address the projected gap of more than 70,000 technicians by 2030, semiconductor firms have raised wages and deepened partnerships with community colleges and technical institutes. Short-term "micro-credential" programs lasting six to twelve months are increasingly used to retrain workers from other sectors and rapidly expand the semiconductor talent pipeline.

V. The Chinese Semiconductor Industry

1. China in the Global Semiconductor Supply Chain

According to a BCG report in May 2024, China contributed 11% to the overall semiconductor value chain in 2022. China's assembly, test and packaging (ATP) segment was its most significant contributor, accounting for 30% of the global semiconductor added value. Its wafer manufacturing came in second at 24%, semiconductor materials came in third at 18% of the global semiconductor value-added. Other value-added activities include design of discrete, analog, and other (DAO) chips (9%), design of logic chips (5%), design of memory chips (3%), semiconductor equipment (3%), and EDA and Core IP (less than 1%) *(see Table 18)*.

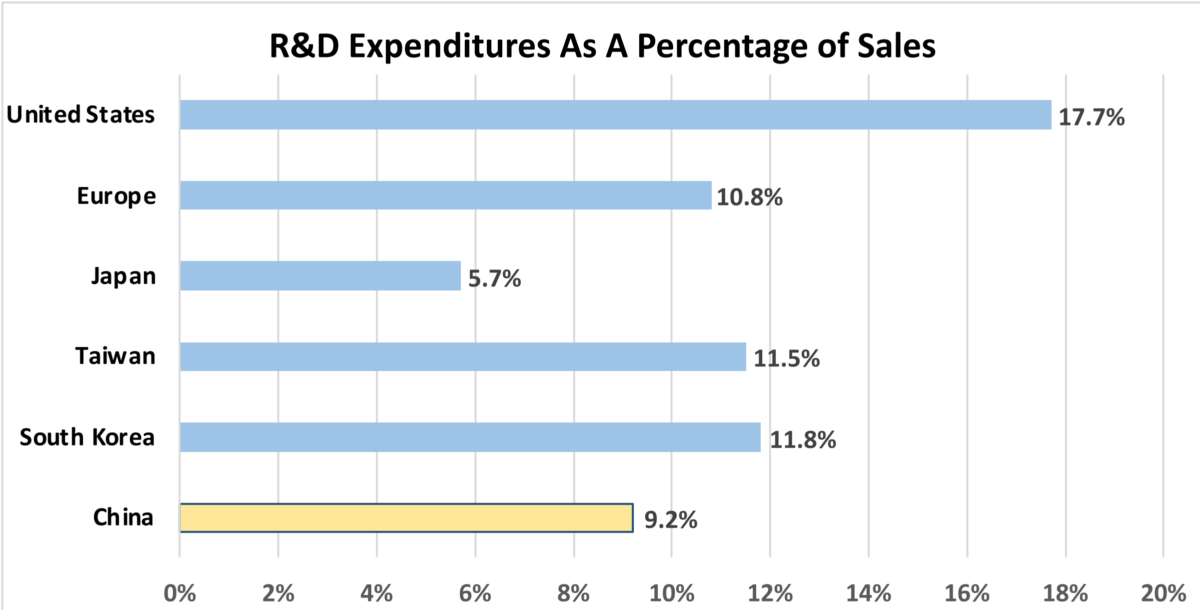
Research and Development

The outline of China's 14th Five-Year Plan (2021-25) for National Economic and Social Development and the Long-Range Objectives through the Year 2035 stated that China will speed up the development of high-end chips. To bolster semiconductor R&D, China has poured significant resources into creating research centers, universities, and industrial parks dedicated to semiconductor technology. In early 2023, for example, reports surfaced that the Chinese government had designated five key firms— Huawei, Semiconductor Manufacturing International Corporation (SMIC), Yangtze Memory Technologies Company (YMTC), and toolmakers Naura and Advanced Micro-Fabrication Equipment Inc. (AMEC) — to gain privileged access to government R&D.[33]

According to the SIA, Chinese semiconductor companies allocated 7.6% of their total sales to R&D in 2023, lagging behind their global counterparts. In that year, the U.S. led with an R&D intensity of 19.3%, followed by Europe (14.0%), Japan (12.0%), Taiwan (11.0%), and South Korea (9.5%). Notably, China's R&D intensity was just 39% of the U.S. level and 54% of Europe's. However, 2024 saw a shift. SIA data indicates that China's investment rose significantly to 9.2%. While the U.S. maintained the top spot at 17.7%, the rankings evolved, with South Korea (11.8%) and Taiwan (11.5%) surpassing Europe (10.8%) and Japan (5.7%) (see Figure 32).

33 Qianer Liu, "China Gives Chipmakers New Powers to Guide Industry Recovery," Financial Times, March 20, 2023.

Figure 32. Semiconductor Industry R&D Spending Across Regions: 2024



Source: SIA 2025 Factbook, Semiconductor Industry Association, May 27, 2025, p. 20.

EDA and Core IP

China accounted for less than 1% of the global value-added EDA market share in 2022. The EDA market is oligopolistic, dominated by U.S. headquartered companies like Synopsys, Cadence, and Siemens EDA. Chinese companies captured 11.5% of its domestic EDA market in 2020 and this is expected to increase to 14% by 2025.[34] Empyrean Technology is the leader of China's EDA industry but even its technology, revenue scale, and overall influence fall far behind the American EDA industry.

Due to U.S. export controls, Chinese companies have been denied access to advanced EDA software and design IP. On December 2, 2024, Empyrean Technology and its subsidiaries were placed on the U.S. Department of Commerce's Entity List, restricting Empyrean from accessing U.S. technology and components, which can directly impact its ability to develop and produce EDA tools. Following the blacklisting, Empyrean transferred full control to its state-owned shareholder, China Electronics Corporation.

In June 2023, China established the National Center of Technology Innovation for EDA (NCTI-EDA), its first national innovation center dedicated to advancing IC design. This initiative reflects China's strategic push to develop domestic EDA tools and reduce its dependence on foreign technologies, particularly in light of U.S. export restrictions. However, building a competitive, homegrown EDA ecosystem is a complex and resource-intensive process that requires sustained investment, long-term talent development, and technological breakthroughs — all of which will take considerable time to materialize.

Chip Design

In 2022, China's share in chip design was modest. In the design of logic chips, its value-added share was 5%. In contrast, the U.S. led the way with a dominant 65% value-added, followed by Taiwan at 11%

34 "The Localization Rate of Chip EDA Has Exceeded 11%, and Silergy Will Join Hands with Tencent Cloud to Create EDA Cloud Services (芯片EDA国产化率已超过11%，思尔芯将与腾讯云联合打造EDA云服务)," TMT Post, January 22, 2024.

value-added and the EU at 9% value-added. In the design of memory chips, China's share was 4% value-added, significantly lower compared to Taiwan, which led the market with a 60% value-added share. In the design of DAO chips, China's global value-added share was 5%, significantly lower compared to the U.S., which held a dominant 41% value-added share in this segment *(see Table 18)*.

China's major IC design companies form a broad but uneven ecosystem, spanning image sensors (such as Will Semiconductor/OmniVision), memory and MCUs (GigaDevice), mobile and IoT SoCs (UNISOC, Rockchip, Allwinner), analog and power management ICs (SG Micro, Silergy), and RF components (Maxscend). Collectively, these firms demonstrate growing design capabilities and strong positions in mid-range, cost-sensitive markets, often supported by policy incentives and a large domestic demand base. However, despite notable progress in specific niches, the sector remains constrained by limited access to advanced manufacturing nodes, heavy reliance on external foundries, and weaker competitiveness in high-end logic, CPUs/GPUs, and foundational semiconductor ecosystems compared with global leaders.

Compared with the world's leading semiconductor and IC design companies, Chinese IC design firms remain much smaller in scale, with a pronounced gap in both revenue and global market presence. As shown by the 2023 revenue rankings, the global industry is dominated by firms such as TSMC, Intel, NVIDIA, Qualcomm, Broadcom, and Samsung, each generating tens of billions of US dollars annually and accounting for substantial shares of total industry revenue.

In contrast, no Chinese IC design company appears among the global top 20 by revenue in 2023, and even the largest Chinese players operate at a fraction of the scale of leading U.S., Taiwanese, Korean, European, and Japanese firms. This disparity highlights not only differences in market reach and product positioning, but also deeper structural gaps in technology depth, ecosystem integration, and long-term competitiveness at the high end of the semiconductor value chain (see Table 29).

Table 29. World's 20 Largest Semiconductor Companies (including foundries) by Revenue: 2023

Rank	Company	Headquarters	2023 Revenue (US$ billion)	% of Industry Revenue
1	TSMC	Taiwan	69.3	12.7%
2	Intel	U.S.	51.2	9.4%
3	NVIDIA	U.S.	49.2	9.0%
4	Samsung Electronics	South Korea	44.4	8.1%
5	Qualcomm	U.S.	31.0	5.7%
6	Broadcom	U.S.	28.4	5.2%
7	SK Hynix	South Korea	23.7	4.4%
8	Advanced Micro Devices (AMD)	U.S.	22.4	4.1%
9	Apple	U.S.	18.6	3.4%
10	Infineon Tech	Germany	17.3	3.2%

11	STMicroelectronics	Switzerland	17.3	3.2%
12	Texas Instruments	U.S.	16.6	3.1%
13	Micron Technology	U.S.	16.0	2.9%
14	MediaTek	Taiwan	13.9	2.6%
15	NXP	Netherlands	13.1	2.4%
16	Analog Devices	U.S.	11.8	2.2%
17	Renesas Electronics Corporation	Japan	10.5	1.9%
18	Sony Semiconductor Solutions Corporation	Japan	10.2	1.9%
19	Microchip Technology	U.S.	8.2	1.5%
20	Onsemi	U.S.	7.9	1.4%
N/A	TOP 20		481.0	88.2%
N/A	Others		64.0	11.8%
N/A	Total		545.0	100%

Source: Omdia, "New Omdia Research Reveals 2023 Semiconductor Market Revenue down 9% from 2022," March 27, 2024; TSMC Annual Report 2023.

Semiconductor Equipment Manufacturing

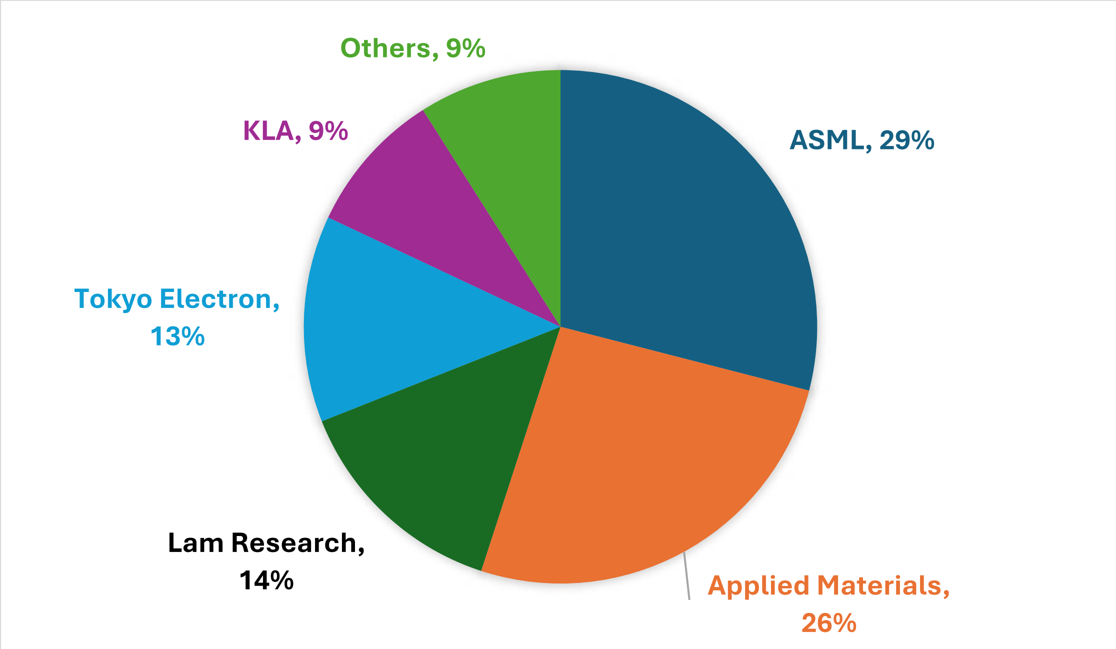
Semiconductor equipment manufacturing, the third highest value-added activity within the semiconductor value chain, accounted for 12% value-added to the global semiconductor value chain in 2022. Nevertheless, China's value-added share of the global semiconductor manufacturing equipment market was only 3%. This is relatively low compared to other leading countries, highlighting the challenges China faces in this sector (see Table 18).

Although China has struggled to break through in the lithography equipment market, it has gradually gained traction in the dry etching and PVD equipment segments. Led by Naura, its equipment portfolio covers nearly all major stages of the semiconductor manufacturing process. Naura and AMEC together account for approximately 6% of the global dry etching market, while Naura's share of the PVD equipment market reaches 12%.[35]

The global semiconductor manufacturing equipment market is highly concentrated, dominated by a small group of firms largely headquartered in the United States, underscoring U.S. leadership in this critical segment of the semiconductor value chain. In 2023, the top five vendors accounted for the vast majority of global revenue. The Netherlands' ASML led the market with a 29% share, reflecting its near-monopoly in advanced lithography. U.S.-based Applied Materials followed closely with 26%, while Lam Research captured 14% of global revenue. Japan's Tokyo Electron ranked fourth with a 13% share, and KLA Corporation, also headquartered in Silicon Valley, completed the top five with 9%. Collectively, U.S. firms alone accounted for nearly half of the global market, highlighting the structural dominance of American equipment suppliers in semiconductor manufacturing (see Figure 33).

35 TrendForce, "ASML EUV Dominance & China's Semiconductor Equipment Push," Dec. 23, 2025.

Figure 33. Semiconductor Manufacturing Equipment Vendor Market Share by Revenue Worldwide: 2023



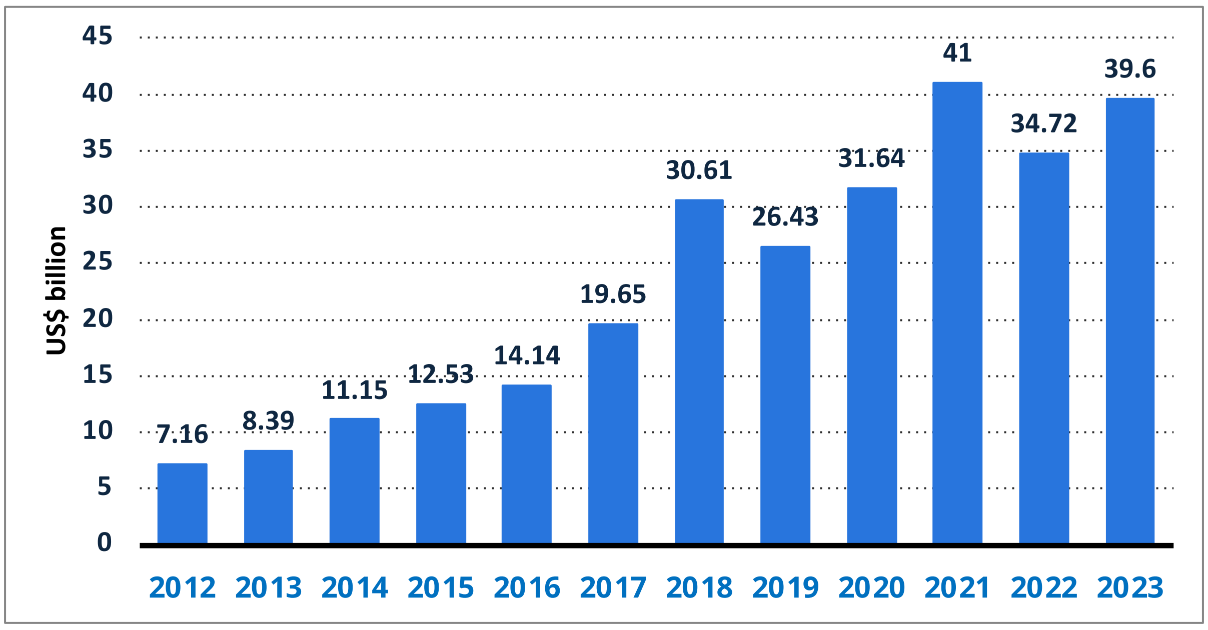
Source: Market share derived from revenue figures from CompaniesMarketCap.com, accessed on February 3, 2025; "Semiconductor Manufacturing Equipment Market Report," Grand View Research, accessed on February 3, 2025.

While China's local equipment industry has made much progress and appears to be able to cover the various stages required in semiconductor manufacturing processes, lithography machines remain a challenge. Due to export restrictions, China has been prevented from acquiring Extreme Ultraviolet (EUV) machines from ASML, the primary supplier of this advanced technology. In recent years, Chinese companies have been stockpiling deep ultraviolet (DUV) machines from Japan's Tokyo Electron and Nikon and the Netherlands' ASML to maintain their semiconductor manufacturing capabilities.

China's imports of semiconductor manufacturing equipment show a clear long-term upward trend, punctuated by short-term fluctuations. Import values rose steadily from 2012 through 2018, dipped in 2019, and then accelerated sharply after 2020, reflecting intensified capacity expansion and front-loaded equipment purchases amid rising technology and geopolitical constraints.

In 2023, China imported semiconductor machines valued at about US$ 39 billion, an increase of roughly US$ 5 billion from 2022, bringing imports close to their historical peak. Among these purchases, lithography tools stand out as the most critical equipment in the semiconductor manufacturing process. For this core technology, China remains heavily dependent on imports, underscoring a persistent structural reliance on foreign suppliers despite sustained investment in domestic semiconductor development (see Figure 34).

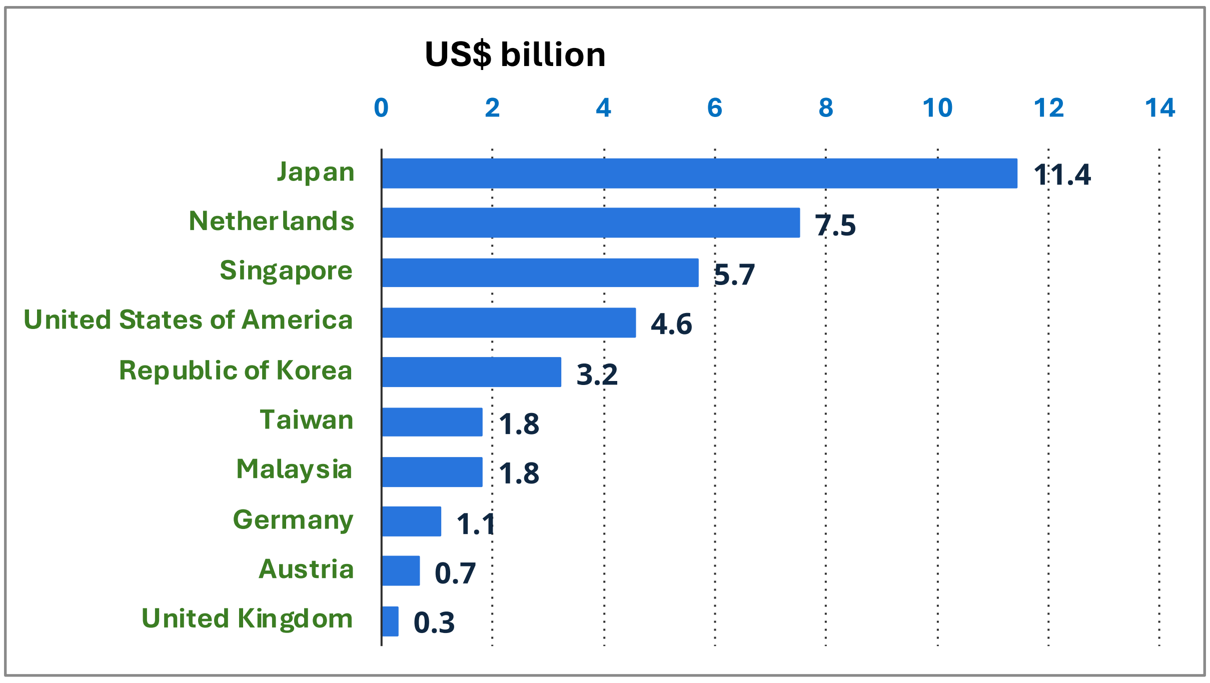
Figure 34. Import Value of Machines for Manufacturing Semiconductors in China: 2012 to 2023



Source: Statista, retrieved February 06, 2025.

In 2023, Japan was China's largest source of imported semiconductor manufacturing equipment, accounting for approximately US$ 11.4 billion in imports, followed by the Netherlands at US$ 7.5 billion and Singapore at US$ 5.7 billion. Together, these three economies supplied a substantial share of China's semiconductor equipment imports, underscoring China's heavy dependence on a small number of technologically advanced regions for critical manufacturing tools. This concentration highlights both the central role of Japanese, Dutch, and Singapore-based firms in the global semiconductor equipment supply chain and China's ongoing vulnerability to external technology controls and supply disruptions (see Figure 35).

Figure 35. Leading Region of Origin for Imported Semiconductor Equipment in China by Import Value: 2023



Source: Statista, retrieved February 03, 2025.

Chinese firms are making strategic efforts to develop domestically produced lithography capabilities in order to reduce reliance on foreign suppliers. Shanghai Micro Electronics Equipment (SMEE), China's leading lithography equipment manufacturer, has filed patents related to EUV lithography systems, a segment currently dominated by ASML and subject to stringent export controls.

At the same time, a broader ecosystem of research institutions and industry players—including teams linked to Huawei as well as other domestic semiconductor ventures— is actively exploring advanced patterning approaches such as self-aligned quadruple patterning (SAQP) in combination with deep ultraviolet (DUV) lithography. By applying SAQP and other multi-patterning techniques to existing DUV tools, Chinese manufacturers seek to approximate feature sizes associated with more advanced process nodes without direct access to EUV equipment.

Overall, China's semiconductor equipment industry exhibits uneven self-sufficiency rates across different subsegments, reflecting relative strength in mature process nodes and weakness in advanced process nodes. In photoresist stripping equipment, the self-sufficiency rate in the low-to-mid range market has reached 75% to 90%. In cleaning and etching equipment, domestic self-sufficiency is approximately 50% to 60%, with AMEC's plasma etching equipment achieving 5-nanometer technology capability. However, development in CMP, ion implantation, and lithography equipment mainly focuses on mature processes, with self-sufficiency rates ranging from 10% to 25%. For advanced lithography equipment, under ASML's monopoly, China's domestic self-sufficiency currently approaches zero. As TrendForce points out, the true barrier in EUV does not lie merely in replicating equipment, but in the global supply chain and the high-volume manufacturing (HVM) data feedback loop that ASML has built over three decades.[36]

Semiconductor Materials

The materials segment of the semiconductor value chain accounted for only 5% global value-added in 2022. China's value-added share of the global semiconductor materials market was 18%, behind Taiwan's 28% value-added share. Other regions such as South Korea (18%), and Japan (12%) also play a significant role in the production of essential materials used in semiconductor manufacturing *(see Table 18)*.

China is a major player in the global supply of rare earth elements, producing around 60% of the world's supply and processing 85% of them.[37] Rare earths are critical for producing components used in various electronic devices, including magnets, catalysts, and lighting systems. Additionally, they are also essential for the manufacturing of semiconductor-related materials like neodymium, lanthanum, and cerium. The concentration of rare earth elements in China poses risks for countries and companies heavily reliant on these materials, as any disruptions in supply or export restrictions could impact chip production and innovation.

Semiconductor Assembly, Test and Packaging

The semiconductor assembly, test, and packaging (ATP) segment accounted for approximately 6% of total value-added across the global semiconductor value chain in 2022. Compared with other stages of manufacturing, ATP—particularly traditional ATP—entails less complex processes and equipment,

36 TrendForce, "ASML EUV Dominance & China's Semiconductor Equipment Push," Dec. 23, 2025.
37 Gracelin Baskaran, "Could Africa replace China as the world's source of rare earth elements?" Brookings, December 29, 2022

making it relatively more labor-intensive. Globally, ATP activities are heavily concentrated in China and Taiwan, which in 2022 accounted for about 30% and 28% of global ATP value-added, respectively (see Table 18).

Semiconductor Manufacturing

In 2022, China accounted for the largest share of global semiconductor manufacturing value-added at 24%, followed by Taiwan at 18%. Japan and South Korea each contributed 17%, while the United States and Europe accounted for 10% and 7%, respectively (see Table 18).

In 2022, China's share of overall value-added in the global semiconductor industry was approximately 11%. Within its domestic semiconductor ecosystem, China's largest contribution came from the ATP segment, where it has developed substantial capacity. The country has also built significant capabilities in chip fabrication, particularly at mature process nodes (28 nm and above), and expanded production across these more established technologies.

However, China's domestic strengths remain relatively limited in critical upstream areas such as electronic design automation tools and core intellectual property, where much of the global market continues to be dominated by foreign suppliers, constraining local self-sufficiency. Similarly, China's ability to produce advanced semiconductor manufacturing equipment lags behind global leaders, necessitating substantial imports of high-end tools to support its manufacturing needs.

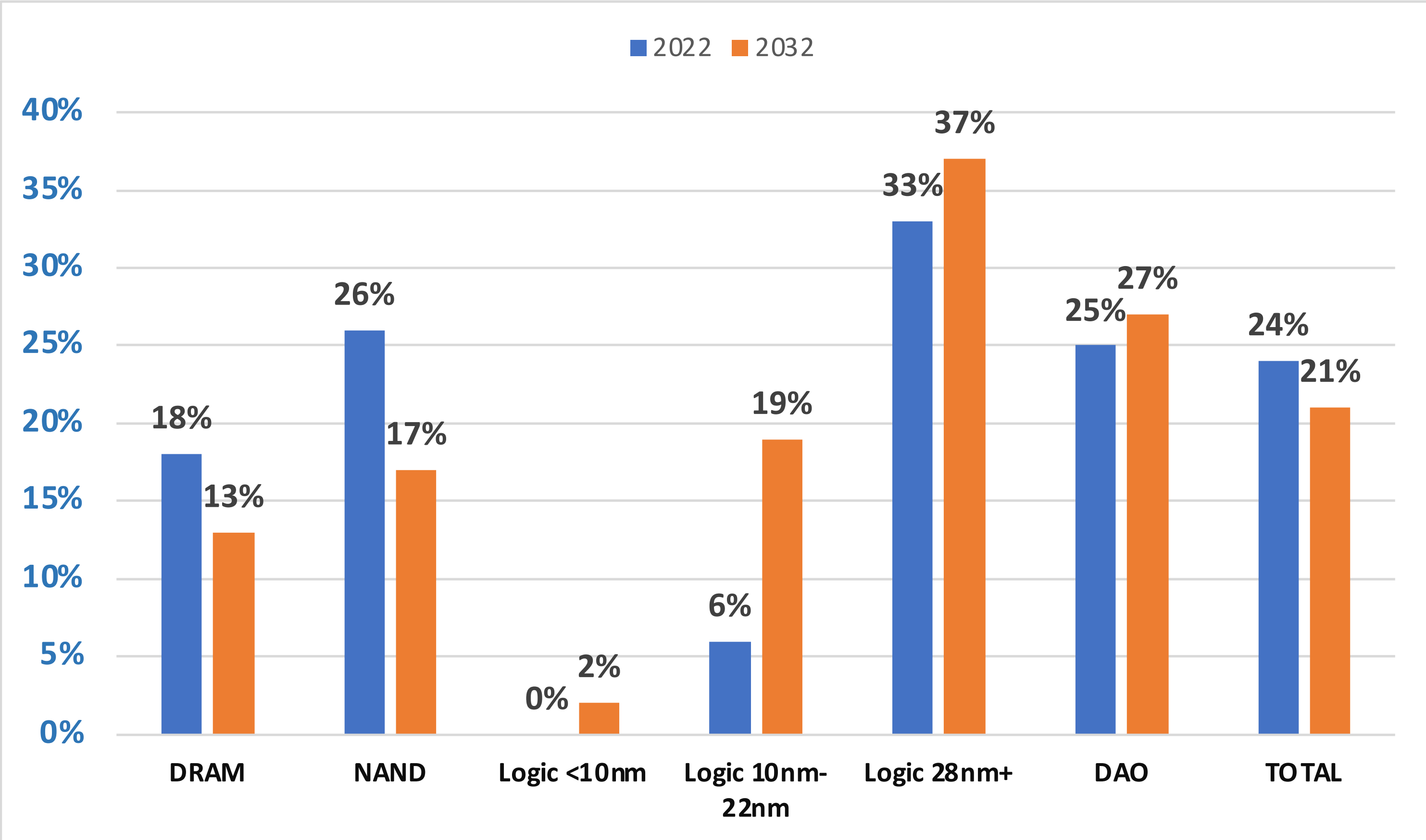
According to BCG's May 2024 report, Chinese firms accounted for approximately 24% of global wafer fabrication capacity in 2022, underscoring China's substantial footprint in semiconductor manufacturing by volume. This strength is particularly evident in memory chips. In 2022, China held around 18% of global DRAM wafer fabrication capacity and an even larger 26% share in NAND flash memory, both of which are widely used in computing and consumer electronics.

Beyond memory chips, China's wafer manufacturing capacity has been heavily concentrated in mature technologies. In logic chips, Chinese firms had no measurable share of global capacity for advanced nodes below 10 nm in 2022. Their share was about 6% in the 10–22 nm range, but rose sharply to 33% for mature logic nodes at 28 nm and above, highlighting a strategic focus on established process technologies rather than cutting-edge fabrication.

A similar pattern is observed in discrete, analog, and other (DAO) chips, where China accounted for roughly 25% of global wafer fabrication capacity in 2022. These segments are generally less technologically demanding but critical for industrial, automotive, and consumer applications.

Looking ahead, China's share of global wafer fabrication capacity is projected to decline to about 21% by 2032, down from 24% in 2022. Notably, its share of sub-10 nm capacity is expected to reach only around 2% of the global total, suggesting that China's progress in advanced semiconductor manufacturing will remain constrained. These projections reflect persistent challenges related to technology access, equipment capabilities, and structural gaps in advanced process development (see Figure 36).

Figure 36. China's Share of Global Fabrication Capacity on Site (Quantity): 2022 and 2032



Source: Raj Varadarajan, Iacob Koch-Weser, Christopher Richards, Joseph Fitzgerald, Jaskaran Singh, Mary Thornton and Robert Casanova "Emerging Resilience in The Semiconductor Supply Chain," Boston Consulting Group and Semiconductor Industry Association, May 2024, p. 14.

Advanced chips, specifically those with process nodes of 7nm or less, represent the cutting edge of semiconductor technology. Taiwan's TSMC, South Korea's Samsung, and U.S.'s Intel are leading the industry in manufacturing advanced chips using EUV lithography machines. ASML, the sole company that manufactures EUV lithography machines, is required to comply with U.S. export controls and is prohibited from selling EUV machines to China. Unable to access EUV lithography technology, China's largest chipmaker, SMIC has reportedly achieved a quasi-7nm process using DUV machines.

TechInsights' teardown of the Huawei Mate 60 series in 2023 confirmed that the device was powered by a 7 nm-class chip manufactured by SMIC, with the Kirin 9000S produced on SMIC's second-generation 7 nm (N+2) process. Huawei's Mate 70 Pro, launched in November 2024, continued this trajectory by adopting the Kirin 9020, which likewise relied on an SMIC-made 7 nm-class process, featuring incremental improvements in die size optimization and layout efficiency rather than a true node transition.

More recently, TechInsights' analysis of the Kirin 9030 and Kirin 9030 Pro—used in Huawei's Mate 80 series—indicates that these SoCs are fabricated on SMIC's so-called N+3 process. While N+3 represents the most advanced manufacturing technology currently available at SMIC and enables higher core counts and modest density gains, TechInsights characterizes it as a scaled extension of the existing 7 nm (N+2) node rather than a genuine 5 nm-class process. Fundamental front-end transistor parameters remain largely unchanged, with performance and density improvements derived primarily from DUV-based design-technology co-optimization and aggressive back-end metal pitch scaling. As a result, despite incremental progress, SMIC's N+3 process still falls materially short of the 5 nm-class technologies deployed by leading foundries such as TSMC and Samsung, and is expected to face notable yield and cost challenges.[38]

While these developments represent meaningful progress and demonstrate the resilience of China's semiconductor ecosystem, they remain several generations behind the most advanced chips from industry leaders such as TSMC and Samsung, which have moved into 3 nm and beyond. Chinese firms have been refining existing process technologies to improve performance and yields, but they have not yet achieved parity with cutting-edge nodes in terms of efficiency, density, and overall competitiveness. Various media reports suggest that SMIC may be able to make 7nm and 5nm chips with yields of 50% and 30-40%, respectively, but priced at a 40-50% premium over what TSMC charges for similar technology nodes.[39]

China is expected to continue to hold a substantial position in the industry, especially in more mature nodes. Its share for the 10-22nm category is forecasted to triple from 6% in 2022 to 19% in 2032 and its share for chips for the 28nm and above category is projected to increase from 33% in 2022 to 37% in 2032.

2. Policy Measures

According to Omdia, the world's top 20 semiconductor firms generated about US$ 480 billion, or 88.2%, of global revenue in 2023. China's leading foundry, SMIC, is absent from this group; with US$ 6.3 billion in revenue, it accounted for only 1.2% of the global total, highlighting the limited scale of China's semiconductor industry relative to the United States, Taiwan, South Korea, Japan, and Europe.

That said, a December 2023 BIS report shows China has gained a foothold in certain segments of the value chain. In 2022, China-based firms held 12% of global fabless revenue, 9% of foundry revenue, 20% of OSAT revenue, and 6% of total semiconductor revenue (see Table 20).

China's semiconductor policy is thus less about current market leadership than about strategic self-sufficiency. Since 2014—following the State Council's designation of semiconductors as a national security–critical industry—Beijing has pursued supply-chain security and indigenous innovation through initiatives such as the "Big Fund" and Made in China 2025, aiming to reduce dependence on foreign technology and elevate China's long-term global standing.

National Integrated Circuit Industry Investment Fund

The "Big Fund" has acted as China's most centralized instrument for directing money to the various segments of the semiconductor value chain, including design, manufacturing, packaging, testing, equipment, and materials. The "Big Fund" seeks to enhance China's technological self-sufficiency and global competitiveness by making strategic financial investments. Its goal is to foster coordinated development across the semiconductor supply chain's upstream and downstream sectors (see Table 29).

38 Anton Shilov, "Huawei's latest mobile is armed with China's most advanced process node to date despite using blacklisted chipmaker," Tom's Hardware, December 13, 2025.
39 Jeff Pao, "SMIC to sell Huawei costly, inefficient 5nm chips," Asia Times, February 8, 2024; Qianer Liu, "China on cusp of next-generation chip production despite US curbs," Financial Times, February 6, 2024.

Table 30. National Integrated Circuit Industry Investment Fund Initiative

Initiative: National Integrated Circuit Industry Investment Fund ('Big Fund')
Measures include: • **Direct investment in domestic semiconductor companies:** Funding promising startups, established players, and research institutions to foster innovation and strengthen the domestic ecosystem. • **Intensified R&D support:** Allocating resources to advance cutting-edge technologies in areas like chip design, manufacturing equipment, manufacturing, and materials science. • **Strategic foreign direct investment (FDI):** Leveraging the Big Fund to acquire critical foreign technology through overseas acquisitions of companies or intellectual property. • **Facilitating inbound FDI:** Attracting foreign investment through incentives and joint ventures to bring in advanced manufacturing capabilities, expertise, and market access. The Big Fund is managed by Sino IC Capital, a company established by China Development Bank in 2014. The fund's shareholders include the Ministry of Finance, China Tobacco, China Telecom, and several local governments and investment funds. It operates as a corporate entity under the guidance and supervision of the Ministry of Industry and Information Technology and the Ministry of Finance. **The fund has three phases, each with different fundraising targets and investment focuses:** • **Phase I (2014-2019):** RMB 138.7 billion (~US$ 19 billion) in 2014 invested in 23 domestic semiconductor companies, mainly in chip manufacturing, design, and packaging. The fund also facilitated several mergers, acquisitions, and IPOs in the industry. • **Phase II (2019-2024):** RMB 204 billion (~US$27 billion) with increased focus on etching machines, film, test, and cleaning equipment, and new applications enabled by 5G and AI. • **Phase III (2024-2029):** RMB 344 billion (~US$47.5 billion) with focus on semiconductor equipment and advancing third-generation semiconductors requiring materials like silicon carbide (SiC) and gallium nitride (GaN), and high-value-added dynamic random-access memory chips.

Despite being a key player in China's semiconductor investment landscape, the "Big Fund" faced a scandal in mid-2022 involving allegations of illegal activities. Several officials, including former General Manager of the National Big Fund, and senior executives from SINO-IC Capital, fund manager, were investigated by the Central Commission for Discipline Inspection of the Chinese Communist Party (CCP). This incident raised concerns about its potential impact on the development of China's semiconductor industry.[40]

The latest Big Fund III saw US$ 47.5 billion in funding from 19 government and state-owned entities in 2024. China is also using a range of levers, including local content preferences, domestic standards, and informal government directives to create demand for domestically produced semiconductors. Big Fund III's initial investment of RMB 93 billion (US$ 12.7 billion) targets key material and equipment manufacturers, including Advanced Chemical Materials (ACM), NAURA Technology Group and Advanced Micro-Fabrication Equipment Inc. China (AMEC). Big Fund III focuses on supporting foundries and equipment manufacturers and fabless companies, creating a comprehensive and self-

40 News, "China's Big Fund Faces Hurdles in Organizing Third Phase, Initial Funding Encounter Challenges," TrendForce, September 28, 2023.

sufficient semiconductor ecosystem (see Table 30).

Table 31. Big Fund's Key Industry Players

Big Fund I	Big Fund II	Big Fund III
• Anji Micro • Zhejiang Juhua • NAURA • SMIC • Navtech • Changchuan Tech • YMTC • Unisoc • Sanechips Technology • JCET • Huahong Group • AMEC • Tongfu Microelectronics • Huatian Technology • Giga Device	• NAURA • AMEC • SMIC • Huahong Group • Jiangsu Nata Opto • G-Gas	Existing foundries are expanded and new foundries are established in China, but they lack profitability. First half of 2024 results (Net profit): • SMIC (year on year), -45.1% • Huahong Group, -83.3% • CR Micro, -64% • National Silicon Industry Group (NSIG), -307.4% In contrast, semiconductor equipment companies have seen strong revenue growth due to rebound gains from US pressure (Revenue): 1. NAURA (year-over-year), +46.4% 2. AMEC, +36.5% 3. ACM, +49.3% Design, CPU, and packaging and test are performing well due to recovering demand in mobile and automotive markets in China(Net profit): WillSemi (year-over-year), +792.8% Montage, +624.6% GigaDevice, +53.9%

Source: Ardi Janjeva, Seoin Baek, Andy Sellars, CETaS Briefing Paper: "China's Quest for Semiconductor Self-Sufficiency: The impact on UK and Korean industries," The Alan Turing Institute, December 4, 2024, pp. 16-17.

"Made in China 2025" Initiative

Made in China 2025 is a strategic plan to upgrade China's manufacturing base, with semiconductors a core focus. Key measures include boosting R&D to reduce reliance on foreign technology, localizing production to strengthen supply-chain security, fostering partnerships to build a domestic semiconductor ecosystem, and scaling up Chinese foundries to compete with global leaders such as TSMC and Samsung (see Table 31).

Table 32. Made in China 2025 (MIC 2025) Initiative

1. MIC 2025 focuses on intelligent manufacturing in 10 strategic sectors: 2. advanced information technology; 3. automated machine tools and robotics; 4. aerospace and aeronautical equipment; 5. ocean engineering equipment and high-tech shipping; 6. modern rail transport equipment; 7. energy saving and new energy vehicles; 8. power equipment; 9. new materials; 10. medicine and medical devices; and 11. agricultural equipment. *MIC 2025 entails a 3-step strategy:* • **Step 1 (2015-2025):** basic industrialization, progress made in smart and green manufacturing; • **Step 2 (2025-2035):** complete industrialization, tier-2 manufacturing leader with solid indigenous R&D, breakthrough in key sectors; and • **Step 3 (2035-2050):** Tier-1 manufacturing leader with advanced technology and industrial system. *With reference to semiconductors, the goals are:* 1. To develop the IC design industry, speed up the development of the IC manufacturing industry, upgrade the assembly, testing and packaging (ATP), and facilitate breakthroughs in the key equipment and materials of integrated circuits. 2. By 2020, China's semiconductor design and manufacturing should be one to two generations behind industry leaders and supported by a robust domestic supply chain of equipment, material and ATP service suppliers. 3. By 2030 the main segments of the IC industry should reach advanced international levels.

The "Made in China 2025" initiative encompasses several measures to bolster the semiconductor industry. These measures include tax incentives, special economic zone subsidies, a whole-of-nation approach for semiconductor R&D, the establishment of the Central Science and Technology Commission (CSTC), and the promotion of new national champions within the local semiconductor industry.

The CSTC was established in March 2023 to beef up the CCP Central Committee's "centralized and unified leadership over science and technology-related work." This reflects the CCP's commitment to centralized control over scientific and technological development, its prioritizing of national security concerns in technological advancement and its goal to drive economic growth through technological innovation.

The original "Made in China 2025" plan included ambitious targets for increasing the local content of semiconductor chips to 40% by 2020 and 70% by 2025. However, these targets were revised in 2019.[41] The new focus shifted to reaching US$ 305 billion in semiconductor output by 2030 and meeting 80% of domestic demand for semiconductors (see Table 32).

41 Congressional Research Service, "China's New Semiconductor Policies: Issues for Congress," April 20, 2021.

Table 33. Measures Under "Made in China 2025" Initiative

MEASURE	DETAILS
Tax Incentives	**Corporate Tax Breaks** Preferential tax treatment from the first profitable year for domestic semiconductor players in 2020: • Qualifying integrated circuit (IC) projects and enterprises that have operated for more than 15 years will be exempt from corporate income tax for up to 10 years if they employ the 28 nm process or more advanced nodes. • Those producing 65 nm to 28 nm chips will get 5 years of tax exemption and a 50% discount on the corporate tax rate for the subsequent five years.
	Exemption of Import Duties in Chip Equipment and Inputs until 2030 Exemption of tariffs from July 27, 2020 to December 31, 2030 on imports of some semiconductor companies that are critical to the country's IC development, including IC production equipment parts, raw materials and other consumables.
	Tax Credit for Investments in Semiconductor Research and Development Tax credit for investments in semiconductor R&D was upgraded by 20%. For the entire calendar years from 2023 to 2027, the pre-tax deduction rate for R&D related expenses will increase from the current 100% to 120%.
	"Super-input" value-added tax (VAT) credit From 1 January 2023 to 31 December 2027, general VAT taxpayers engaging in IC design, manufacturing, equipment, materials, packaging and testing would be eligible for an extra 15% "super-input VAT credit." This allows qualified IC enterprises to credit their eligible input VAT at a rate of 115%.

MEASURE	DETAILS
Special Economic Zone Subsidies	**Lin-gang Special Area** Established in 2019, Lin-gang New Area is part of the Shanghai Pilot Free Trade Zone to build a comprehensive industrial base for integrated circuits. It provides guidance on its entire supply chain layout, innovation, openness and cooperation. Besides promoting the development of key areas such as core chips, specialty processes, key equipment, and basic materials, it also supports multinational companies in setting up offshore R&D and manufacturing centers. Corporate income tax rates for companies specializing in IC, artificial intelligence, biomedicine and civil aviation have been set at 15% in Lin-gang for five years from the date of establishment, compared to the usual 25% in the rest of China. *Lin-gang As A Hub for Wide-Bandgap Semiconductors* On March 29, 2024, a wide-bandgap semiconductor industry base was unveiled in Lin-gang. The Lin-gang Special Area aims to hit its "Double Hundred Billion" goal by 2026, with equipment materials and wafer manufacturers topping 10 billion (US$ 1.6 billion) each in value – making it a leading base for the wide bandgap semiconductors sector in China.
Special Economic Zone Subsidies	**China-Korea Integrated Circuit Industrial Park** The municipal government of Wuxi and memory chip giant SK Hynix started construction of the industrial park in October 2021. The project involves a total investment of about RMB 2 billion (US$ 310 million) and aims to strengthen the high-quality development of the IC industry in Wuxi by attracting more upstream and downstream projects in its industrial chain.
	Special Economic Zone in Hengqin Established in July 2022 as a major new outpost for China's semiconductor industry, the Hengqin Special Economic Zone offers: 1. Up to RMB 30 million (US$ 4.4 million) each for semiconductor firms to set up new offices or conduct R&D activities in Hengqin; 2. RMB 5 million (US$ 686,502) and 50% of tapeout cost to firms that establish R&D programs in Hengqin; 3. Up to RMB 25 million (US$ 3.43 million) to firms involved in 14 nm or lower chip processing design; 4. More than RMB 100,000 (US$ 13,930) each to researchers and senior managers who signed contracts with Chinese semiconductor firms and were assigned to work in Hengqin for a three-year period; and 5. RMB 1 million (US$ 139,300) to companies that can nurture semiconductor talent in Hengqin.

MEASURE	DETAILS
"Whole Nation System" for Chip R&D	The new "Whole Nation System" is embedded in China's 14th five-year plan, as well as its local and sector-specific versions, which collectively map key strategies for advancing the country's development from 2021 to 2025. Specifically, the new "Whole Nation System" for R&D consists of key elements including integrating and diverting resources to priority cutting-edge technologies such as artificial intelligence and quantum science, strengthening basic research, and establishing national labs and industry clusters.
Central Science and Technology Commission	Established in March 2023, the commission, which sits directly under the Communist Party of China's Politburo, is higher ranking than all government ministries. It has authority over the Ministry of Science and Technology, and is intended to accelerate progress towards China's goal of scientific self-reliance and to ease China's technological chokepoints.
Foster New National Champions	China is nurturing closer co-operation with a select group of companies, namely, chipmakers SMIC, Hua Hong Semiconductor and Huawei, as well as equipment suppliers Naura and Advanced Micro-Fabrication Equipment Inc China. These chosen few will have access to additional government funding without having to achieve performance goals that were previously necessary.

China's MIC 2025 initiative shows its determination to assert its technological and economic dominance on the global stage. Its centralized approach through initiatives like the Big Fund is having a profound impact on its semiconductor industry. By strategically directing substantial investments, the Big Fund has been able to support various companies across the semiconductor value chain, from chip design and manufacturing to equipment production and testing.

3. Policy Outcomes

China's Semiconductor Self-Sufficiency Below 25%

In the "Made in China 2025" plan announced in 2015, the Chinese government aimed to achieve a semiconductor self-sufficiency rate of 70% by 2025. The "Big Fund" was launched to promote the development of the domestic semiconductor industry.

The first phase of the fund (2014–2019) raised US$ 19 billion, the second phase (2020–2024) raised US$ 27 billion, and the third phase (2024–2029) raised US$ 47.5 billion. The third phase, launched in May 2024, focuses on investments in advanced chips, equipment, and materials to counter the restrictions placed by the United States and its allies on China's semiconductor development.

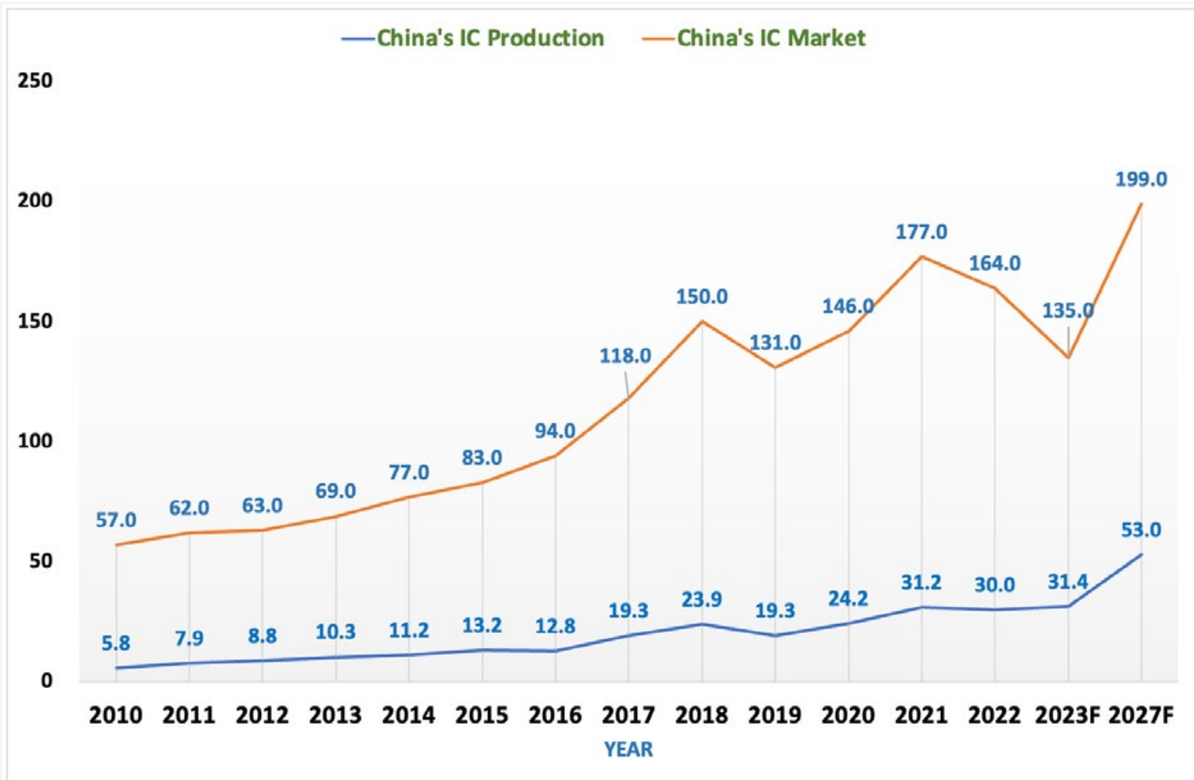
The rapid growth of China's electronics industry coupled with the restrictions imposed by Western countries have widened the gap between the country's IC market and its production. As demand for consumer electronics, smartphones, electronic vehicles and other technology products continues to rise, the need for semiconductors has soared in China. The complexity of semiconductor manufacturing, technological barriers, and global competition for advanced semiconductor equipment and expertise, however, have placed hurdles on China's efforts to ramp up IC production.

Data from TechInsights, a Canada based technology analysis firm for the semiconductor industry, shows that the Big Fund has significantly boosted domestic semiconductor production, which increased from US$ 11.2 billion in 2014 to US$ 31.2 billion in 2021. However, China's semiconductor market demand also grew substantially, from US$ 77 billion in 2014 to US$ 177 billion in 2021. Consequently, the semiconductor self-sufficiency rate only slightly improved, rising from 14.5% in 2014 to 17.6% in 2021, fluctuating between 13.6% and 17.6% during this period.

Through continued investments, China's domestic chip self-sufficiency rate increased to 23.3% in 2023. According to SEMI China Senior Director Feng Li, China's semiconductor industry's self-sufficiency rate is expected to reach 26.6% by 2027 but there remains a significant gap of US$ 146 billion in the industry (see Figures 37 and 38).[42]

Figure 37. China's IC Market vs IC Production Trends: 2010-2027

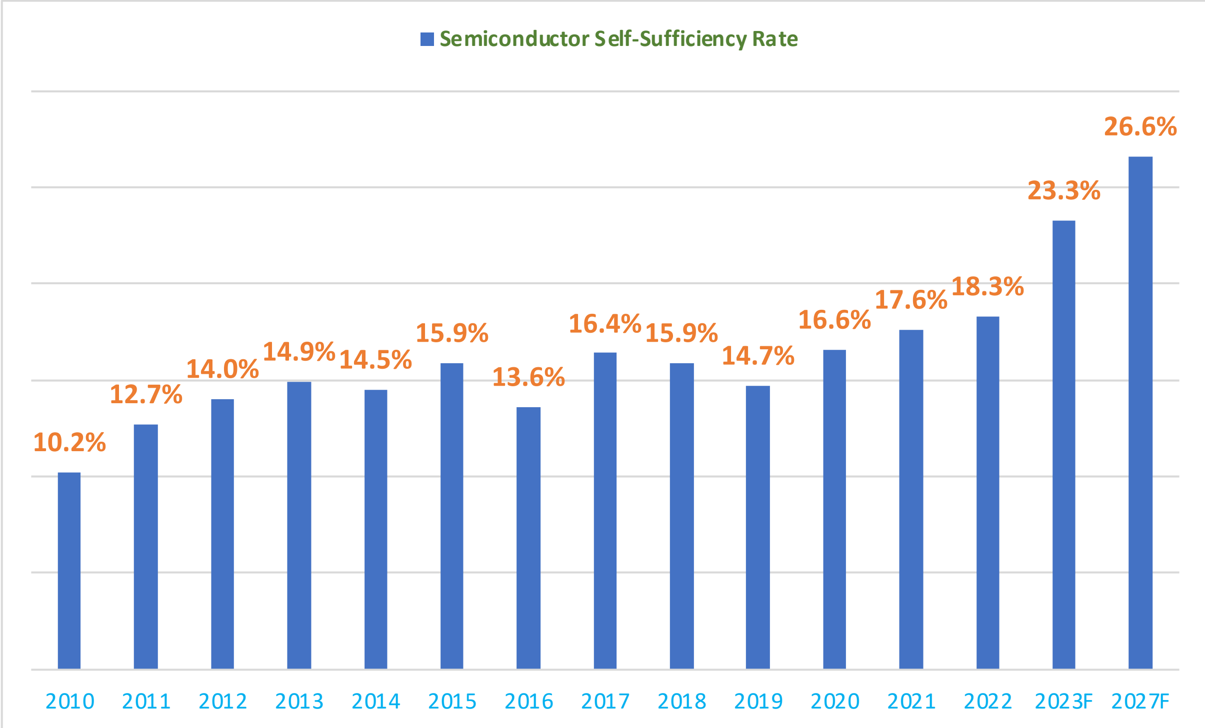
US$ billion



Source: Data from TechInsights cited in Nikkei Asia, "China rushes to boost domestic chip supply ahead of Trump's return," November 19, 2024.

42 "China's Semiconductor Industry Self-Sufficiency Rate Continues to Rise, Expected to Reach 26.6% by 2027," MIRU News and Reports, October 2, 2024.

Figure 38. China's Semiconductor Self-Sufficiency Rate: 2010-2027



Source: Data from TechInsights cited in Nikkei Asia, "China rushes to boost domestic chip supply ahead of Trump's return," November 19, 2024.

Although China's significant investments in semiconductor manufacturing has led to increased semiconductor production, its semiconductor production continues to lag behind its IC demand and falls short of its ambitious 'Made in China 2025' self-sufficiency targets.

Furthermore, of the US$ 31.2 billion worth of ICs manufactured in China in 2021, China-headquartered companies only produced US$ 12.3 billion (39.4%), accounting for only 6.9% of the country's US$ 177 billion IC market.[43] TSMC, SK Hynix, Samsung, Intel, UMC, and other foreign companies that have IC wafer fabs located in China produced the rest. The real self-sufficiency rate by China-headquartered companies should be 6.9% in 2021, instead of 17.6%.

In 2023, China's semiconductor market was valued at approximately US$ 154.3 billion. SMIC, as China's largest and most advanced domestic semiconductor foundry, recorded a revenue of US$ 6.3 billion, accounting for around 4.1% of China's semiconductor market. Hua Hong Semiconductor, the second-largest domestic chipmaker in China, had a revenue of US$ 2.3 billion, making up about 1.5% of the Chinese market. Nexchip, another Chinese giant supported by the "Big Fund" had an annual revenue of approximately US$ 1.0 billion, accounting for 0.6% of China's semiconductor market. In total, the three leading Chinese chipmakers raked in a revenue of about US$ 9.6 billion, or 6.2% share of China's semiconductor market in 2023. The real self-sufficiency rate by China-headquartered companies should be around 6.2% in 2023, instead of 23.3%.

Chinese Foundries Continue to Lose Global Market Share

Looking at China's three major foundries—SMIC, Huahong Group, and Nexchip—their combined global revenue market share stood at approximately 8.4% in the first quarter of 2026, down from 8.8% in 2025 and well below the 9.6% peak reached in 2022. Individually, SMIC accounted for 5.1%, Huahong for 2.5%, and Nexchip for approximately 0.8% of the global market.

43 David Manners, "Chinese chip companies supplied 6.6% of China market in 2021," Electronics Weekly, May 19, 2022.

Although all three companies continued to record revenue growth, the global foundry market expanded at a faster pace, resulting in a gradual erosion of their collective market share. This trend suggests that China's substantial capacity expansion in recent years has yet to translate into greater global market influence (see Table 34).

Table 34. Global Market Share of Top 3 Chinese Foundries by Revenue: 2022-2026

	2022	2023	2024	2025	2026Q1
SMIC	5.3%	5.4%	5.7%	5.3%	5.1%
Huahong Group	3.1%	2.7%	2.4%	2.6%	2.5%
Nexchip	1.3%	1.0%	0.9%	0.9%	0.8%
Total	9.6%	9.0%	9.1%	8.8%	8.4%

Source: Trendforce, Press Releases.

China Focused on Mature Process Chips

As Chinese companies are increasingly blocked from access to modern process nodes and manufacturing equipment, China's fast-growing semiconductor sector has pivoted to the manufacture of "legacy chips", with increased semiconductor production primarily concentrated on mature process chips. The term mature process chips (or legacy chips) generally describe semiconductors manufactured using well-established, "older" fabrication technologies. While there is no single, universal threshold, the global industry standard—supported by the U.S. CHIPS Act and leading foundries like TSMC and UMC—typically classifies any node at 28 nanometers (nm) or larger as "mature."

According to TrendForce's data in January 2024, China has 44 operational semiconductor wafer fabs, with an additional 22 under construction. By the end of 2024, 32 Chinese wafer fabs will expand their capacity for 28nm and older mature chips.[44] As a result, the global matured process foundry landscape is undergoing a profound transformation, moving from a Taiwan-centered model toward a future where China holds the largest share of capacity.

In 2022, Taiwan was the undisputed leader, commanding 49%of the world's mature node capacity. However, this dominance is projected to steadily erode, falling to 42% in 2024 and to 37% by 2027. This downward trend reflects a strategic pivot by Taiwanese firms toward high-margin advanced nodes rather than a loss of overall manufacturing prowess, as the industry leaders there prioritize cutting-edge technology over legacy capacity expansion.

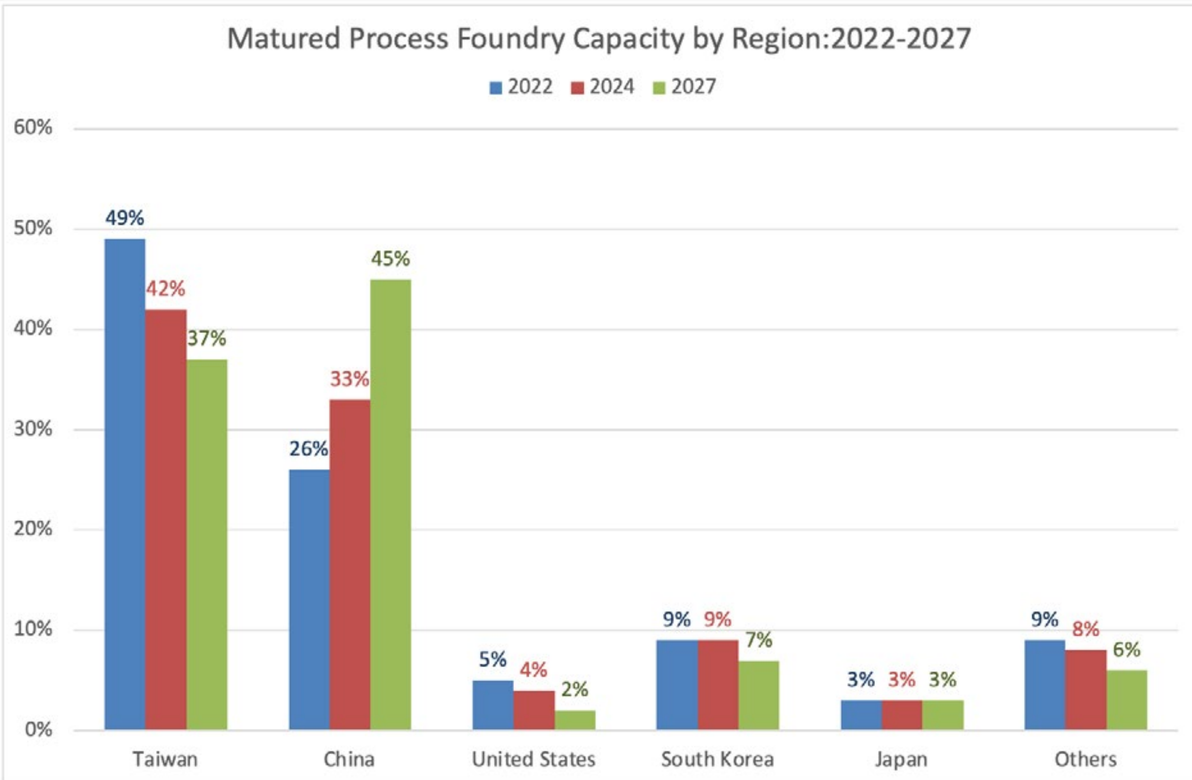
In sharp contrast, China is poised for an unprecedented expansion, with its market share surging from 26% in 2022 to a forecasted 45% by 2027. This aggressive growth is largely a result of heavy government subsidies and a domestic push for self-sufficiency in the face of international trade restrictions on advanced equipment. By concentrating on mature processes—which remain vital for automotive

44 News, "Overview of China's Semiconductor Equipment Industry," TrendForce, February 17, 2024.

components, power management, and IoT devices—China is effectively positioning itself as the world's primary supplier for these essential legacy chips, nearly doubling its global footprint in just five years.

By 2027, the data suggests a bifurcated global supply chain where the vast majority of mature node production is consolidated within China. China's rapid expansion of mature chip production capacity has contributed to a glut of mature-node ICs. The aggressive pricing strategies and increased production capacity of Chinese foundries have squeezed profit margins for many established semiconductor companies (see Figure 39).

Figure 39. Matured Process Foundry Capacity by Region: 2022-2027



Source: News, "Trendforce: Foundry Capacity Market Share of Advanced Process to Decline in Taiwan, Korea until 2027, While US on the Rise," TrendForce, May 14, 2024.

Surge in Chip Companies in China Going Bankrupt Since 2022

The Made in China 2025 initiative and the Big Fund spurred a wave of entry into China's semiconductor sector, much of it by undercapitalized and inexperienced firms. As financing tightened, market discipline returned, leading to a sharp rise in bankruptcies and deregistrations from 2022 onward.

In 2023, about 10,900 chip-related firms exited the market—nearly double the 2022 level—and by mid-December 2024, exits had climbed to roughly 14,600, a record high. While exits are accelerating, new registrations remain elevated, with around 52,000 new firms in 2024. This pattern points to an ongoing shakeout and consolidation phase, even as policy-driven expectations continue to sustain new entry (see Table 35).

Table 35. New Chip-Related Company Bankruptcies and Registrations: 2017 to 2024

Year	Bankruptcies/Deregistrations (Companies)	New Registrations (Companies)
2017	500	5,700
2018	700	7,400
2019	1,300	8,400
2020	1,400	23,000
2021	3,400	47,000
2022	5,700	62,000
2023	10,900	66,000
2024	14,600 (as of Dec 13, 2024)	52,000 (as of Dec 5, 2024)

Note:

1. Figures for 2017 to 2023 are rounded to the nearest 1,000.
2. 2024 numbers are up to early/mid December, so full-year figures could be slightly higher.

Source: Lai Ying-chi, "China's chip market faces intense competition: 52,000 new companies registered this year, while 14,600 exited," Commercial Times (Chinese), December 24, 2024.

China Faces Challenges in Producing Sub-7nm Chips

SMIC is currently China's only foundry capable of producing 7 nm–class chips, but it has struggled to scale production due to U.S. export controls restricting access to advanced semiconductor technologies, including critical design tools. China's domestic substitutes, particularly in electronic design automation (EDA), remain insufficiently mature, creating a major upstream bottleneck. Lacking access to EUV lithography, SMIC relies on immersion DUV lithography with multi-patterning to produce 7 nm–class chips—a technically viable but costly and inefficient workaround imposed by restrictions on EUV systems from suppliers such as ASML.

However, lithography itself is only one element of a broader ecosystem. Cutting-edge production depends heavily on EDA software, core IP architectures, advanced materials, precision metrology, and critical deposition and etching tools. Furthermore, relying on multi-patterning entails more steps, higher overlay error risks, and longer production cycles, presenting formidable challenges in cost and yield. Without EUV, achieving high yield, competitive cost, and stable mass production simultaneously is extraordinarily difficult.

Chinese firms have begun pursuing long-term alternatives, including EUV-related patent filings by Huawei and Shanghai Micro Electronics Equipment (SMEE). While these efforts signal progress, the path from patents to commercial EUV production is long and uncertain. ASML itself required decades of sustained R&D before achieving high-volume EUV manufacturing.

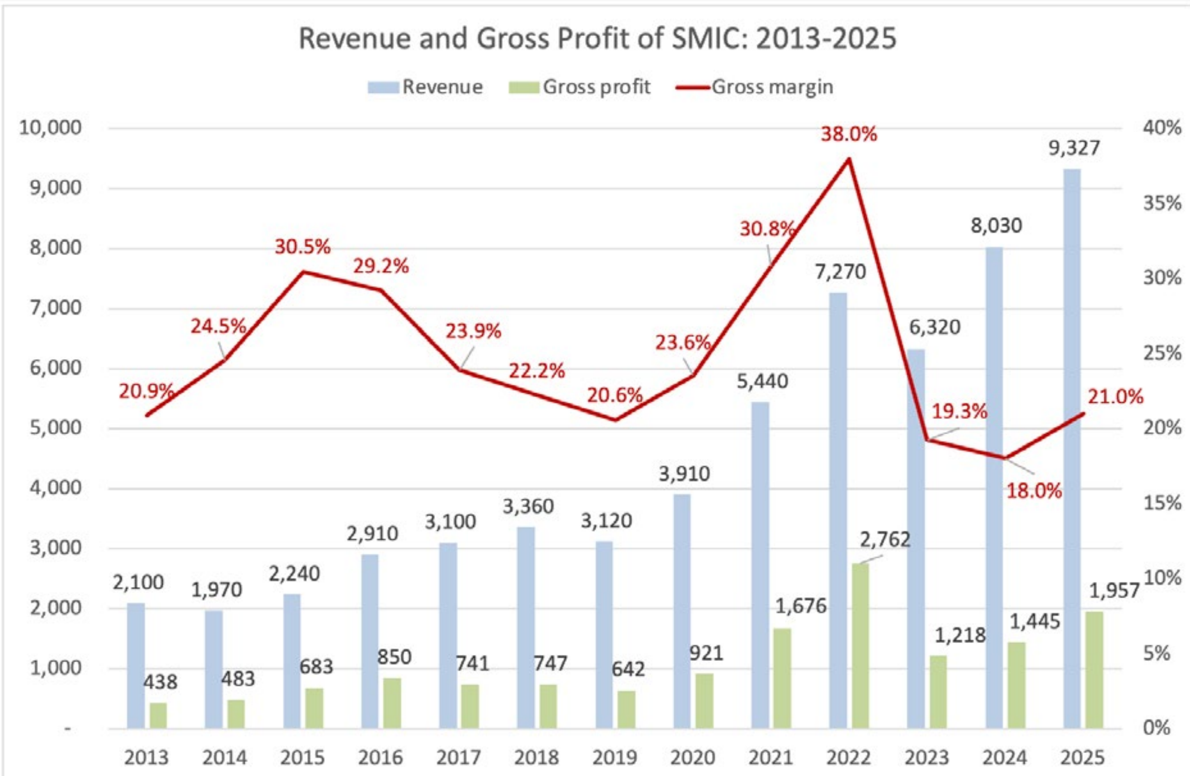
Even if China succeeds in developing Low-NA EUV tools, the technological frontier continues to advance. By early 2025, Intel had already brought High-NA EUV systems into production, highlighting the persistent—and potentially widening—gap at the leading edge of semiconductor manufacturing.

SMIC's Revenue and Profit

SMIC has posted strong revenue growth since 2013, reaching a record US$ 8.03 billion in 2024 and expanding further to US$ 9.33 billion in 2025 after a downturn in 2023. However, aggressive expansion in mature-node capacity has led to persistent oversupply, depressing prices and constraining profitability. While gross profit rebounded modestly in 2024, margins continued to erode. Gross margin fell from 38.0% in 2022 to 18.0% in 2024 (recovering slightly to 21.0% in 2025), and net margin declined even more sharply—from 25.0% to 6.1% over the same period (edging up only to 7.3% in 2025)—despite record revenues.

This widening gap between scale and profitability reflects structural challenges: heavy reliance on legacy nodes, elevated capital expenditures, and sustained price pressure in China's mature-process market. In short, SMIC has expanded rapidly, but turning scale into sustainable profits remains an uphill battle (see Figure 40).

Figure 40. Revenue and Gross Profit of SMIC: 2013 to 2025



Source: Statista for the data from 2013-2023 and news release from SMIC for the data of 2024-2025.

Although SMIC has developed a 7 nm–class process, it continues to lag far behind TSMC and Samsung in scale, yield, and cost efficiency. Its 7 nm yield reportedly reached about 40% in 2024—well below the roughly 60% threshold for economic mass production.[45] External estimates suggest that pushing toward a 5-nanometer-class node could see yields fall to 30–40 percent, with production costs 40–50 percent higher than TSMC's comparable processes. Even access to EUV would not guarantee smooth progress, as advanced fabrication is fundamentally a systems endeavor requiring decades of accumulated

45 Mavis Tsai and Levi Li, "Huawei Ascend 910C reportedly hits 40% yield, turns profitable; aims for 60% industry standard," DIGITIMES Asia, February 25, 2025.

process integration expertise, defect management, and supply-chain coordination.

Lacking access to EUV lithography, SMIC relies on DUV multi-patterning, a costly and defect-prone workaround further constrained by the use of less mature domestic equipment.[46] In late 2024, Bloomberg reported that SMIC's 7nm production lines continued to suffer from low yields and reliability issues, making it difficult to sustain stable output volumes.[47]

These limitations have sharply widened the profitability gap with TSMC. In 2024, TSMC posted a 56.1% gross margin and a 40.5% net margin, compared with 18.1% and 6.1% for SMIC. This divergence remained stark in 2025: TSMC posted an impressive 59.9% gross margin and a 45.1% net margin, whereas SMIC's gross margin stood at 21.0% with a net margin of just 7.3%, underscoring SMIC's sustained cost pressures.[48]

As TSMC moves toward 2 nm mass production—roughly three generations ahead of China's current frontier—the gap in process technology and intellectual property continues to widen. While SMIC has expanded revenue, its difficulty in translating scale into profitability highlights the structural limits of China's semiconductor self-sufficiency push (see Table 35).

Table 36. TSMC vs SMIC: 2020-2025

Unit: US$ Billion

Year	TSMC			SMIC		
	Revenue	Gross Margin	Net Margin	Revenue	Gross Margin	Net Margin
2020	47.69	53.1%	38.7%	3.91	23.6%	17.1%
2021	57.23	52.0%	37.9%	5.44	30.9%	31.3%
2022	73.67	59.6%	44.9%	7.27	38.0%	25.0%
2023	70.60	54.4%	38.8%	6.32	19.3%	14.3%
2024	90.08	56.1%	40.5%	8.03	18.1%	6.1%
2025	122.42	59.9%	45.1%	9.33	21.0%	7.3%

Source: Financial reports of TSMC and SMIC, and statistical data from Statista.

4. Updates in 2025-2026 and Prospects

A Dual-Track Semiconductor Strategy under Intensifying Technology Controls

46 News, "Overview of China's Semiconductor Equipment Industry," TrendForce, February 17, 2024.
47 Yuan Gao and Debby Wu, "China's Chip Advances Stall as US Curbs Hit Huawei AI Product," Bloomberg, November 19, 2024
48 News, "SMIC 2024 Sales Hit Record, But Profit Drops Reportedly Due to High Huawei Chip Costs," TrendForce, February 12, 2025.

By the end of 2025, China's semiconductor industry has taken on a distinctly "dual-track" character. On one track, blocked by the United States and its allies through a high-intensity technology embargo centered on EUV lithography, China has been forced to adopt a costly and extremely complex multi-patterning route for sub-7 nm advanced nodes. On the other track, the Chinese government has launched an unprecedented capacity expansion in mature-node manufacturing, pushing ahead with "import substitution" across equipment, materials, and packaging/testing.

The year 2026 marks the beginning of China's 15th Five-Year Plan (2026-2030), shifting the overarching policy focus toward an AI-centric high-value economy driven by "New Quality Productive Forces". To support this strategic pivot, the state-backed "Big Fund Phase III" entered deep operations with a capital pool of RMB 344 billion, aggressively targeting "extreme bottlenecks" in the supply chain, particularly in advanced lithography systems, photoresists, and deposition tools.

Advanced Nodes and AI Sovereignty

In the realm of advanced manufacturing, SMIC officially announced in 2026 that it had achieved mass production of a 5nm-class process (N+3 node) without the use of EUV lithography tools. Despite incremental progress, SMIC's N+3 process still falls materially short of the 5 nm-class technologies deployed by leading foundries such as TSMC and Samsung, and is expected to face notable yield and cost challenges. This milestone was realized through extremely complex DUV multi-patterning, particularly self-aligned quadruple patterning (SAQP). While this approach demonstrates significant engineering ingenuity in pushing the physical limits of DUV technology, its economic viability remains uncertain. Production costs are estimated to be 40–50% higher than those of competitors' EUV-based 5nm processes, and initial yields were reportedly around 20–30%, only gradually improving toward roughly 50% with substantial government subsidies.

In contrast to the slow progress of advanced nodes, China's mature-node segment continues to expand at a rapid pace. According to data from SEMI and TrendForce, China constructed 18 new fabrication plants in 2024—more than any other region in the world. By the end of that year, China was projected to account for approximately 33% of global mature-node capacity, a figure that could rise to 45% by 2027. This surge in capacity is already reshaping the global competitive landscape. Chinese foundries are reportedly offering prices 20–30% lower than those of UMC and GlobalFoundries, enabling them to rapidly gain market share in segments such as PMICs, MCUs, and display driver ICs, while also triggering a new round of price competition in the mature-node market (see Table 37).

Table 37. Progress of Semiconductor Investment and Production in China: 2025-2026

Category	Segment / Indicator	Details & Progress	Key Challenges

Advanced Nodes	7 nm Process	Mass-produced by SMIC via DUV multi-patterning; used in Huawei flagship devices.	Cost: 40–50% higher than TSMC. Yield: Only ~1/3 of TSMC's yield.
	5 nm Process	Attempting to use DUV multi-patterning workarounds.	Approaching physical/economic limits of DUV; high uncertainty for domestic EUV tools.
Mature Nodes	Capacity Growth	18 new fabs built in 2024.	Concerns over global overcapacity.
	Market Share	Projected to hold 33% (2024) and up to 45% (2027).	Heavy reliance on government subsidies to maintain low-margin operations.
	Pricing Strategy	Undercutting competitors (UMC, GlobalFoundries) by 20–30%.	Triggering intense price wars.

Leveraging this 5nm node breakthrough, Huawei launched its Ascend 950 series (including the Ascend 950 PR and 950DT) in 2026 to directly challenge Nvidia. The Ascend 950 achieves 1 PFLOPS of compute power (in FP8 format) and integrates 144GB of domestic HBM with a bandwidth of 4 TB/s. This marks an important step in China's push for "AI sovereignty" and "full-stack autonomy," aiming for 90% domestic AI infrastructure adoption by 2030.

Memory Supercycle and Advanced Packaging

Amid a global AI-driven memory supercycle, Chinese memory makers made significant leaps to address the severe supply-demand imbalance. In 2026, Changxin Memory Technologies (CXMT) launched large-scale manufacturing of HBM3 modules, reportedly dedicating approximately 20% of its total capacity (around 60,000 wafers per month) to the HBM3 line. CXMT also demonstrated autonomous DDR5-8000 and LPDDR5X-10667 capabilities, while Yangtze Memory Technologies (YMTC) sustained its edge in 232-layer and above 3D NAND.

To bypass front-end advanced process restrictions, China declared 2026 the "Packaging Technology Revolution Year". The industry is heavily investing in Chiplet designs, 3D stacking, and panel-level packaging (PLP) led by OSAT giants like JCET, seeking to achieve system-level performance enhancements and cost reductions.

Capacity Expansion, Price Competition, and the "Silicon Fortress"

In contrast to the slow march of advanced nodes, China's mature-node segment continues to expand rapidly. According to SEMI and TrendForce, China built 18 new fabs in 2024, and by 2027 it is projected to hold up to 45% of global mature-node capacity. This continuous expansion yielded notable economic shifts in early 2026. In the first two months of 2026, China's IC export value surged 68.9% year-over-year to

RMB 304.67 billion. This massive jump in value was primarily driven by memory price cycles and product structure improvements, far outpacing the 13.7% growth in actual export volume.

However, external pressures and geopolitical frictions remain severe. The U.S. government tightened export controls further in 2026, implementing strict "Know Your Customer" (KYC) requirements for cloud services to prevent Chinese entities from remotely accessing advanced compute. Furthermore, the U.S. initiated trade investigations into Chinese mature process chips due to overcapacity concerns. In response, China is accelerating a "Silicon Fortress" strategy, unofficially mandating that at least 50% of the equipment in newly added fab capacities must be sourced from domestic suppliers, pushing for a completely self-sufficient ecosystem.

VI. The Japanese Semiconductor Industry

1. Japan in the Global Semiconductor Supply Chain

According to a BCG report in May 2024, Japan held 12% share of the global semiconductor value chain, as does South Korea. With a 38% share in global semiconductor value chain in 2022, the U.S. remains a powerhouse. They are followed by the E.U., Taiwan and China, with each holding 11% share of the global semiconductor value chain in 2022 (see Table 18).

IC Design, Electronic Design Automation and Intellectual Property

Japan was once a global leader in IC design, with companies such as NEC, Renesas, and Fujitsu playing pivotal roles in the early development of the semiconductor industry. Unlike many leading semiconductor firms outside Japan—which have increasingly concentrated on the fabless business model—Japanese semiconductor companies traditionally operated under the integrated device manufacturer (IDM) model. Under this structure, firms design and manufacture chips primarily for their own end products rather than for the broader merchant market.

According to the U.S. Bureau of Industry and Security (BIS), Japan's presence in the fabless semiconductor segment remains limited, accounting for just 1% of global market share in 2022. By contrast, Japan's IDM sector retains greater international significance, representing 17% of the global semiconductor IDM market.

Over the past several decades, as the global competitiveness of Japanese consumer electronics eroded, Japan's overall share of the semiconductor industry declined in parallel. Fabless semiconductor firms from other regions—such as NVIDIA, Qualcomm, and Broadcom in the United States, as well as MediaTek, Novatek Microelectronics, and Realtek Semiconductor in Taiwan—have overtaken Japanese companies to become the dominant global players in IC design. These firms derive the bulk of their value from IC design capabilities, electronic design automation (EDA), and proprietary core intellectual property.

Despite this relative decline in fabless IC design, Japan remains internationally competitive in several key semiconductor device categories, including memory, CMOS image sensors (CIS), microcontroller units (MCUs), and power semiconductors. Major players include Kioxia in NAND flash memory, Sony in CIS, Renesas in automotive MCUs, and Toshiba, ROHM, DENSO, and Mitsubishi in power semiconductors.

While Japan faces structural challenges in EDA tools and core IP development, it continues to hold a strong position in specific design-intensive segments. In 2022, Japan accounted for 18% of global value-added in the design of discrete, analog, and other (DAO) semiconductors, ranking second only to the United States. By comparison, Japan's share of global value-added in the design of logic chips and memory chips stood at 4% and 7%, respectively (see Table 18).

Wafer Fabrication

In 2022, Japan accounted for 17% of global value-added in wafer fabrication within the semiconductor industry. This share was on par with South Korea's, but trailed behind China's 24% and Taiwan's 18% (see Table 18).

In front-end wafer fabrication, Japan's comparative strength lies primarily in the production of legacy chips. These chips—typically manufactured at 28 nanometers (nm) or larger—are less technologically advanced but remain indispensable components across a wide range of applications, from automobiles to consumer electronics.

As of March 2024, the most advanced logic chips produced in Japan were at the 40 nm node. By contrast, Taiwan and South Korea had already entered mass production at 3 nm or smaller process nodes, underscoring the widening generational gap between Japan and the world's leading-edge semiconductor manufacturers.

Assembly, Testing and Packaging

In 2022, Japan accounted for 6% of global value-added in the assembly, testing, and packaging (ATP) segment of the semiconductor industry. At the same time, outsourced semiconductor manufacturing in Japan is almost negligible, reflecting the dominance of the IDM model, under which Japanese firms typically manage the entire value chain—from wafer fabrication to assembly, packaging, and testing—internally.

Despite the limited role of outsourcing, Japanese companies remain highly competitive in semiconductor packaging technologies. Firms such as Shinko Electric Industries, Ibiden, and Toppan Holdings are recognized as major players not only within Japan but also across global semiconductor supply chains, particularly in advanced substrate and packaging solutions.

Manufacturing Equipment

Three segments—lithography, deposition, and materials removal and cleaning—account for roughly 70% of the global semiconductor manufacturing equipment market, each dominated by a small group of suppliers. Lithography is the most concentrated, with ASML alone controlling about 87% of global market share. Deposition and materials removal and cleaning show similar concentration, with three firms—two U.S.-based and one Japanese—collectively holding 70–80% of the market.

Japan accounted for 26% of global value-added in semiconductor manufacturing equipment in 2022, underscoring its enduring role in this critical upstream segment (see Table 18). Leading Japanese firms—including Tokyo Electron (TEL), Advantest, and Hitachi High-Tech—rank among the world's top equipment suppliers. A 2023 World Economic Forum report estimates that Japanese companies collectively command about 32% of the global equipment market, reflecting deep technological capabilities and strong customer lock-in.[49]

Japan's dominance is especially pronounced in photoresist processing, a niche with exceptionally high entry barriers. In 2022, Japanese firms captured 92% of global revenue in this segment, led by JSR, Tokyo Ohka Kogyo, Shin-Etsu Chemical, and Fujifilm Electronic Materials, whose long-standing expertise and close integration with advanced fabs provide a decisive advantage.

Beyond core tools and materials, Japanese vendors also play a vital role in semiconductor manufacturing automation. Companies such as Omron supply advanced control, motion, and robotics solutions for front-end processes, further reinforcing Japan's strategic position in enabling high-yield, high-reliability semiconductor production worldwide (see Table 38).

Table 38. Semiconductor Manufacturing Equipment Vendors, by HQ Region Revenue: 2022

Wafer fabrication process	US	EU	CN	KR	JP	Others	Market size (US$ B)
Lithography	1%	89%			10%		17.5
Photoresist processing			3%	5%	92%		3.7
Ion implant & doping eqpt	83%				17%		2.5
Thermal processes	57%	4%	2%	1%	37%		2.9
Deposition	67%	11%	2%	5%	15%		22.8
Material removal & cleaning	56%	0%	5%	4%	35%	0%	30.5
Manufacturing automation	5%			11%	64%	21%	4.2
Process control	76%	7%			11%	6%	13.5
Other	1%	8%		5%	43%	42%	3.4

Note: Geographies based on company HQ's; distribution based on company revenues.
Source: Raj Varadarajan, Iacob Koch-Weser, Chris Richard, Joseph Fitzgerald, Jaskaran Singh, Mary Thornton, Robert Casanova and David Isaacs, "Emerging Resilience in The Semiconductor Supply Chain," Boston Consulting Group, May 2024, p. 18

Nikon Precision and Canon have long been global players in the lithography systems market, alongside the Netherlands' ASML. Beyond lithography, Japanese firms hold critical positions across a wide range of semiconductor manufacturing equipment segments, including DUV photolithography,

49 Naoko Tochibayashi and Naoko Kutty, "How Japan's semiconductor industry is leaping into the future," World Economic Forum, November 20, 2023.

CVD and oxidation–diffusion systems, sputtering, CMP, and factory handling and automation. Together, these capabilities underscore Japan's structural importance in the global semiconductor equipment supply chain.

On October 13, 2023, Canon announced the launch of its FPA-1200NZ2C nano-imprint lithography (NIL) system, offering a potential alternative for smaller manufacturers to produce advanced chips. Canon claims the technology can achieve 5 nm feature sizes at significantly lower cost than EUV lithography. If successfully commercialized at scale, NIL could challenge ASML's EUV tools in cost-sensitive 5 nm applications.50

Japan exports the majority of the semiconductor equipment it produces. In 2022, domestic demand totaled US$ 8.35 billion (7.8% of global demand), while exports reached ¥ 4.3 trillion (about US$ 28.5 billion). Notably, 23.8% of exports—around US$ 6.78 billion—went to Taiwan, highlighting the deep interdependence between Japanese equipment suppliers and Taiwan's semiconductor manufacturing ecosystem.

Materials

Companies headquartered in Japan, the United States, and the European Union dominate the global semiconductor materials industry. Japan, in particular, plays a pivotal role in photoresist materials, hosting four major global suppliers—JSR, Tokyo Ohka Kogyo, Shin-Etsu Chemical, and Fujifilm Electronic Materials—that together form the backbone of this highly specialized and high–barrier-to-entry segment.

According to a 2023 World Economic Forum report on Japan's semiconductor industry, Japanese firms collectively account for approximately 56% of global market share in semiconductor materials.51 In wafer manufacturing, Shin-Etsu Chemical and SUMCO Corporation alone control roughly half of the global silicon wafer market, underscoring Japan's dominant position in foundational inputs critical to advanced chip production.

As investments in artificial intelligence (AI) accelerate in Japan and worldwide, demand for high-performance and innovative semiconductor materials—particularly those supporting advanced logic, memory, and AI-driven applications—is expected to rise further, reinforcing Japan's upstream strengths.

2. Japan's Share of the Global Semiconductor Market

Japan's position in the global semiconductor industry has undergone a profound transformation over the past several decades. In the 1980s, Japan was among the world's most dominant semiconductor powers. In 1989, Japanese firms overwhelmingly occupied the global rankings of the top ten semiconductor vendors by revenue. Nippon Electric Company (NEC) ranked first worldwide, and the top ten list included six Japanese companies—NEC, Toshiba, Hitachi, Fujitsu, Mitsubishi, and Matsushita—alongside three

50 Canon, Press Release, "Nanoimprint lithography semiconductor manufacturing system that covers diverse applications with simple patterning mechanism," October 13, 2023.
51 Naoko Tochibayashi and Naoko Kutty, "How Japan's semiconductor industry is leaping into the future," World Economic Forum, November 20, 2023.

U.S. firms and one European company.[52]

This dominance, however, proved difficult to sustain. Beginning in the 1990s, Japan's semiconductor industry encountered intensifying competition from emerging rivals, particularly South Korea, while also grappling with structural shifts in the industry toward specialization and new business models. As a result, Japan's global market share steadily eroded over time.

By 2023, the transformation was complete: no Japanese company appeared among the world's top ten semiconductor vendors by revenue. The contemporary rankings were instead dominated by firms from the United States and South Korea, reflecting a fundamental reordering of leadership within the global semiconductor industry and underscoring Japan's transition from a front-line semiconductor champion to a more specialized, upstream-oriented player (see Table 39).

Table 39. Top 10 Semiconductor Vendors by Revenue Worldwide (excluding pure play foundries): 1989 vs 2023

1989 Ranking		2023 Ranking	
Rank	**Vendor (Country of Headquarters)**	**Rank**	**Vendor (Country of Headquarters)**
1	NEC (Japan)	1	Intel (U.S.)
2	Toshiba (Japan)	2	Samsung Electronics (South Korea)
3	Hitachi (Japan)	3	Qualcomm (U.S.)
4	Motorola (U.S.)	4	Broadcom (U.S.)
5	Fujitsu (Japan)	5	NVIDIA (U.S.)
6	Texas Instruments (U.S.)	6	SK Hynix (South Korea)
7	Mitsubishi (Japan)	7	Advanced Micro Devices (U.S.)
8	Intel (U.S.)	8	STMicroelectronics (Switzerland)
9	Matsushita (Japan)	9	Apple (U.S)
10	Philips (Netherlands)	10	Texas Instruments (U.S.)

Source: Gartner statistics cited in 福田昭, "日本の半導体が1980年代に興隆した最大の理由は「運が良かった」から," ビジネス＋IT, August 2, 2021; Gartner, Press Release: "Gartner Says Worldwide Semiconductor Revenue Declined 11% in 2023," January 16, 2024.

In production terms, Japan accounted for more than 50% of global semiconductor output in the late 1980s, but its share has declined steadily since the 1990s, falling to around 10% by 2019. A key factor was a shift in demand: while the 1980s were driven by consumer electronics, the 1990s saw rapid growth in personal computers, favoring microprocessors and logic large-scale integration. Japan's continued emphasis on DRAM, rather than logic and microprocessors, increasingly disadvantaged it relative to U.S. competitors.[53]

Structural factors reinforced this decline. Major Japanese electronics firms such as NEC, Toshiba, and Hitachi operated semiconductor businesses as internal divisions, unlike U.S. firms such as Intel, Texas Instruments, and Micron, which functioned as specialized stand-alone chipmakers, or European firms that enjoyed greater operational autonomy.

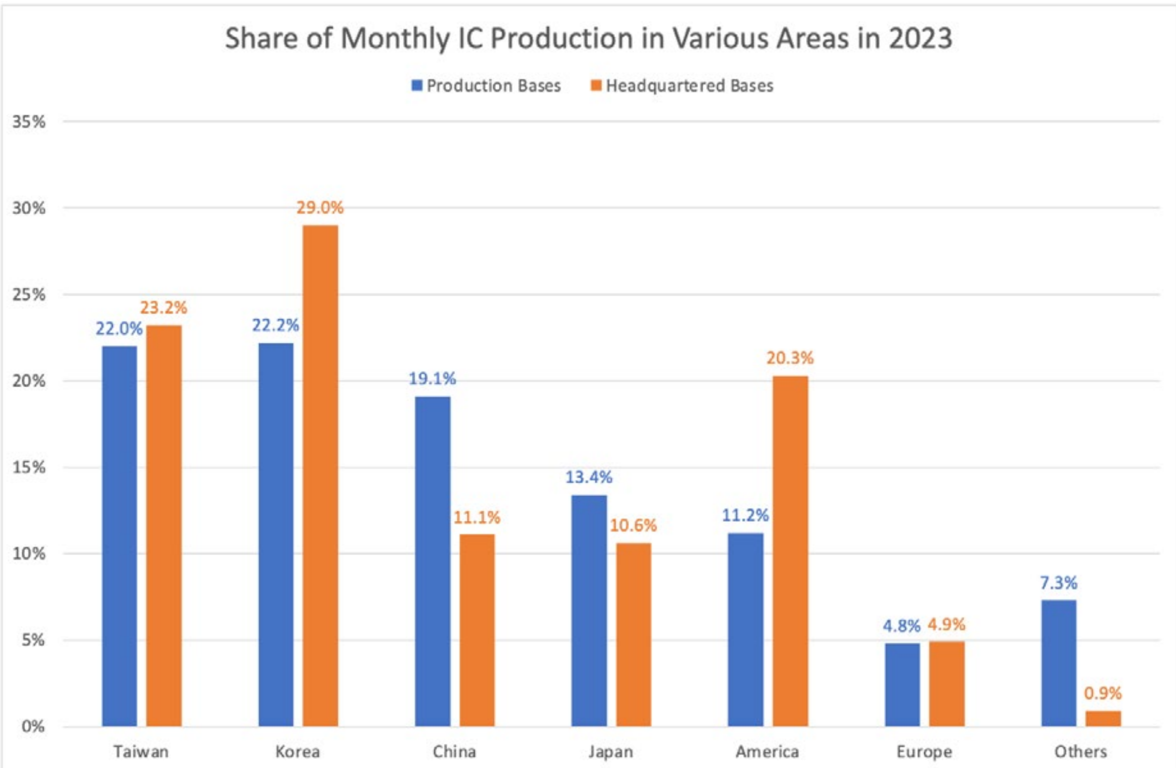
52 Elizabeth Beattie, "Can Japan again master semiconductors to relive its glory days?" The Japan Times, January 29, 2024; IC Insights, Research Bulletin, "Tracking the Top 10 Semiconductor Sales Leaders Over 26 Years," December 12, 2011.
53 Semiconductor Industry News (Sangyo Times Co., Ltd.), "Episode 20 Rise and Fall of Japanese Semiconductors," Makimoto Library, January 9, 2008, p. 3.

As competition intensified and development cycles shortened, Japanese firms began restructuring in the 2000s. A notable step was the 2003 merger of Hitachi's and Mitsubishi's semiconductor operations into Renesas Technology, followed by the integration of NEC Electronics in 2010.

Meanwhile, the industry underwent a more fundamental transformation. TSMC's introduction of the pure-play foundry model in 1987 enabled the rise of fabless firms and a horizontal division of labor, allowing more efficient deployment of R&D and capital. Japanese companies, however, largely retained the integrated device manufacturer (IDM) model, and their slower adaptation contributed to continued market share erosion.

By 2023, Japan's share of global semiconductor production capacity had fallen behind that of Taiwan, South Korea, and China, underscoring the long-term impact of these strategic and structural shifts. According to Knometa Research, total global monthly IC production capacity (including image sensors) reached approximately 23.2 million wafers that year. Measured by production bases—including fabs operated by both domestic and foreign-invested firms within a country—Japan ranked fourth globally, with monthly output of 3.1 million wafers, accounting for 13.4% of global capacity. However, when assessed by headquartered bases—counting fabs operated worldwide by companies headquartered in a given country—Japan's ranking slipped to fifth, with production of 2.5 million wafers per month, or 10.6% of global capacity (see Figure 41).

Figure 41. Share of Monthly IC Production Capacity of 8-Inch Equivalent by Geography: 2023



Source: Chia-Chen Lee, "Policy-Driven Regional Semiconductor Manufacturing development," IEK, ITRI, March 20, 2024, p. 1.

Despite the structural challenges facing its semiconductor industry, Japan remains a critical pillar of the global semiconductor supply chain, particularly within the Indo-Pacific region alongside Taiwan, South Korea, and China. Among these top 30 firms were four Japanese IDMs—Murata, Kioxia, Renesas, and Sony Imaging & Sensing Solutions—which together accounted for 6.7% of total revenue, or US$ 46.1 billion, in 2022. This underscores Japan's continued relevance not through scale leadership alone, but through its concentration in strategically important segments of the semiconductor ecosystem (see Table 40).

Table 40. Japan's Share of World's 30 Largest Semiconductor Companies: 2022

Unit: US$ Billion

Company	Primary Segment	Process Role	Country of Headquarters	Revenue
Samsung*	Memory	IDM	South Korea	76.2
TSMC	Foundry	Foundry	Taiwan	75.9
Intel	Micro	IDM	U.S.	63.1
Qualcomm	Logic	Fabless	U.S.	43.0
Apple**	Logic	Fabless	U.S.	40.0
SK Hynix	Memory	IDM	South Korea	34.0
Broadcom	Logic	Fabless	U.S.	33.2
Nvidia	Logic	Fabless	U.S.	29.6
Micron Technology	Memory	IDM	U.S.	27.2
Advanced Micro Devices	Micro	Fabless	U.S.	23.6
Advanced Semiconductor Engineering	AT&P	AT&P	Taiwan	22.2
Texas Instruments	Analog	IDM	U.S.	19.6
MediaTek	Logic	Fabless	Taiwan	18.4
Western Digital	Memory	IDM	U.S.	16.4
STMicroelectronics	Analog	IDM	Switzerland	16.1
Infineon	Discretes	IDM	Germany	15.8
Murata	Sensors	IDM	Japan	14.0
NXP Semiconductors	Micro	IDM	Netherlands	13.2
Analog Devices	Analog	IDM	U.S.	12.0
Kioxia	Memory	IDM	Japan	11.7
Renesas	Analog	IDM	Japan	11.3
United Microelectronics Corporation	Foundry	Foundry	Taiwan	9.2
Sony-Imaging and Sensing Solutions***	Optoelectronics	IDM	Japan	9.1
onsemi	Discretes	IDM	U.S.	8.3
GlobalFoundries	Foundry	Foundry	U.S.	8.1
Microchip Technology Incorporated	Micro	IDM	U.S.	8.1
Semiconductor Manufacturing International Corporation (SMIC)	Foundry	Foundry	China	7.2
Amkor Technology	AT&P	AT&P	U.S.	7.1
Marvell Semiconductor, Inc.	Logic	Fabless	U.S.	5.8
Skyworks Solutions	Analog	IDM	U.S.	5.3
Japan's Total				**46.1**
Top 30 Total				**684.5**

Data is based on annual and quarterly financial filings via company websites and U.S. Securities and Exchange Commission. *Data is for Samsung's Semiconductor (DS) segment. **Estimated value of Apple's semiconductor production based on publicly reported share of TSMC's revenue. ***Data is for Sony's Imaging and Sensing Solutions segment.				

Source: Office of Technology Evaluation, Bureau of Industry and Security, U.S. Department of Commerce, "Assessment of the Status of the Microelectronics Industrial Base in the United States," December 2023, p. 15.

In 2026, the Japanese semiconductor market is projected to reach US$ 57.05 billion, a 27.6% year-over-year increase, reflecting a structural strengthening driven by AI demand and localized production. While Japan accounts for approximately 5.1% of the global semiconductor market by sales location, its influence in the upstream supply chain remains indispensable.

3. Strategy and Policies

In recent years, Japan has repositioned the development of its semiconductor industry as a core national project, advancing it through coordinated policy reforms, large-scale strategic investment, and structured international collaboration. The Strategy for Semiconductors and the Digital Industry, first issued by Japan's Ministry of Economy, Trade and Industry (METI) in June 2021 and revised in June 2023, underscores the revitalization of Japan's domestic manufacturing base. The strategy places particular emphasis on joint ventures with overseas foundries and the upgrading of domestic suppliers, while explicitly taking into account shifts in the regional geopolitical environment and the rising importance of advanced technologies such as generative artificial intelligence.[54]

To operationalize this strategy, Japan has committed approximately ¥ 3.9 trillion (US$ 25.7 billion) in subsidies between 2022 and 2025, with the objective of tripling domestic semiconductor sales to over ¥ 15 trillion (US$ 112.55 billion) by 2030. Policy support is concentrated on five priority areas: advanced logic integrated circuits, advanced memory, industrial-use semiconductors, advanced packaging, and semiconductor manufacturing equipment as well as components and materials.

Looking ahead, combined public and private investment in advanced semiconductors and related supply chains is projected to exceed ¥ 5 trillion (US$ 32.1 billion) by 2030. In parallel, Japan aims to further reinforce its domestic semiconductor equipment ecosystem and to develop next-generation capabilities, including advanced and environmentally sustainable manufacturing equipment (see Table 41).

54 Ministry of Economy, Trade, and Industry, Japan, "Strategy for Semiconductors and the Digital Industry (Compiled)," June 4, 2021. Hiroshi Hiyama, "Rapidus 'last opportunity' to put Japan back on global chip map," AFP, May 17, 2024.

Table 41. Japan's Semiconductor Policy

Guidance	Target	**¥ 15 trillion (US$ 112.55 billion) in semiconductor sales by 2030.**
	Policy	**Strategy for Semiconductors and the Digital Industry** (launched in 2021, revised in 2023) • Jointly develop cutting-edge semiconductor manufacturing technology and securing sufficient production capability • Accelerate digital investment and strengthen the design and development of cutting-edge logic semiconductors • Promote green innovation • Strengthen portfolio of the domestic semiconductor industry and enhance its resilience • Strengthen efforts to develop and produce advanced semiconductors critical for economic security measures and advanced technology like generative AI
Measures	Key Incentive Amounts	¥ 3.9 trillion (US$ 25.7 billion) in subsidies (does not include subsidies by local governments)
	Key Initiatives	• 'Specified critical materials' designation for semiconductors • Acquisition of JSR by Japan Investment Corporation (JIC) to promote the consolidation of the semiconductor materials sector • National fiscal funding • R&D: Leading-Edge Semiconductor Technology Center
Outcome	Key Investments To Boost Domestic Production	• **Rapidus:** ¥ 920 billion (US$ 6.1 billion) subsidy for buying chipmaking equipment and developing advanced back-end chipmaking processes. • **TSMC:** ¥ 476 billion (US$ 3.3 billion) subsidy for TSMC's Kumamoto factory, a joint venture named Japan Advanced Semiconductor Manufacturing Inc. (JASM), ¥732 billion (US$ 4.9 billion) subsidy for TSMC's Kumamoto Fab 2 • **Kioxia Holdings Corporation:** ¥ 243 billion yen (U$ 1.64 billion) subsidy for Kioxia's Yokkaichi and Kitakami plants to mass produce cutting-edge chips. • **Micron:**¥ 192 billion (US$ 1.3 billion) for Micron's production of next-generation chips at its Hiroshima plant. • **ROHM and Toshiba Electronic Devices & Storage:** up to ¥ 129.4 billion (US$ 900 million) subsidy, or a third of the total investment, for ROHM and Toshiba to jointly produce power chips.

On December 20, 2022, Japan designated 11 categories of materials—including semiconductors—as "specified critical materials" under the Act on the Promotion of Economic Security. To enhance supply chain resilience, the Economic Security Promotion Act provides subsidies to firms undertaking large-scale equipment investments exceeding ¥ 30 billion (US$ 231 million), thereby reinforcing domestic manufacturing capacity and reducing vulnerabilities in strategically important supply chains.

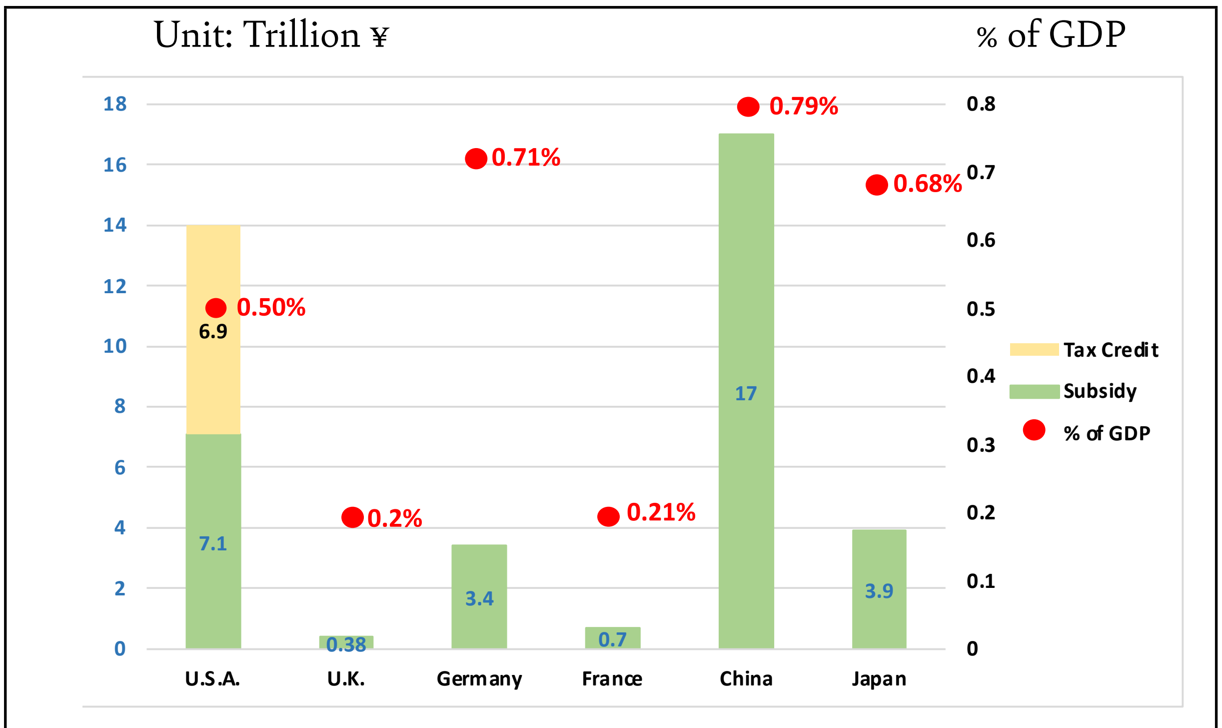
A notable illustration of this policy direction is the acquisition of JSR Corporation by the state-backed Japan Investment Corporation (JIC). Between March 19 and April 16, 2024, JIC acquired more than 84% of JSR's outstanding shares through a tender offer valued at approximately ¥ 900 billion (US$ 6.5 billion). Following the successful bid, Nikkei announced that JSR would be removed from the Nikkei Semiconductor Stock Index as of May 1, 2024.

JIC is expected to purchase the remaining shares, turning JSR into a wholly owned subsidiary. JSR holds roughly a 30% share of the global photoresist market—a critical light-sensitive material used in semiconductor lithography. By acquiring the world's leading photoresist supplier, Japan is consolidating control over a production stage in which it already enjoys global technological leadership, reflecting a deliberate effort to secure strategic leverage as semiconductors become increasingly central in the digital economy.

As part of its broader "two-track strategy"—simultaneously attracting foreign semiconductor investment while fostering the expansion of domestic champions—Japan has mobilized substantial public funding through nationally coordinated, project-specific grants, complemented by targeted tax incentives.

According to Japan's Ministry of Economy, Trade and Industry (METI), Japan's level of public financing for the semiconductor sector is broadly comparable to that of the United States, Germany, and China when measured as a share of gross domestic product. A METI report published in May 2024 indicates that Japan has provided more than ¥ 3.9 trillion (approximately US$ 28-29 billion) in semiconductor-related subsidies, equivalent to 0.68% of GDP. By comparison, China's support amounts to 0.79% of GDP, Germany's to 0.71%, and the United States' to 0.50% (see Figure 42).

Figure 42. Government Investments in Domestic Semiconductor Industry



Note:
1. With regards to GDP, METI used real figures, which excludes changes in price fluctuations.
2. METI included preferential taxation treatments into its calculations of subsidies. The U.S. CHIPS Act provides tax credits of up to 25% for investments in semiconductor and manufacturing equipment. Japan's strategic tax system does not allow the application of subsidies and tax systems to the same investment plan, while the US CHIPS Act allows the overlapping application of subsidies (5-15%) and tax systems (25%).

Source: METI website (in Japanese), "Semiconductor and Digital Industry Strategy," May 31, 2024,

p. 79.

METI further notes that local governments in major semiconductor-producing economies—including the United States, China, and Japan—supplement central government incentives with additional support measures. In the United States, for instance, federal funding of more than US$ 50 billion under the CHIPS Act is complemented by state-level incentives, such as New York State's 5% investment tax credit.

While the U.S. CHIPS Act allows firms to combine overlapping subsidies (typically 5–15%) with generous tax credits (up to 25%), Japan's strategic tax framework generally prohibits the simultaneous application of subsidies and tax incentives to the same investment project. Nonetheless, local governments play an active role in strengthening Japan's semiconductor ecosystem. Kumamoto Prefecture, for example, offers subsidies for capital investment, R&D, and product development, while also supporting business matchmaking, technology linkages between large firms and local suppliers, and the testing of technologies and prototypes essential for commercialization.[55]

According to METI, China, by contrast, has pursued an even more aggressive investment strategy. Government support for its domestic semiconductor industry exceeds US$ 115 billion in total. This includes a recent US$ 47.5 billion capital injection into the third phase of the "Big Fund", bringing central government investment to more than US$ 81 billion, alongside over US$ 34 billion mobilized by local governments. China further reinforces these measures through extensive tax incentives, including corporate income tax exemptions and reductions of up to 10 years.

To further expand domestic semiconductor production, the Japanese government has indicated that it will subsidize up to one-third of the capital expenditures incurred by both domestic and foreign manufacturers producing designated semiconductor devices—such as power semiconductors, microcontrollers, and analog chips—as well as related equipment, materials, and raw inputs. By 2026, the Japanese government's support entered an "emergency foundation strengthening" phase. Under the Economic Security Promotion Act, facilities receiving subsidies for "specified semiconductors" are now required to commit to over 10 years of domestic production, prioritize domestic supply during global crunches, and implement strict cybersecurity measures to prevent core technology leaks. To ensure supply chain resilience, METI has institutionalized support not only for wafer fabs but also for semiconductor manufacturing equipment, critical materials, and essential raw gases like Helium and Neon.

Japanese semiconductor companies that have responded to the government's investment push include the state-backed startup Rapidus Corporation, which aims to begin producing 2 nm chips in Hokkaido as early as 2027; Kioxia Holdings Corporation, a global leader in memory solutions, which is expanding the development and production of advanced flash memory at its Yokkaichi and Kitakami plants; and Toshiba and Rohm, which are jointly investing ¥ 388.3 billion (US$ 2.7 billion) to manufacture power semiconductors. This latter project will receive subsidies of up to ¥ 129.4 billion (US$ 900 million)—roughly one-third of the total investment—as part of Japan's broader effort to preserve the competitiveness of its domestic power chip industry.[56]

55 Kumamoto Prefecture Government, "Kumamoto Semiconductor Industry Promotion Vision," March 6, 2023, p. 39.
56 Ryohtaroh Satoh, "Japan's Rapidus and universities aim for 'beyond 2nm' chip tech," Nikkei Asia, February 9, 2024.

Leading foreign semiconductor firms, including Taiwan's TSMC and the U.S.-based Micron Technology, are also establishing new production bases in Japan. In Micron's case, its Hiroshima plant received a ¥ 46.5 billion (US$ 332 million) subsidy in 2022 to support the expansion of advanced memory manufacturing capacity and to improve yields for mass production of 1β(1-beta) DRAM.

In October 2023, the Japanese government approved up to ¥ 192 billion (US$ 1.3 billion) in additional subsidies for Micron's Hiroshima facility as part of its strategy to strengthen domestic production of next-generation semiconductors. Backed by strong government support and in anticipation of medium- to long-term demand driven by AI, data centers, and autonomous vehicles, Micron announced in the same month that it would invest ¥ 500 billion (US$ 3.6 billion) over the coming years to introduce EUV equipment at the Hiroshima plant.

Beyond manufacturing, Japan's semiconductor policy has placed equal emphasis on strengthening research and development capabilities. To this end, the government established the Leading-Edge Semiconductor Technology Center (LSTC), a public research organization modeled in part on—and intended to collaborate with—the U.S. National Semiconductor Technology Center. Chaired by Rapidus Chairman Tetsuro Higashi, the LSTC brings together research institutes and universities, spearheading R&D efforts while Rapidus focuses on commercialization and production.

The Japanese government has committed ¥ 920 billion (US$ 6.1 billion) to Rapidus, a joint venture involving Sony, Toyota, IBM, and other major firms, which is currently constructing its fabrication facility in Hokkaido. Founded in 2022, Rapidus aims to mass-produce cutting-edge 2 nm chips by 2027, with total project costs estimated at ¥ 5 trillion (US$ 31.8 billion). According to Nikkei, the government also plans to provide loan guarantees to help Rapidus secure bank financing for large-scale production.

South Korea's Samsung Electronics is likewise set to receive subsidies of up to ¥ 20 billion (US$ 140 million) to establish an advanced semiconductor R&D facility in Yokohama. In 2023, Samsung announced plans to collaborate with Japanese semiconductor materials and equipment suppliers to develop next-generation production technologies over the next five years.

With the presence of Rapidus, TSMC, United Microelectronics Corporation (UMC), and Powerchip Semiconductor Manufacturing Corporation (PSMC), TrendForce has identified three emerging semiconductor hubs in Japan: Hokkaido, Tohoku, and Kyushu.

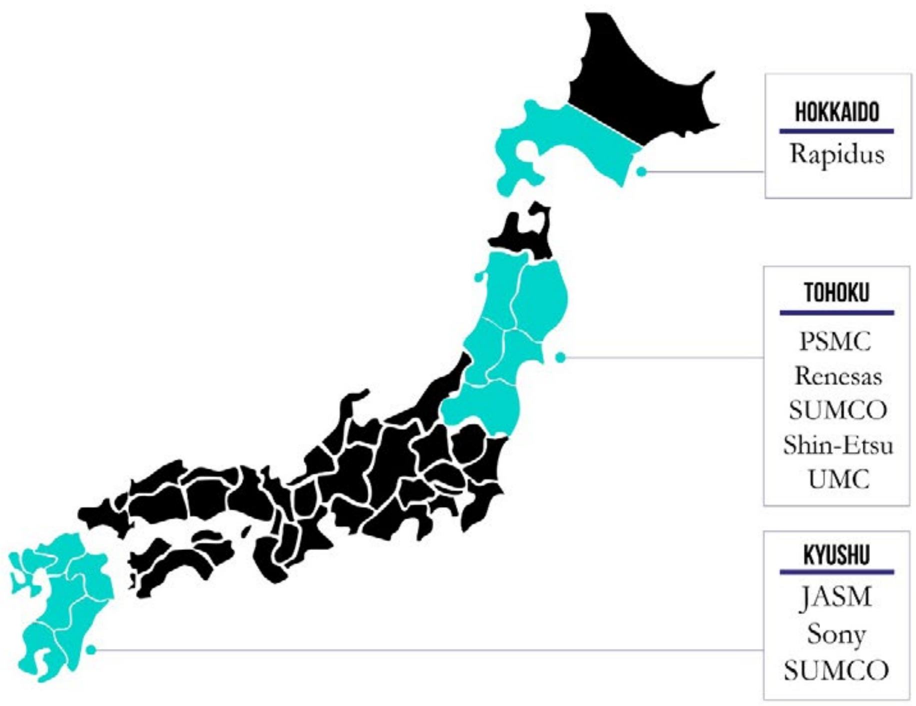
Hokkaido, home to Rapidus, is expected to attract upstream equipment and materials suppliers, effectively anchoring a new advanced-node ecosystem in northern Japan.

Tohoku, meanwhile, hosts the Renesas Yonezawa plant as well as major silicon wafer producers SUMCO and Shin-Etsu, making it the heart of Japan's semiconductor materials industry. In October 2019, UMC fully acquired Mie Fujitsu Semiconductor Ltd., renaming it United Semiconductor Japan Corporation (USJC). USJC now operates as UMC's fourth 12-inch wafer foundry, producing chips based on mature process technologies ranging from 40 nm to 90 nm.

On October 31, 2023, PSMC formally announced plans to build a 12-inch wafer fab in Sendai, initially focusing on 40 nm process technology, with more advanced nodes included in its longer-term roadmap. Automotive electronics will be a production priority, further reinforcing Tohoku's strategic importance within Japan's semiconductor landscape.

Lastly, Kyushu hosts JASM (TSMC's Kumamoto plant), Sony, and SUMCO—one of the world's leading raw wafer suppliers—alongside a dense network of small and medium-sized semiconductor-related firms. Together, these actors form a highly synergistic supply chain ecosystem that underpins Kyushu's role as Japan's third major semiconductor hub (see Figure 43).

Figure 43. Three Emerging Regional Semiconductor Bases in Japan



Source: Press Release: "Japan Flexes Its Advantages in Semiconductor Upstream Equipment and Raw Materials, and Unveils Strategic Progress of Key Players in Kyushu, Tohoku, and Hokkaido, Says TrendForce," TrendForce, October 31, 2023.

4. Updates in 2025-2026 and Prospects

Japan's State-Led Industrial Rebuild

Japan has elevated semiconductors to the center of its economic security agenda in 2025, defining the sector as essential infrastructure for national resilience. METI's Semiconductor and Digital Industry Strategy—first released in 2021 and updated in 2023—sets an ambitious goal of tripling domestic semiconductor revenue from roughly ¥ 5 trillion (US$ 45.5 billion) in 2020 to over ¥ 15 trillion (US$ 136.4 billion) by 2030. To advance this agenda, in November 2025, the government approved an additional ¥ 252.5 billion (about US$ 1.61 billion) specifically for strengthening AI and semiconductor infrastructure, marking a transition from "emergency" measures to a permanent system of strategic support.

The 2022 Economic Security Promotion Act further institutionalized this shift by designating semiconductors as "specified critical materials," empowering the government to deploy subsidies, preferential financing, and regulatory tools to stabilize domestic production. Together, these policies aim to reinforce Japan's capabilities across both mature and leading-edge manufacturing, while expanding next-generation R&D as the foundation for long-term technological autonomy.

Under this framework, Japan is channeling unprecedented public resources into rebuilding its semiconductor ecosystem. Between 2021 and 2023, Tokyo allocated approximately ¥ 3.9 trillion (approximately US$ 28-29 billion)—0.68% of GDP—to semiconductor support, a proportion exceeding that of comparable U.S. or European initiatives. Total government assistance is expected to approach ¥ 10 trillion (about US$ 66.7 billion) by 2030. A substantial portion of this funding is dedicated to attracting global chipmakers: Japan has committed over ¥ 1 trillion (US$ 6.67 billion) of subsidy to TSMC's two new fabs in Kumamoto, with the first 22/28 nm facility subsidized at roughly ¥ 476 billion (US$ 3.17 billion) and the second 6 nm fab—scheduled for 2027—receiving up to ¥ 732 billion (US$ 4.88 billion).

Dual-Track Manufacturing and Ecosystem Reconstruction

TSMC's presence in Kumamoto has become the ballast of Japan's current semiconductor production capacity, complementing Rapidus's future-oriented ambitions. JASM Fab 1 entered stable mass production in 2025, supplying 12–28 nm chips critical for Sony's image sensors, Denso's automotive electronics, and other industrial applications. Although Fab 2's construction was initially delayed by local logistics and infrastructure constraints, it officially began in October 2025 following coordination with local governments. Fab 2 will bring 6 nm and 7 nm processes online, with mass production planned for late 2027.

Domestic players are receiving similar levels of backing. Rapidus—positioned as Japan's "national policy" foundry—has secured roughly ¥ 920 billion (US$ 6.13 billion) for 2 nm R&D. Major memory manufacturers are also expanding with state support: Micron has received up to ¥ 536 billion (US$ 3.57 billion), and Kioxia ¥ 150 billion (US$ 1 billion), for capacity upgrading. At the same time, leading Japanese firms including Sony, Mitsubishi Electric, and Rohm plan to invest an additional ¥ 5 trillion (US$ 33.3 billion) in private capital through 2029. These initiatives reflect a whole-of-ecosystem strategy spanning manufacturing, materials, and equipment.

In the memory segment specifically, Micron's Hiroshima plant secured a subsidy of up to ¥ 536 billion (US$ 3.57 billion) to deploy its 1-gamma DRAM production line incorporating EUV technology, with an emphasis on High-Bandwidth Memory (HBM) to meet soaring AI-related demand. This move underscores the government's commitment to strengthening Japan's entire semiconductor value chain—from logic to memory to specialty sensors.

Japan's 2025 roadmap places particular emphasis on leadership in next-generation technologies, including the 2 nm node, advanced packaging, and specialized chips for AI-driven applications. Rapidus, backed by national champions and the state, is collaborating with IBM and Imec to develop 2 nm technologies, targeting pilot production in 2025 and full-scale manufacturing by 2027. In mid-2025, Rapidus announced the successful fabrication of a prototype 2 nm GAA transistor—an important milestone signaling Japan's re-entry into advanced logic manufacturing.

Japan has adopted a "dual-track" manufacturing strategy, simultaneously supporting cutting-edge and mature nodes. On the advanced logic front, the state-backed Rapidus consortium launched its trial production line at the Innovation Integrated Manufacturing (IIM-1) facility in Chitose, Hokkaido, in April 2025. Deep collaboration with IBM and Imec has allowed Japan to rebuild operational experience with EUV lithography and implement the 2 nm GAA transistor architecture.

Acknowledging its inability to compete on massive volume with Taiwan or South Korea, Rapidus has adopted a "Speed as a Service" model, aiming to shorten chip production cycles from the industry standard of around 120 days to just 50 days. Its business strategy centers on high-value, small-batch chips for AI and HPC (see Table 42).

Table 42. Progress of Semiconductor Investment and Production in Japan: 2026

Company / Project	Technology / Node	Status & Milestones
TSMC (JASM Fab 1)	12–28 nm	Entered stable mass production in 2025; supplying Sony and Denso.
TSMC (JASM Fab 2)	3 nm	Construction began in Oct 2025; mass production planned for late 2027.
Rapidus	2 nm (GAA architecture)	Trial production at IIM-1 started April 2025; full-scale manufacturing by 2027.
Micron	1-gamma DRAM (EUV / HBM)	Deploying production lines to meet AI-related demand.
Kioxia	Memory Capacity	Capacity upgrading with state support.
Sony, Mitsubishi, Rohm	Specialized Chips/Sensors	Additional private capital investment planned through 2029.

Japan is also leveraging its global dominance in semiconductor materials—where it commands 50–90% of the market in several essential categories—to accelerate breakthroughs in advanced packaging and chip integration. R&D hubs such as the LSTC are developing chiplet-based architectures aligned with national priorities in AI, data centers, autonomous mobility, and 5G/6G. Collectively, these initiatives underpin Japan's attempt to re-enter the high-performance semiconductor arena.

As of spring 2026, Rapidus entered a decisive validation phase at its "IIM-1" plant in Chitose, Hokkaido. The company aims to launch its "Rapi-Service" by late 2026, providing global clients with 2nm test chip design and production validation, offering a competitive alternative to TSMC with a "Speed as a Service" (Short TAT) model. To complement its front-end progress, Rapidus completed a 9,000-square-meter back-end R&D facility focusing on chiplet integration and High-Bandwidth Memory (HBM) to meet the massive data throughput required for AI. Furthermore, in March 2026, imaging giant Canon announced a partnership with Rapidus to co-develop 2nm image processing chips, supported by a ¥ 40 billion NEDO subsidy. The government also expanded the cumulative R&D budget limit for Rapidus to ¥ 1.72 trillion, though the project still faces pressure to secure over ¥ 7 trillion in total funding by 2031 amid severe structural challenges.

Strategic Alignment and Structural Constraints

Japan's semiconductor strategy is deeply intertwined with shifting geopolitical and trade dynamics. Working closely with the United States and the Netherlands, Tokyo tightened export controls on advanced semiconductor equipment through a 2023 package restricting 23 categories of tools used in leading-edge fabrication. Although formally country-neutral, the measures primarily affected exports to China and prompted immediate objections from Beijing.

At the same time, Japan is expanding cooperation with trusted partners to bolster supply chain resilience. Japan participates in the U.S.-led "Fab 4" (Chip 4) grouping with Taiwan and South Korea, has launched joint R&D collaborations linking LSTC and the U.S. NSTC, and is deepening partnerships with Europe through Imec, the EU, and the UK. These initiatives represent a deliberate "friend-shoring" strategy—anchoring advanced R&D with the U.S. and Europe while partnering with Taiwan and others in manufacturing—to diversify technology access and reduce systemic risks.

Despite robust momentum, Japan faces structural challenges in sustaining a globally competitive semiconductor revival. Foremost is the acute talent shortage: decades of industry contraction have left Japan with a limited pool of semiconductor engineers, and workforce scarcity is increasingly viewed as a more severe constraint than capital. Rapidus has had to send more than one hundred engineers to IBM in the United States for intensive training—highlighting the scale of the capability rebuilding effort ahead.

Cost competitiveness represents another major hurdle. Leading-edge fabs require investments approaching ¥ 5 trillion (US$ 33.3 billion), and Japan must overcome scale disadvantages relative to Taiwan and South Korea to maintain long-term viability once subsidies taper off.

Geopolitical exposure adds an additional layer of risk. Japan remains dependent on Chinese processing for several rare earth materials essential to chipmaking equipment, creating potential chokepoints should bilateral tensions intensify or export restrictions tighten.

Internally, Japan must also overcome two structural bottlenecks. The first is talent: regions like Kyushu alone will need tens of thousands of skilled workers in the coming decade. Local governments and universities have launched reskilling programs and expanded industry-academia partnerships, while immigration rules for foreign engineers have been eased. Yet the talent gap remains a long-term challenge.

The second is energy. Semiconductor production is extremely power-intensive, and despite corporate commitments to RE100, Japan's limited and costly green electricity supply threatens the cost competitiveness of domestic fabs. METI and industry leaders have urged accelerated upgrades to the national grid and expanded renewable energy development.

Externally, Japan skillfully navigated the tariff negotiation of the U.S. "Trump 2.0" administration in 2025. Leveraging its near-monopoly in upstream materials and key manufacturing equipment—such as photoresists and coating/developing tools—Japan positioned itself as an indispensable partner for

Washington's CHIPS Act objectives. This culminated in the landmark U.S.–Japan Strategic Trade and Investment Agreement in July 2025, granting Japanese semiconductor products critical tariff exemptions or safeguards in the U.S. market.

In return, Japan agreed to tighten export controls targeting China, including stricter oversight of high-end photoresist shipments—demonstrating a willingness to forgo some short-term commercial interests in exchange for deeper integration with the Western technology alliance and enhanced geopolitical security.

Geopolitical realignments in early 2026 further integrated Japan into a trilateral semiconductor stronghold. Following the January 2026 US-Taiwan trade agreement, which mandated greater supply chain localization, hundreds of Taiwanese SME suppliers accelerated their decentralization by clustering around TSMC's Kumamoto plant. Japan serves as a favored "buffer zone" due to its cultural compatibility, efficient infrastructure, and government efficiency. However, Japan faces profound structural challenges: acute talent shortages have reached a critical point in 2026, forcing the industry to heavily rely on cross-border technology transfers and the recruitment of Taiwanese engineers to sustain its rapid capacity expansion.

VII. The Korean Semiconductor Industry

1. Korea in the Global Semiconductor Value Chain

From the same BCG report of May 2024, South Korea (Korea) accounted for approximately 12% of the global semiconductor value chain, a share comparable to that of Japan. By contrast, the United States remained the dominant player, capturing 38% of global semiconductor value-chain value in 2022. The European Union, Taiwan, and China followed, each holding roughly 11% of the global share in the same year.

Yet aggregate value-chain shares conceal important structural differences. In several critical segments, South Korea exercises outsized global influence. It controls roughly 60% of the value-added in the global memory chip design market, alongside 18% and 17% of worldwide semiconductor materials and wafer fabrication, respectively. These figures highlight Korea's concentration of strength in capital-intensive, technologically complex segments of the industry (see Table 18).

At a structural level, the Korean semiconductor model is anchored in integrated device manufacturers (IDMs), in contrast to the U.S.–Taiwan division of labor, where the United States leads in chip design while Taiwan specializes in foundry manufacturing and outsourced semiconductor assembly and testing (OSAT). A further competitive advantage of the Korean ecosystem lies in its robust assembly, testing, and packaging (ATP) capabilities, which are predominantly integrated in-house rather than outsourced.

As a result, chip design activities in Korea are deeply embedded within the internal operations of firms such as Samsung Electronics and SK hynix, rendering them far less visible in conventional fabless rankings. This tightly coupled organizational model—integrating design, manufacturing, and ATP within a single firm—enables high technological performance and rapid iteration. However, it can also limit price competitiveness and customer diversification, particularly in comparison with more modular, platform-based ecosystems.

Korea's dominance is most pronounced in memory semiconductors. The single most important driver of its recent resurgence has been the surge in global AI demand following the introduction of ChatGPT. As AI models have grown larger and more computationally intensive, leading technology firms such as Microsoft, Google, and Amazon have rapidly expanded their data center capacity. These hyperscale facilities rely heavily on high-performance chips, especially high-bandwidth memory (HBM) and advanced DRAM, to process massive datasets at high speed—precisely the segments in which Korean firms excel.

Another critical node in the global semiconductor value chain is Korea's ATP infrastructure. While South Korea is not the world's largest OSAT hub—a distinction held by Taiwan, China, and Malaysia—it is a global leader in advanced memory and AI-related packaging. In particular, Korea excels in HBM packaging, 2.5D and 3D stacking, through-silicon via (TSV) technologies, and chiplet-adjacent integration capabilities.

This memory-centric leadership in advanced packaging is most clearly illustrated by SK hynix, the world's leading supplier of HBM. The company provides HBM products to NVIDIA and other major AI data center customers, with packaging co-designed alongside memory architecture through an integrated, end-to-end process.

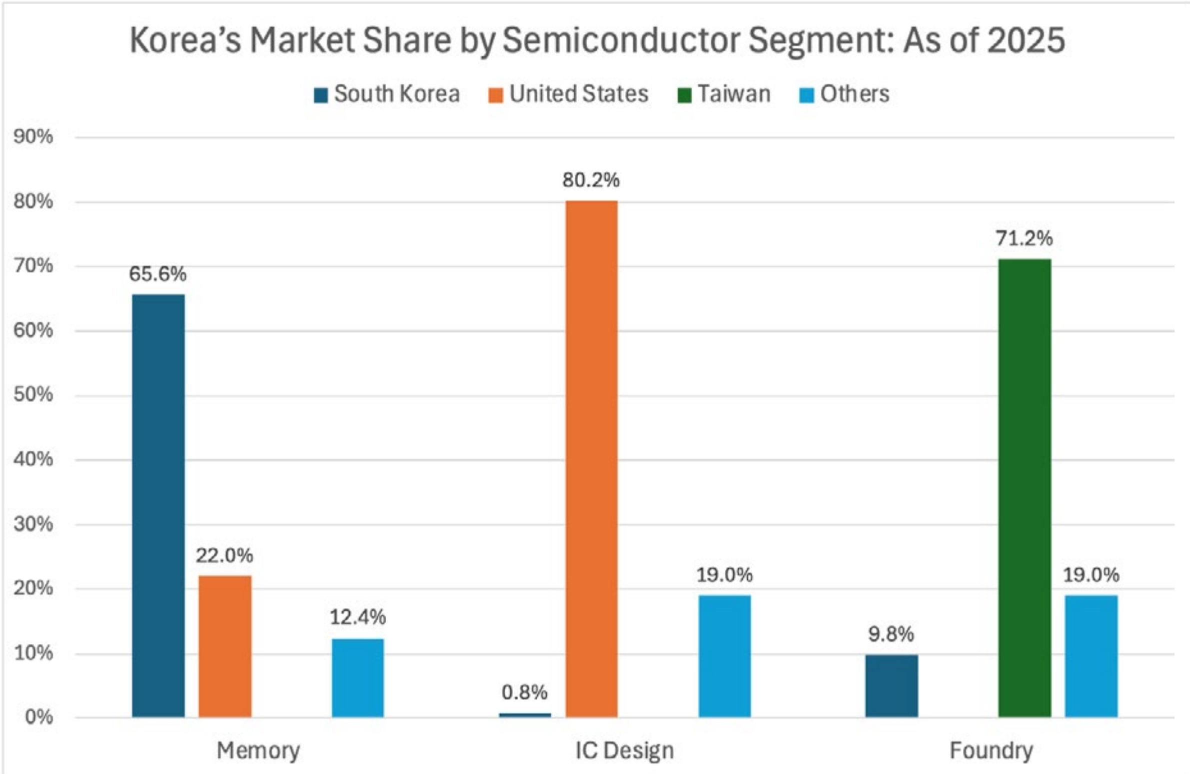
Samsung Electronics has similarly developed advanced packaging platforms such as I-Cube (2.5D) and X-Cube (3D), which enable the integration of logic, memory, and interposer chips within a single package. In selected segments, Samsung's packaging technologies compete directly with TSMC's Chip-on-Wafer-on-Substrate (CoWoS), underscoring Korea's growing relevance in advanced system-level integration—an arena where physics, not just process nodes, increasingly determines competitive advantage.

According to The Chosun Daily, South Korea remains the undisputed global leader in memory semiconductors, commanding 65.6% of global market share as of 2025. This dominance reflects decades of accumulated advantages in DRAM and NAND flash production, including economies of scale, high manufacturing yields, and deep integration with downstream electronics industries. Memory, therefore, continues to serve as the cornerstone of Korea's semiconductor sector.

By contrast, in integrated circuit (IC) design—the segment that increasingly captures value in the AI era—South Korea accounts for only 0.8% of the global market, while the United States dominates with 80.2%. This stark disparity underscores a structural weakness in high-value chip architecture, system design, and platform-level innovation, precisely the domains that are becoming decisive as the semiconductor industry shifts from volume-driven manufacturing toward intelligence-driven competition.

In foundry manufacturing, Korea remains a secondary but still significant player, holding 9.8% of global market share, well behind Taiwan's commanding 71.2%. Although Korean firms possess advanced process technologies, they have yet to match Taiwan's ecosystem depth, customer trust, and scale in pure-play contract manufacturing (see Figure 44).

Figure 44. Korea's Market Share by Semiconductor Segment: As of 2025



Source: Park Soon-chan and Kim Tae-jun, "Government Invests 700 Trillion Won in Semiconductors," The Chosun Daily, December 11, 2025.

2. Korea's Share of the Global Semiconductor Market

Semiconductor Vendors

The performance of Korean semiconductor vendors in 2023–2024 reflected a clear, memory-led rebound accompanied by a sharp rise in global market presence. In 2023, Samsung Electronics and SK hynix were still constrained by a severe memory downturn. Their combined revenue reached US$ 63.9 billion, and their global market share remained subdued despite Samsung's continued status as a top-tier chipmaker and SK hynix's gradual emergence from the trough of the memory cycle.

The situation shifted decisively in 2024. Combined semiconductor revenue surged to US$ 109.9 billion, representing a 71.8% year-over-year increase—more than three times the global market growth rate of 21%. Consequently, Korean vendors' global market share expanded significantly to 16.7%, signaling not merely cyclical recovery but clear outperformance relative to many non-memory peers.

At the firm level, Samsung Electronics generated US$ 65.7 billion in semiconductor revenue in 2024, achieving 60.8% annual growth and capturing 10.0% of the global market, ranking second worldwide. SK hynix posted an even stronger rebound, with revenue reaching US$ 44.2 billion, up 91.5% year-over-year, raising its global share to 6.7% and securing fourth place. Together, the two firms constituted the largest national bloc among the world's top ten semiconductor vendors in terms of combined market share (see Table 43).

Table 43. Korea's Top Semiconductor Vendors by Revenue and Market Share: 2023-2024

Unit: US$ Million

2024 Rank	2023 Rank	Vendor	2024 Revenue	2024 Market Share (%)	2023 Revenue	2024-2023 Growth (%)
2	2	Samsung Electronics	65,697	10.0	40,868	60.8
4	6	SK hynix	44,186	6.7	23,077	91.5
Korean Vendors			109,883	16.7	63,945	71.8

Source: Gartner, "Gartner Says Worldwide Semiconductor Revenue Grew 21% in 2024," April 10, 2025.

Foundry Share

In the foundry segment, Samsung held a relatively strong 16.0% share of global foundry revenue in 2022, firmly positioning South Korea as the second-largest player after TSMC. However, this share declined to 12.0% in 2023, fell further to 9.4% in 2024, and dropped sharply to 7.2% in 2025.

This trajectory represents a loss of more than half of Samsung's foundry market share within just three years, reflecting several structural challenges. These include delays in advanced-node yield improvements, intense competition from TSMC at leading-edge process nodes, and relatively weaker exposure to high-performance computing and AI workloads—segments that have driven much of the recent growth in global foundry demand.

In contrast to TSMC's rapid expansion and increasing dominance, Korea's foundry position has shifted from that of a strong challenger to a more distant second tier, with its market share now only marginally higher than those of SMIC, UMC, and GlobalFoundries. The data suggest that Korea's influence in the global foundry landscape is not only contracting but also becoming increasingly vulnerable to mid-tier competitors, unless strategic realignment or technological breakthroughs alter the current trajectory (see Table 44).

Table 44. Market Share of Global Top 5 Foundries by Revenue: 2022-2025

Ranking	Company	Market Share			
		2025	2024	2023	2022
1	TSMC	69.9%	64.4%	58.9%	55.4%

2	Samsung	7.2%	9.4%	12.0%	16.0%
3	SMIC	5.3%	5.7%	5.4%	5.3%
4	UMC	4.4%	5.2%	6.1%	6.8%
5	GlobalFoundries	3.9%	4.8%	6.3%	6.0%

Source: Raw data are from TrendForce press releases; yearly market shares are calculated by the author

Advanced Manufacturing

Korea's 2029 outlook reveals a constrained expansion at the leading edge, driven almost solely by Samsung Foundry. By 2029, South Korea is projected to account for about 11% of global sub-6nm manufacturing capacity, confirming that it remains firmly within the small group of countries capable of producing at advanced logic nodes.

At the node level, Korea's strengths are most visible at 3nm, where Samsung is expected to hold roughly 23% of global capacity. This positions the 3nm node as Korea's most substantial advanced-node foothold. At 2nm, Korea's projected share stands at around 19%, demonstrating ongoing progress toward the next frontier of logic scaling, albeit with more limited capacity than at slightly more mature nodes. In contrast, Korea's presence in the 4/5/6nm range is more modest, with a projected capacity share of about 12%.

The 2029 outlook portrays Korea's advanced-process development as technically credible, strategically targeted, and structurally limited by scale. Korea continues to invest in the most advanced nodes and maintains meaningful capacity at 2nm and 3nm, ensuring its place in the global leading-edge ecosystem. However, the distribution of capacity also suggests a cautious approach, prioritizing yield learning, process stability, and long-term competitiveness over aggressive capacity expansion (see Figure 26 and 27).

Memory Chip Dominance

Memory chips, particularly DRAM and NAND, have consistently accounted for a very high share of Korea's semiconductor production, while system and logic (non-memory) semiconductors have remained a comparatively smaller segment. Against this backdrop, the development of Korea's memory market over the past decade reads less like a straight line and more like a dramatic novel, complete with sharp twists, sudden reversals, and an unmistakable upward ending.

Between 2016 and 2026, combined DRAM and NAND revenue is projected to rise from about US$ 77 billion in 2016 to a forecasted US$ 287 billion by 2026, implying almost a fourfold expansion in market size. This long-term increase firmly anchors Korea at the core of the global memory industry.

At the same time, year-over-year growth rates reveal how uneven this ascent has been. Growth surged to 65% in 2017 and remained strong at 26% in 2018, before plunging to −34% in 2019, underscoring the inherently cyclical nature of memory manufacturing. The industry repeatedly oscillated between boom and bust as capacity expansion, pricing dynamics, and end-market demand drifted out of balance and then realigned.

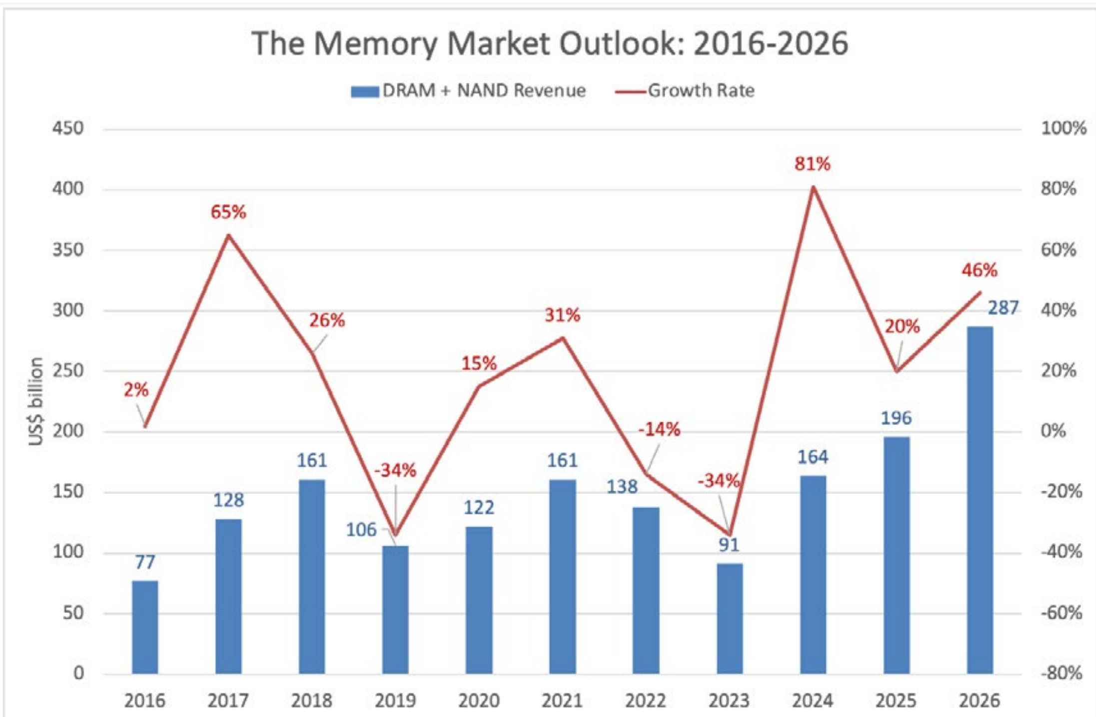
The upswing in 2017 and 2018, when revenues climbed from US$ 128 billion to US$ 161 billion, reflected tight supply conditions and strong demand from smartphones and data centers, allowing Korean memory producers to enjoy exceptional pricing power. This momentum reversed abruptly in 2019, when revenues fell to around US$ 106 billion, marking one of the sharpest downturns of the period.

A recovery followed in 2020 and 2021, with revenues rebounding to US$ 122 billion and then US$ 161 billion, supported by cloud computing expansion and accelerated digital adoption during the pandemic. Yet, this recovery proved short-lived, as the market slipped back into contraction in 2022 and 2023, with revenues declining to US$ 138 billion and then US$ 91 billion, alongside growth rates of −14% and −34%, respectively.

What distinguishes the most recent phase is the extraordinary rebound in 2024. Revenue jumped to roughly US$ 164 billion, accompanied by an exceptional 81% growth rate. This rebound signals more than a conventional cyclical recovery; it reflects the structural impact of artificial intelligence, in particular, the explosive demand for high-bandwidth memory used in AI servers and advanced computing platforms.

Looking ahead, growth moderates but remains solid, with revenues rising to a forecasted US$ 196 billion in 2025 and a forecasted US$ 287 billion in 2026, corresponding to growth rates of 20% and 46%. (see Figure 45).

Figure 45. The Memory Market Outlook: 2016-2026



Source: TechInsights, “5 Expectations for the Memory Markets in 2026,” October 30, 2025.

However, the industry is currently experiencing a severe shortage driven by the explosive growth of AI applications. Starting in the second half of 2025, the DRAM and NAND flash markets have faced severe supply constraints that are expected to last until 2027. According to IDC, supply growth for DRAM and NAND in 2026 will be limited to 16% and 17% respectively, far below historical averages, as capacity expansion fails to keep pace with demand.

This supply-demand mismatch has triggered a dramatic surge in pricing. Nomura estimates that in the first quarter of 2026 alone, mainstream DRAM prices will jump by 90%, and NAND by 60%. For the full year of 2026, commodity DRAM and NAND prices could skyrocket by 176% and 146% respectively, significantly boosting the operating margins of leading Korean memory makers like SK hynix. Furthermore, the "vacuum effect" created by AI servers is squeezing the production space for consumer electronics, forcing manufacturers to sacrifice memory supply for mid-range smartphones and PCs.

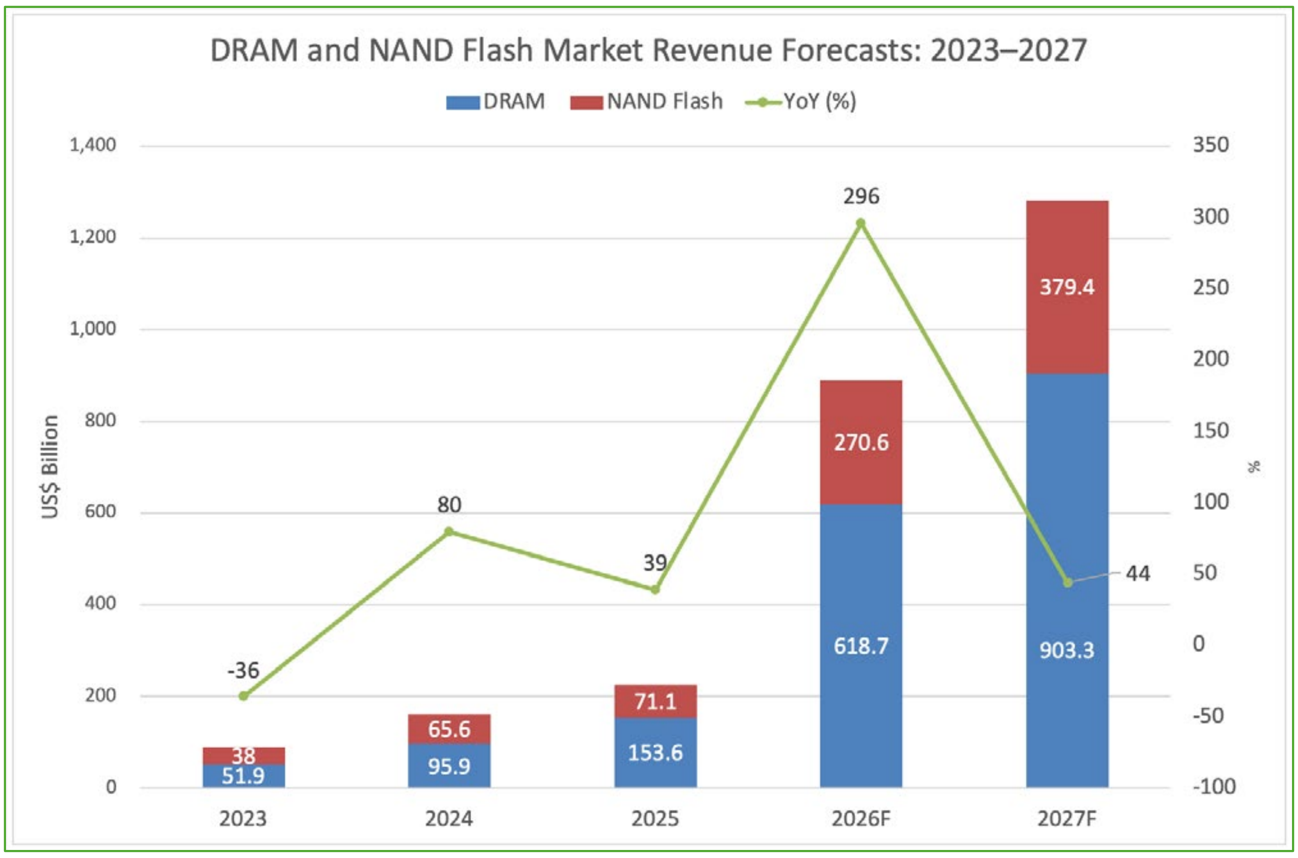
Furthermore, TrendForce's latest research released in May 2026 highlights that Agentic AI-driven innovation is fundamentally reshaping the memory industry. Surging data-access requirements from continuous iterative cycles in Agentic AI systems and expanding context windows are accelerating structural demand growth. As a result, the global memory market is projected to reach an unprecedented US$ 889.3 billion in 2026 and further expand to more than US$ 1.28 trillion in 2027, representing a robust 44% year-on-year increase.

Updated projections in May 2026 point to an even more explosive trajectory. North American cloud service providers (CSPs) have substantially raised capital expenditures and accelerated large-scale AI server deployments, with the combined capital expenditures of the world's nine largest CSPs projected to reach 79% growth in 2026 and capital intensity increasing to 34%. Under this momentum, the global memory market is now forecast to climb to US$ 889.3 billion in 2026 and peak at more than US$ 1.28 trillion in 2027.

Within this expansion cycle, the DRAM segment stands out. After generating US$ 165.7 billion in 2025, DRAM contract prices surged by 53–58% quarter-on-quarter in the fourth quarter of last year and are expected to rise by more than 60% in the first quarter of 2026. This strong pricing environment, coupled with robust demand for DDR5, growing wafer consumption associated with HBM production that compresses conventional DRAM capacity, and rising CPU deployment in AI servers (with CPU-to-GPU ratios shifting from 1:8 toward 1:4 or 1:2), could propel DRAM revenue to US$ 618.7 billion in 2026, marking a remarkable 303% year-on-year increase, and expanding further to US$ 903.3 billion in 2027.

The NAND Flash market is also poised for substantial growt. Facing massive and continuously rising memory demand, HBM remains too costly for broad deployment at scale, while HDDs are constrained by access speed, making them unsuitable for real-time AI workloads. This dynamic is creating significant growth opportunities for NAND solutions, such as SCM SSDs, HBF, and SLC/pSLC SSDs, which are rapidly penetrating AI inference and agentic workloads. TrendForce has therefore revised its forecast upward, now projecting overall NAND Flash revenue to reach US$ 270.6 billion in 2026, representing an annual growth of 280.7%, and to further expand to nearly US$ 379.4 billion in 2027. According to TrendForce's May 2026 release, the AI-fueled supercycle is propelling the memory market to a record US$ 889.3 billion by 2026, a scale that will more than double the global wafer foundry market (projected at US$ 218.7 billion) (See Figure 46).

Figure 46. DRAM and NAND Flash Market Revenue and Growth Forecasts: 2023-2027



Source: TrendForce, "Agentic AI Drives Structural Expansion in Memory Demand, Global Memory Market Projected to Reach US$1.28 Trillion by 2027, Says TrendForce ," May 29, 2026.

According to TrendForce's February 2026 release, the AI-fueled supercycle is propelling the memory market to a record US$ 551.6 billion by 2026, a scale that will more than double the global wafer foundry market (projected at US$ 218.7 billion). This new memory supercycle is structurally tighter and possesses far stronger pricing power than the 2017–2019 period. A key driver is that current procurement is dominated by Cloud Service Providers (CSPs), whose exponential volume growth and lower price sensitivity have enabled record-high price increases.

Furthermore, as the AI industry shifts from model training to large-scale inference, the need for real-time responsiveness and efficient data access has surged. Notably, NVIDIA's promotion of its Vera Rubin platform has significantly boosted demand for high-performance storage, prompting operators to increasingly deploy high-capacity QLC enterprise SSDs to optimize token-generation performance and cost efficiency.

DRAM Market Share

Korea occupies a structurally dominant position in the global memory market, particularly in DRAM and, to a slightly lesser extent, NAND flash. This dominance is not episodic but sustained over time, reflecting deep technological capability, scale, and strategic specialization by Korean vendors—above all Samsung Electronics and SK hynix.

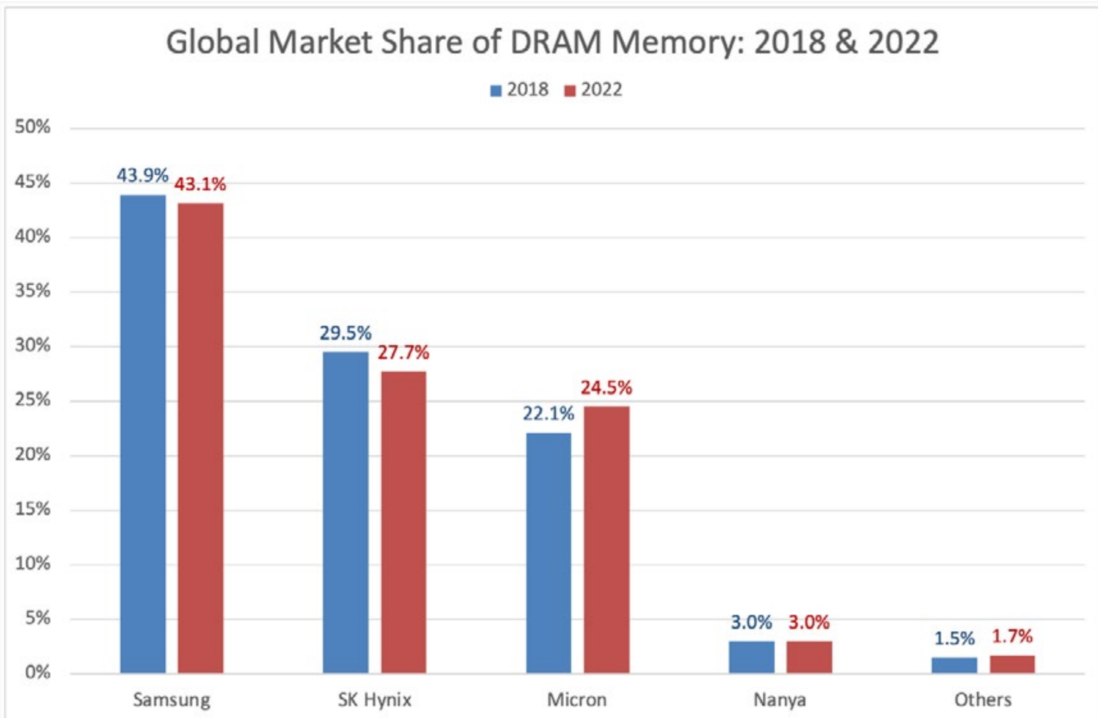
In the late 2010s, Korea's dominance in DRAM was already firmly established. In 2018, Samsung and

SK hynix together controlled more than 73% of the global DRAM market, with Samsung alone accounting for 43.9% and SK hynix 29.5%. At that time, Korea's strength was characterized by a clear hierarchy: Samsung as the unchallenged global leader, SK hynix as a strong second, and competitors trailing at a noticeable distance.

By 2022, this structure remained largely unchanged in aggregate terms, even though some internal shifts were visible. Samsung's share edged down slightly to 43.1%, while SK hynix declined to 27.7%, but Korea as a whole continued to command roughly 71% of the global DRAM share, underscoring the structural resilience of its memory industry despite cyclical downturns.

From 2020 to 2024, Korea's collective dominance proved remarkably stable. Korean vendors consistently held around 71–76% of the global DRAM market share, peaking at 76.0% in 2024. This period coincided with growing demand from cloud computing and the early stages of AI acceleration, allowing Korean firms to consolidate their technological edge. During these years, Samsung maintained a share slightly above 40%, while SK hynix gradually strengthened its position, rising from 29.3% in 2020 to 34.2% in 2024 (see Figure 47 ; Table 45).

Figure 47. Global Market Share of DRAM Memory: 2018 & 2022



Source: TADVISER, "DRAM Memory (Global Market)," March 12, 2025.

Table 45. Korea's DRAM Market Share: 2020-2025

Year	Korean Vendors Total	Samsung Electronics	SK hynix
2020	72.1%	42.8%	29.3%
2021	71.5%	43.0%	28.5%
2022	71.0%	43.2%	27.8%
2023	72.2%	42.0%	30.2%

2024	76.0%	41.8%	34.2%
3Qs 2025	69.0%	33.0%	36.0%

Note: TrendForce only provides quarterly data; the author therefore uses the four-quarter average of market share as a proxy for the full-year data.
Source: TrendForce, Press Releases.

The most recent data, covering late 2024 through the third quarter of 2025, point to a more dynamic phase. Korea's combined DRAM share eased from around 73% in 3Q–4Q 2024 to about 67% by 3Q 2025, reflecting intensifying competition and some capacity expansion by non-Korean producers.

At the same time, leadership within Korea shifted noticeably. Samsung's global DRAM share declined from 40% in 3Q 2024 to around 33% by 3Q 2025, while SK hynix's share rose from 33% to 36% over the same period, briefly becoming the world's largest DRAM supplier by revenue in several quarters.

However, this leadership shifted again in the fourth quarter of 2025. Driven by CSPs expanding data center build-outs to general-purpose servers and aggressive additional orders, total DRAM industry revenue surged to US$ 53.58 billion in 4Q 2025, marking a 29.4% QoQ increase. Samsung successfully reclaimed the No. 1 global market share, reaching 36% with US$ 19.30 billion in revenue (a 43% QoQ increase). SK hynix slipped to second place with a 32.1% share (US$ 17.22 billion), while Micron maintained third place with 22.4%.

In 1Q 2026, the memory industry experienced a significant boost due to rapidly rising contract prices for conventional DRAM, which increased by approximately 93% to 98% QoQ. This surge contributed to an overall industry revenue increase of 81% QoQ, reaching US$ 97 billion. Samsung retained its leading position in 1Q 2026, benefiting from the strongest ASP growth among the top three DRAM vendors and driving quarterly revenue up 93.4% QoQ to US$ 37.32 billion, increasing its market share to 38.5%. SK hynix posted 1Q 2026 revenue of US$ 27.98 billion, up 62.5% QoQ, ranking second with a 28.8% market share. Micron ranked third, with quarterly revenue surging 81.6% QoQ to US$ 21.75 billion, while maintaining a stable 22.4% market share.

Looking ahead to 2Q 2026, inventory levels at DRAM suppliers remain extremely low, while incremental supply is prioritized for high-capacity RDIMMs for AI servers, limiting product availability for PC OEMs and smartphone vendors. As CSPs show a greater willingness to accept price increases, conventional DRAM contract prices are expected to rise another 58–63% QoQ in 2Q 2026. Suppliers are expected to rely primarily on process migrations to expand bit output in 2026, given the increasingly tight supply environment and the time required for new cleanroom construction.

Korea's position in the DRAM market has evolved from static dominance led by a single firm to collective dominance sustained by two highly competitive champions. While Korea's aggregate share has edged down modestly in the most recent quarters, it remains exceptionally high by global standards. More importantly, the internal rebalancing between Samsung and SK hynix suggests not decline, but maturity: Korea's DRAM leadership is no longer dependent on a single company, but supported by a deep and resilient industrial ecosystem that continues to anchor the global memory market (see Table 46).

Table 46. Branded DRAM Supplier Revenue Ranking: 1Q 2026

Ranking	Company	Revenue (US$ M)	Market Share	2Q 2025	3Q 2025	4Q 2025
		1Q26	4Q25	QoQ	1Q26	4Q25
1	Samsung	37,323	19,300	93.4%	38.5%	36.0%
2	SK hynix	27,982	17,221	62.5%	28.8%	32.1%
3	Micron	21,750	11,975	81.6%	22.4%	22.4%
4	Nanya	1,552	970	60.0%	1.6%	1.8%
5	Winbond	568	297	91.4%	0.6%	0.6%
6	PSMC	43	33	29.9%	0.0%	0.1%
Others		7,783	3,782	105.8%	8.0%	7.1%
Total		97,000	53,578	81.0%	100.0%	100.0%
KR Share					67.3%	68.1%
US Share					22.4%	22.4%
TW Share					2.2%	2.5%

1. 4Q25 exchange rate—USD:KRW = 1:1,449; USD:TWD = 1:31
2. 1Q26 exchange rate—USD:KRW = 1:1,466; USD:TWD = 1:31.6
3. Ranking includes listed companies only.
Source: TrendForce, "Rapid Contract Price Surge Drives 1Q26 DRAM Industry Up 81% QoQ, Says TrendForce," June 1, 2026.

High-Bandwidth Memory

The single most important factor underpinning Korea's dominance in memory chips is the surge in global AI demand following the introduction of ChatGPT. As AI models have grown larger and more computationally intensive, leading technology firms such as Microsoft, Google, and Amazon have rapidly expanded their data center capacity. These hyperscale data centers rely heavily on high-performance chips (HPC), particularly HBM and advanced DRAM, to process massive datasets at a high speed.

From 4Q 2024 to 4Q 2025, the global HBM market expanded rapidly while becoming increasingly concentrated. Korean firms—SK hynix and Samsung Electronics—together accounted for roughly 80–90% of global HBM revenue, underscoring Korea's central role in supporting global AI infrastructure. In the high-end HBM market, the dominance of the "Big Three" is absolute, with SK hynix capturing 57% of the market, followed by Samsung at 22% and Micron at 21%.

The race for next-generation HBM is intensifying. As manufacturing difficulty increases significantly with every 4-layer addition, stacking precision has become a critical bottleneck. At the 2026 Consumer Electronics Show (CES), SK hynix showcased the world's first 16-layer HBM4 sample, demonstrating its technological edge. Meanwhile, high-speed versions of HBM4 are expected to command a 30% to 40% price premium due to extremely tight supply.

SK hynix emerged as the dominant market leader, with its share peaking at 69% in 1Q 2025 before easing to 57% by 4Q 2025. This reflects early leadership in HBM3 and HBM3E, strong customer alignment with major AI chip designers, and high manufacturing yields in advanced stacking technologies. Samsung Electronics, after a weaker start, showed a gradual recovery, with market share rising from 13% to 22% over the same period.

Although Micron increased its presence to around 20% market share, Korean firms remain overwhelmingly dominant. This highlights that Korea's importance in HBM extends beyond scale alone. The country has evolved from a traditional memory supplier into a strategic linchpin of the AI semiconductor ecosystem, where memory, logic, packaging, and system integration increasingly converge.

Furthermore, as the AI industry prepares for NVIDIA's next-generation Rubin platform, the HBM landscape is entering a new phase. Accelerated AI infrastructure deployment is expected to sustain strong HBM demand growth through 2026 and 2027. In 2026, HBM demand growth will primarily be driven by AI ASIC capacity upgrades, with HBM capacity per AI chip increasing significantly from 96GB/192GB to 216GB/288GB. In 2027, NVIDIA's Rubin Ultra platform is expected to further increase HBM capacity per GPU to 384GB, while AI ASIC platforms such as Google TPU are projected to further amplify HBM bit demand through rising deployment volumes.

TrendForce estimates that HBM wafer input among the top three suppliers will account for approximately 18%, 22%, and 30% of total DRAM wafer input by the end of 2025, 2026, and 2027, respectively. Meanwhile, HBM bit supply is expected to represent approximately 8%, 9%, and 13% of total DRAM bit supply during the same period.

However, sharp increases in conventional DRAM prices since the second half of 2025 have altered the profitability landscape. Because the annual pricing mechanism for HBM prevents contract prices from fully reflecting quarterly market price increases, HBM wafer revenue and profitability were overtaken by DDR5 64GB RDIMM in 1Q 2026. As HBM generations continue evolving in 2027 with larger die sizes and rising demand, the crowding-out effect on conventional DRAM capacity is expected to intensify. This dynamic will prompt suppliers to adjust production allocation between HBM and conventional DRAM based on HBM pricing outcomes, giving suppliers strong justification and greater pricing power in HBM negotiations for 2027.

At the same time, the supply dynamics are shifting. As conventional DRAM prices have surged sharply since the fourth quarter of 2025, HBM's historical advantage in profitability has narrowed. Consequently, major memory vendors are actively recalibrating their capacity allocation between HBM and conventional DRAM to balance overall revenue growth and meet diverse customer commitments.

As AI workloads continue to grow, HBM is likely to remain a structurally constrained and geopolitically significant technology. In this context, Korea's role is shifting from market leadership toward system-level influence, shaping the cost, resilience, and pace of global AI hardware deployment (see Table 47).

Table 47. Global HBM Market Share by Revenue (Quarterly): 3Q 2024-3Q 2025

Market Share	3Q 2024	4Q 2024	1Q 2025	2Q 2025	3Q 2025
SK hynix	53%	51%	69%	64%	57%
Samsung	35%	40%	13%	15%	22%
Micron	11%	9%	18%	21%	21%
Korean Total	88%	91%	82%	79%	79%
Total	100%	100%	100%	100%	100%

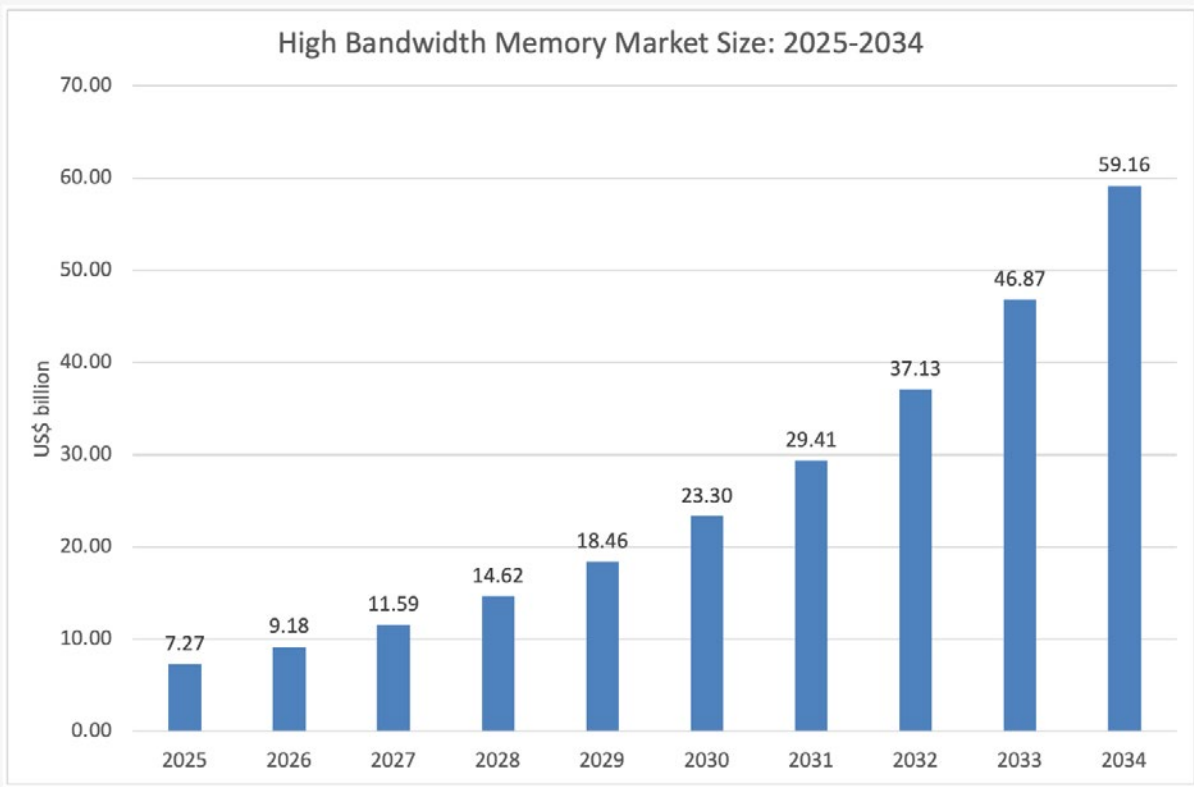
Source: Counterpoint, "Global DRAM and HBM Market Share: Quarterly," December 19, 2025.

The global HBM market size is projected to grow from US$ 7.3 billion in 2025 to nearly US$ 60 billion by 2034, representing more than an eightfold increase within a decade. This exceptionally projected CAGR of 26.23% (2025–2034) underscores the central role of HBM as a foundational component of next-generation computing architectures, particularly in AI accelerators, data centers, and HPC systems.

Unlike previous memory upcycles driven primarily by consumer electronics, the current HBM growth trajectory is anchored in infrastructure-level demand. Large-scale AI model training and inference require sustained bandwidth, low latency, and power efficiency—characteristics that conventional DRAM architectures cannot deliver at scale. As a result, HBM is evolving from a niche, high-end product into a strategic bottleneck technology within the global semiconductor value chain.

In short, the projected 26.23% CAGR signals that HBM is no longer merely riding the AI wave; it is becoming one of the pillars on which the future global digital economy is being built (see Figure 48).

Figure 48. High Bandwidth Memory Market Size: 2025-2034



Source: "High-Bandwidth Memory Market Size, Share and Trends 2025 to 2034," Precedence Research, October 14, 2025.

As AI GPU architecture evolves, HBM has transitioned from a supporting component to the most sensitive resource restricting AI server production. In high-end GPU modules like NVIDIA's H100 and B200 platforms, HBM now accounts for over 50% of the total hardware bill of materials cost. Driven by this structural shift, the global HBM market is projected by Yole Group to grow from US$ 34 billion in 2025 to US$ 47 billion in 2026. Furthermore, Micron recently noted in December 2025 that the total available market for HBM will reach an astounding US$ 100 billion by 2028, underscoring the relentless structural demand for high-performance memory.

In terms of full-year 2025 HBM market share, SK hynix firmly maintained its leadership with 52%, followed by Samsung at 28% and Micron at 20%. To meet explosive AI demand, these top three suppliers are aggressively expanding their HBM capacity with distinct strategies. SK hynix focuses on "speed and yield," projecting a capacity increase from roughly 150,000 wafers per month in 2025 to 200,000 in 2026, primarily anchored in Korea with a new advanced packaging facility planned in Indiana, U.S.. Meanwhile, Samsung is leveraging its "turn-key vertical integration" strategy, expanding its Pyeongtaek P4 fab for HBM4 and retaining its Taylor, Texas facility as a strategic option, with its monthly capacity expected to grow from 150,000 to 180,000 wafers by 2026.

Global Memory Market Structure

According to TrendForce, HBM's share of total DRAM bit capacity is estimated to increase from 2% in 2023 to 5% in 2024, and to exceed 10% by 2025. The shift is even more pronounced in value terms: HBM is projected to account for over one-fifth of the total DRAM market revenue in 2024, with its share potentially surpassing 30% in 2025, underscoring its disproportionate contribution to industry value creation.

In addition, annual HBM demand is expected to grow by nearly 200% in 2024 and to double again in 2025, reflecting the accelerating pull from AI accelerators and high-performance computing applications (Table 48).

Table 48. Estimated HBM Share of DRAM Bit Capacity and Revenue: 2023-2025

HBM Share	2023	2024 (E)	2025 (F)
Output Out of total DRAM	2%	5%	Over 10%
Revenue Out of total DRAM	8%	21%	Over 30%

Source: Press Release, "HBM Prices to Increase by 5–10% in 2025, Accounting for Over 30% of Total DRAM Value, Says TrendForce," TrendForce, May 6, 2024.

The global memory market is undergoing a pronounced structural transition marked by cyclical recovery and a shift toward high-value memory. After the historic downturn of 2022–2023, industry revenue rebounded strongly in 2024, reaching a record US$ 170 billion. DRAM and NAND continue to dominate the market, contributing approximately US$ 97 billion and US$ 68 billion respectively. Within DRAM, HBM has already emerged as a strategically important subsegment, generating about US$ 18 billion despite its still-limited share of total bit output in 2024.

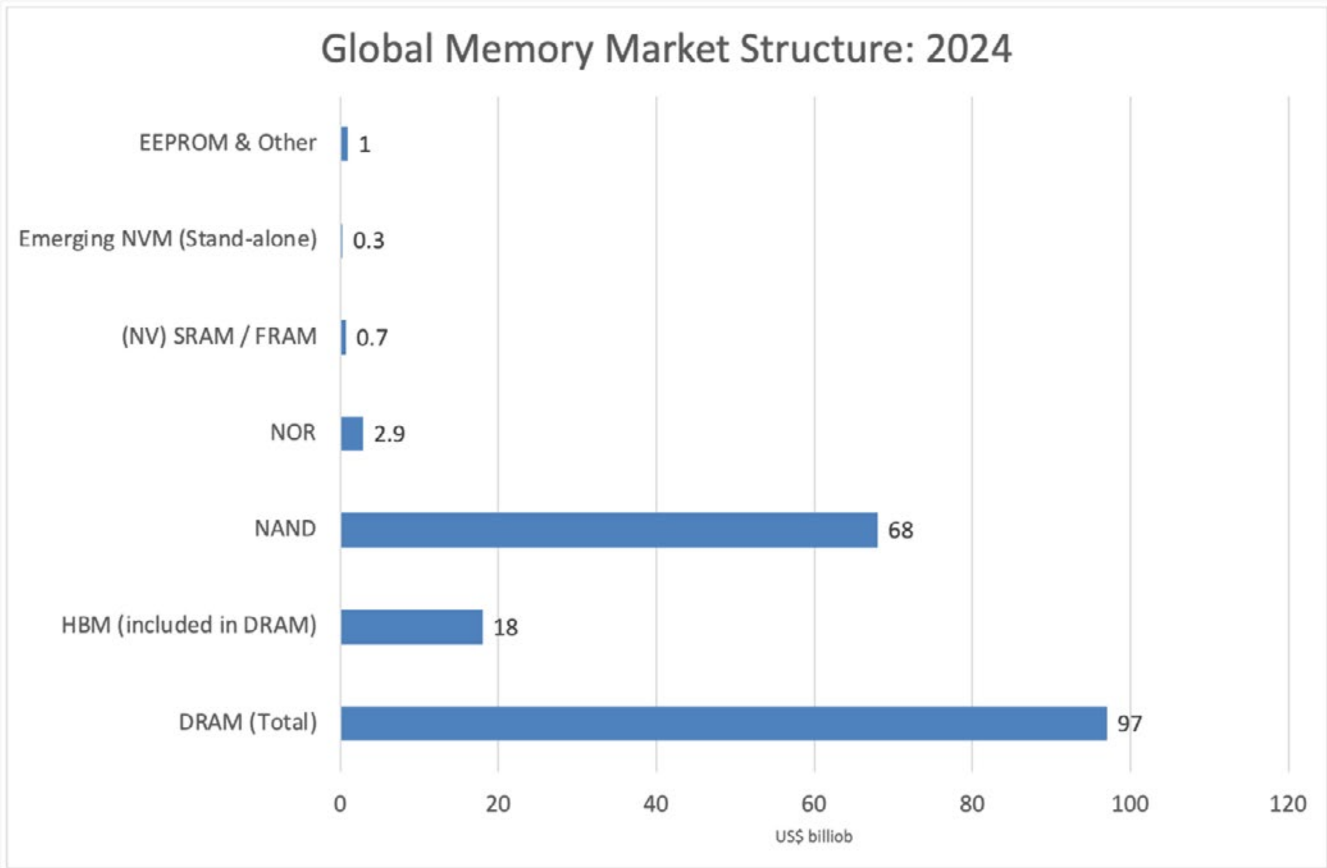
Looking ahead, the market's evolution is increasingly defined by changes in value distribution rather than volume alone. By 2030, global memory revenue is projected to reach roughly US$ 302 billion, implying a CAGR of around 10% from 2024 to 2030. DRAM revenue is expected to double to approximately US$ 194 billion, while NAND grows more moderately to about US$ 101 billion. The most significant shift occurs within DRAM, where HBM revenue is projected to rise to around US$ 98 billion in 2030, exceeding 50% of total DRAM market value.

This reweighting reflects the growing centrality of AI workloads. Data center training and inference have made memory bandwidth and power efficiency system-level constraints, elevating HBM from a niche product to a critical enabler. Yole Group projects a 33% CAGR for HBM through 2030, underscoring how growth in the memory industry is becoming increasingly concentrated in this single, high-margin segment.

At the same time, competitive and geopolitical dynamics are reshaping the industry landscape. Chinese memory producers such as CXMT and YMTC are intensifying competition, particularly in commodity segments, while export controls and localization policies fragment global supply chains.

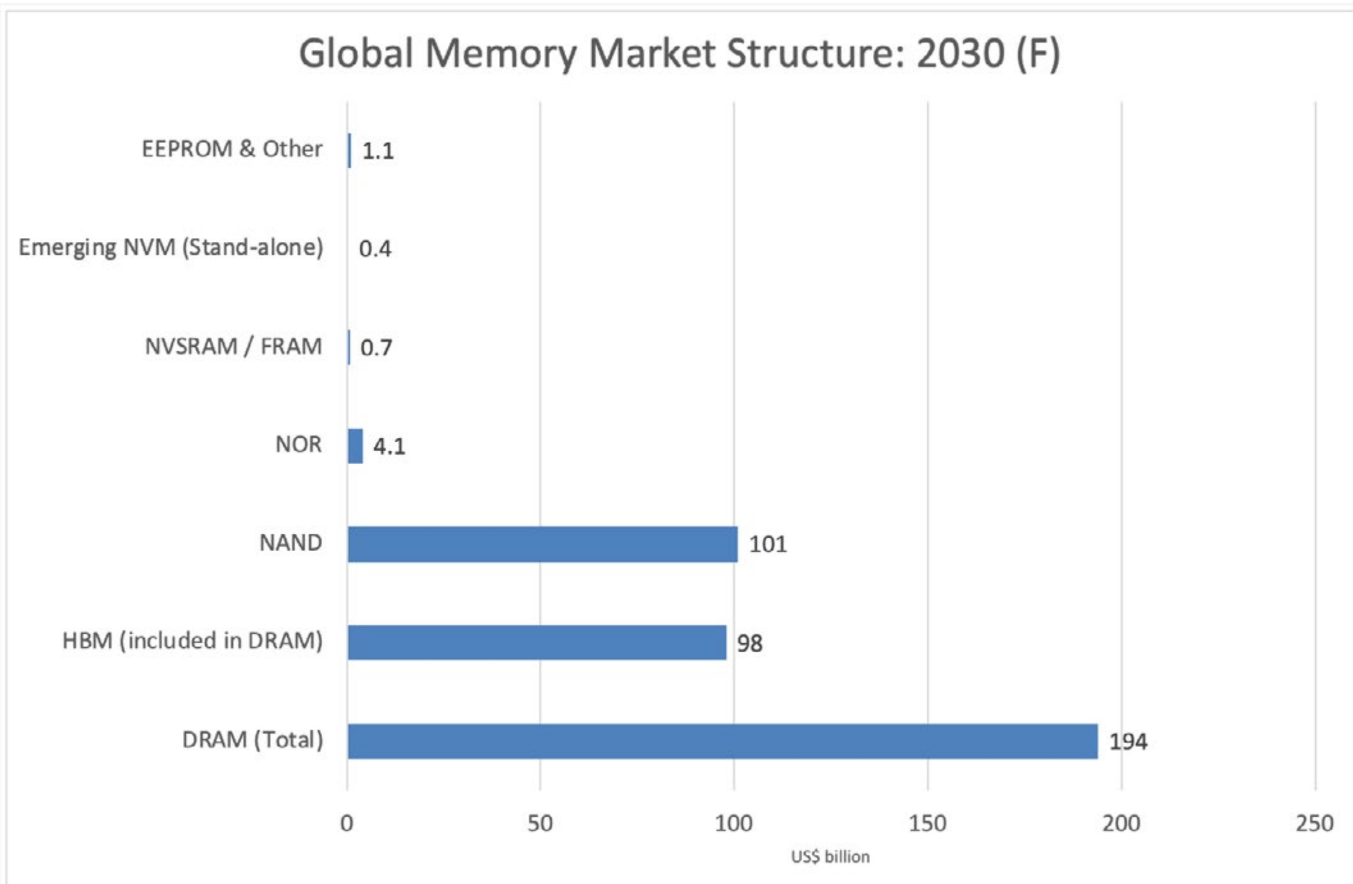
Overall, the global memory market is no longer driven solely by traditional cyclical forces. While DRAM and NAND remain its backbone, HBM is steadily redefining the industry's center of gravity, shifting value creation toward AI-driven infrastructure, technological bottlenecks, and geopolitical resilience (Figure 49 and 50).

Figure 49. Global Memory Market Structure: 2024



Source: “Memory market surges beyond expectations: almost $200 billion in 2025 driven by HBM & AI,” Yole Group, June 19, 2025.

Figure 50. Global Memory Market Structure: 2030 (F)



Source: “Memory market surges beyond expectations: almost $200 billion in 2025 driven by HBM & AI,” Yole Group, June 19, 2025.

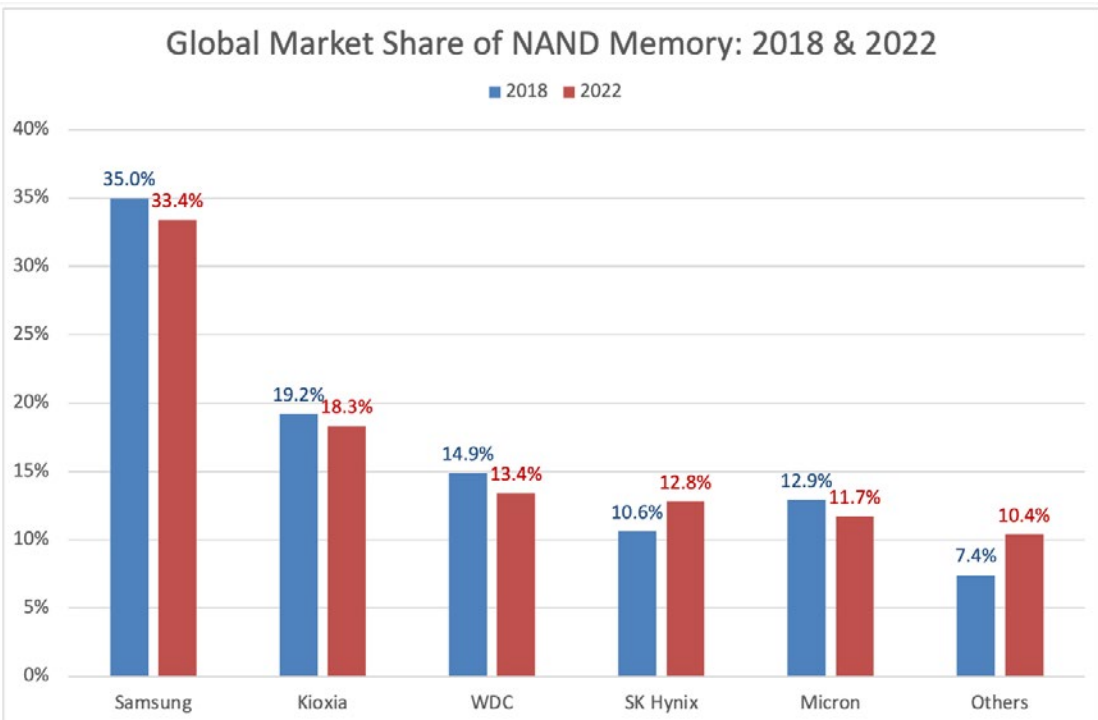
NAND Market Share

In the late 2010s, Korea's presence in NAND was already significant. Samsung dominated the 2018 NAND market with a 35.0% share, while SK hynix accounted for 10.6%. Combined, Korean firms controlled roughly 45–46% of the global NAND market, giving the country a strong contending edge, though not quite a majority position. At that stage, Korea's dominance rested primarily on Samsung's scale and technology leadership, with SK hynix a secondary player.

By 2022, Korea's position had visibly strengthened. Samsung's NAND share eased slightly to 33.4%, but SK hynix expanded its share to 12.8%, partly supported by its acquisition of Intel's NAND business. As a result, Korean vendors together exceeded 52% of the global NAND market share. This marked a structural shift: Korea was no longer dominant because of one firm alone, but because of a consolidated national presence.

From 2020 through 2024, this trend became more pronounced. Korea's combined NAND market share rose steadily from 44.5% in 2020 to 57.1% in 2024, the highest level shown in the data. Samsung remained the anchor supplier, maintaining a share in the low-to-mid-30% range, while SK hynix expanded aggressively, growing from 11.5% in 2020 to 21.4% in 2024. This period reflects Korea's successful scaling of advanced NAND technologies, strong execution in enterprise SSDs, and growing exposure to data center demand (see Figure 51; Table 49).

Figure 51. Global Market Share of NAND Memory: 2018 & 2022



Source: TADVISER, "DRAM Memory (Global Market)," March 12, 2025.

Table 49. Korea's NAND Flash Market Share: 2020-2025

Year	Korean Vendors Total	Samsung Electronics	SK hynix
2020	44.50%	33.00%	11.50%
2021	46.90%	33.80%	13.10%
2022	52.60%	33.3%	18.30%

2023	52.50%	33.60%	18.90%
2024	57.10%	35.70%	21.40%
3Qs 2025	51.30%	32.40%	18.90%

Note: The share of SK hynix includes Intel NAND from 2021. TrendForce only provides quarterly data; the author therefore uses the four-quarter average of market shares as a proxy for the full-year data.
Source: TrendForce, Press Releases.

The most recent quarterly data from mid-2024 through Q3 2025 suggest a more competitive environment. Korea's combined NAND share moderated from 57% in Q2 2024 to around 51% by Q3 2025, indicating renewed pressure from non-Korean suppliers and a more fragmented market structure. However, in the fourth quarter of 2025 (4Q 2025) and extending into the first quarter of 2026 (1Q 2026), the global NAND Flash industry continued to benefit from explosive demand for enterprise SSDs, fueled by large-scale AI server deployments by North American CSPs, as well as severe HDD shortages and extended lead times. Following a 23.8% QoQ rise to US$ 21.17 billion in 4Q25, the combined revenue of the world's top five NAND Flash suppliers jumped an astonishing 83.7% QoQ in 1Q 2026, surpassing US$ 38.9 billion.

In 1Q 2026, Samsung firmly maintained its top position in the revenue rankings, capitalizing on quarterly contract pricing and a significant increase in server-related bit shipments. Samsung posted US$ 13.51 billion in NAND Flash revenue, marking a staggering 104.7% QoQ increase, while expanding its revenue market share from 28.0% in 4Q 2025 to 31.6%. SK Group (SK hynix and Solidigm) secured second place with about US$ 7.53 billion in revenue (a 44.6% QoQ increase), bringing its market share to 17.6%.

Kioxia delivered a strong performance with revenue climbing 80.0% QoQ to US$ 5.96 billion, retaining its third-place ranking with a 13.9% market share. Micron and SanDisk tied for fourth place, each generating US$ 5.95 billion (reflecting a 96.7% QoQ growth) and both capturing a 13.9% market share.

With Samsung and SK Group's combined performance, Korea's total NAND market share stood at 49.2% in 1Q 2026, maintaining its robust national dominance in the sector. Korea's NAND market position has evolved from single-firm leadership to sustained national dominance, supported by two major players with complementary strengths. While NAND remains more competitive and less concentrated than DRAM, Korea has succeeded in building a durable majority position over time. Korea remains a central pillar of the global NAND ecosystem, combining scale, technology depth, and resilience in an increasingly contested memory landscape (see Table 50).

Table 50. Revenue Rankings of the Top Five NAND Flash Suppliers: 1Q2026

Rank	Company	Revenue (US$ M)	Market Share (%)	2Q 2025	3Q 2025
		1Q26	QoQ (%)	1Q26	4Q25
1	Samsung	13,510.1	104.7%	31.6%	28.0%
2	SK hynix Group	7,533.6	44.6%	17.6%	22.1%
(SK hynix + Solidigm)	7,533.6	5,960.0	80.0%	13.9%	14.1%
3	Kioxia	5,950.0	96.7%	13.9%	12.8%

4	Micron	5,950.0	96.7%	13.9%	12.8%
4	SanDisk	38,903.7	83.7%	90.9%	89.9%
Total of Top 5		21,043.7	n.a.	49.2%	50.1%
KR Share		21,043.7	n.a.	49.2%	50.1%

Notes:
[1] 4Q25 Average Exchange Rate: USD:JPY=1:154.1; USD:KRW=1:1,448.8
[2] 1Q26 Average Exchange Rate: USD:JPY=1:156.9; USD:KRW=1:1,465.6
Source: TrendForce, May 2026

3. Strategy and Policies

Korea is not merely a leading participant in the memory market, but its systemic center of gravity. Korean firms command the largest shares in DRAM, dominate the HBM segment, and retain majority control in NAND. While individual company shares fluctuate and competitive pressure has increased, Korea's aggregate position remains remarkably resilient. In a global semiconductor industry where logic manufacturing leadership is more geographically dispersed, memory stands out as the domain in which Korea exercises enduring, structural leadership rather than temporary advantage.

Nevertheless, the South Korean government is pressing ahead with an ambitious plan to establish a US$ 471 billion semiconductor supercluster in Gyeonggi Province by 2047. The initiative envisages the construction of 16 new fabrication facilities, with total capacity reaching 7.7 million wafers per month by 2030, alongside a target of 50% self-sufficiency in critical semiconductor materials.

Samsung Electronics is expected to anchor the project with US$ 375 billion in investment, including six new fabs in Yongin and Pyeongtaek, while SK hynix will invest US$ 94 billion to build 4 additional facilities. Beyond securing sufficient HBM production capacity, these investments are designed to reduce geopolitical exposure, strengthen supply-chain resilience, and partially insulate Korea's semiconductor industry from US export controls.[57]

Massive Funding & Strategic Investment Programs

In March 2025, South Korea announced the establishment of a major advanced strategic industry fund worth KRW 50 trillion (US$ 37 billion) to support semiconductors and other key sectors, including artificial intelligence, secondary batteries, biotechnology, and future mobility. The fund is designed to provide a comprehensive range of financial support instruments—such as equity investments, subordinated capital, and ultra-low-interest loans—targeting both large corporations and smaller firms within the semiconductor ecosystem.[58]

Beyond this initial fund of KRW 50 trillion (US$ 37 billion), the South Korean government plans to work closely with commercial banks to expand total financial support for advanced industries to more than KRW 100 trillion (US$ 74 billion). This initiative goes well beyond fundraising alone.

57 Victor Hale, "South Korea's Semiconductor Resilience: Strategic Investments and Global Supply Chain Adaptation ," September 21, 2025, https://www.ainvest.com/news/south-korea-semiconductor-resilience-strategic-investments-global-supply-chain-adaptation-2509/?utm_source=chatgpt.com
58 Chosun Biz at https://biz.chosun.com/en/en-inance/2025/03/05/ZA5JSW7R3RGZ5ID5LO3LCSFH4Q

Support mechanisms are expected to include direct equity investments by policy lenders such as Korea Development Bank, as well as the establishment of special purpose corporations (SPCs) jointly created with beneficiary firms, enabling longer-term and more flexible capital participation.

In April 2025, the government further announced plans to increase semiconductor-related investments to safeguard the industry's global competitiveness amid heightened uncertainty following the US tariff announcements. Under this plan, public investment in the semiconductor sector will rise from KRW 26 trillion (US$ 19.3 billion) to KRW 33 trillion (US$ 23.2 billion), with the stated objective of building a "private-led" semiconductor innovation ecosystem.

A significant portion of the additional funding will be directed toward essential infrastructure development. This includes financial support for private companies constructing underground power transmission lines in major semiconductor clusters in Yongin, approximately 40 kilometers from Seoul, and Pyeongtaek, about 65 kilometers south of the capital. Both locations already host multiple fabrication facilities operated by Samsung Electronics and SK hynix. In addition, KRW 3 trillion (US$ 2.2 billion) will be allocated to expand existing low-interest loan programs for the semiconductor industry between 2025 and 2027, raising the total loan support to KRW 20 trillion (US$ 15.4 billion).[59]

The expanded budget will also be used to strengthen human capital. Planned measures include new programs to support domestic workers with doctoral and master's degrees, alongside targeted initiatives to attract overseas experts and top-tier global talent. Taken together, these policies underscore South Korea's determination to reinforce the structural foundations of its semiconductor industry at a time of intensifying geopolitical, technological, and economic uncertainty.

K-Semiconductor Vision and Development Strategy 2047

In December 2025, the South Korean government unveiled its Vision and Strategy for K-Semiconductors in the AI Era, laying out a long-term plan to rebalance the country's semiconductor ecosystem and secure technological leadership beyond memory chips as artificial intelligence reshapes global demand.

Under this mid- to long-term blueprint, Korea plans to invest approximately KRW 700 trillion (US$ 520 billion) by 2047 to strengthen its domestic semiconductor industry. A central objective is to expand the IC design sector tenfold while building what the government describes as one of the world's largest and most integrated semiconductor clusters.

A key pillar of the strategy is government support for the construction of 10 advanced semiconductor fabrication plants by 2047, intended to anchor a clustered ecosystem that brings together fabless design, foundry services, and advanced packaging. This clustering approach aims to tighten value-chain integration and enhance competitiveness in next-generation, AI-driven chips.

Importantly, the strategy does not abandon South Korea's traditional strengths. Memory

59 Yonhap, "Korea to expand investment in chip industry to secure global competitiveness," *Korean Times*, April 15.

technologies—particularly HBM—remain core assets. At the same time, policy emphasis is shifting toward system semiconductors, including neural processing units (NPUs) and processing-in-memory (PIM) solutions, to better position Korean firms in AI hardware markets.

To facilitate large-scale investment and ecosystem development, the government is also considering regulatory adjustments, including the potential easing of long-standing restrictions on the separation of financial and industrial capital—rules that have historically constrained conglomerate financing flexibility in strategic sectors.[60]

The policy package further includes tax incentives and subsidies, such as enhanced tax credits for semiconductor facilities and R&D (for example, 15–25% for plant investment and up to 30–50% for R&D) as well as support for the construction costs of fabrication-related infrastructure, aimed at attracting both domestic and foreign investment.

Overall, these measures reflect South Korea's ambition to position itself among the world's top two semiconductor powerhouses by building a more balanced, innovation-driven industry—one that complements its unrivaled memory leadership with competitive capabilities in system semiconductors tailored to the AI era.

Workforce Development & Talent Attraction

South Korea's semiconductor strategy places significant emphasis on workforce development, recognizing that human capital is as critical as capital expenditure in sustaining global competitiveness. As part of its Vision and Strategy for K-Semiconductors in the AI Era, the Korean government has set an ambitious target to cultivate 150,000 additional semiconductor professionals across all educational levels—from junior colleges to undergraduate and graduate programs—by 2030. To support this goal, Korea plans to expand semiconductor-focused research centers and academic departments, fostering a pipeline of skilled researchers and engineers equipped for advanced chip technologies.

Academic institutions are actively aligning with industry needs to realize this vision. For instance, Sungkyunkwan University, in collaboration with Samsung Electronics, has long maintained a dedicated semiconductor department that integrates foundational device physics, design engineering, and systems integration into its curriculum. Following this model, universities such as Yonsei University have pursued similar partnerships with leading industry players including Samsung and SK hynix. These collaborations are designed to ensure that students receive hands-on project experience and mentorship from industry experts, making them workplace-ready upon graduation.

The intent behind these academic-industry linkages is twofold: to provide students with practical skills directly applicable to contemporary semiconductor challenges, and to strengthen the domestic talent pool so that highly capable engineers and researchers can remain and contribute within Korea's semiconductor ecosystem. Early employment opportunities with partnering firms further reinforce this domestic retention strategy (see Table 51).[61]

60 Yoon Da-bin, "Korea plans $520 billion semiconductor industry expansion," *The Donga Ilbo*, December 11, 2025.
61 Ji-Hoon Kim, Sungyeob Yoo, and Joo-Young Kim, "South Korea's Nationwide Effort for AI Semiconductor Industry," Communications of ACM, July 1,

Table 51. Industry-contracted Semiconductor Departments in Korea's Universities

University	Contracting Company	# of Students	Year of Establishment
Sungkyunkwan University	Samsung Electronics	70	2016
Yonsei University	Samsung Electronics	50	2019
Korea University	SK hynix	30	2021
Sogang University	SK hynix	30	2022
Hanyang University	SK hynix	40	2022
POSTECH	Samsung Electronics	40	2022
KAIST	Samsung Electronics	100	2022
Total		350	

Fabless Startups

Korea has made sustained efforts to cultivate a startup-oriented innovation ecosystem in order to complement—and gradually rebalance—its traditionally conglomerate-led industrial structure. This transition gained institutional momentum with the establishment of the Ministry of SMEs and Startups in 2017, which consolidated government functions related to entrepreneurship, venture finance, and technology commercialization. Policy instruments such as the K-Unicorn Program and the Tech Incubator Program for Startups (TIPS) have since formed the backbone of public support for early-stage and scale-up ventures.

Venture capital investment expanded rapidly under this framework, with annual funding exceeding US$ 6.4 billion in 2021, reflecting both strong policy backing and growing private-sector participation. Within this more favorable environment, more than ten domestic fabless startups focused on AI hardware accelerators have emerged. Unlike large incumbents such as Samsung Electronics and SK hynix, which typically develop next-generation AI products by extending existing product lines and technological platforms, these startups tend to design domain-specific AI accelerators from the ground up, targeting clearly defined application domains.

Empirical observations suggest that these firms can broadly be distinguished by their application focus. Some concentrate on data center workloads, including companies such as FuriosaAI, Rebellions, Sapeon, and HyperAccel, while others emphasize edge AI applications, with examples including OpenEdges, Mobilint, DeepX, and Telechips.

In most cases, chip design is carried out domestically in Korea, while tape-out and fabrication are

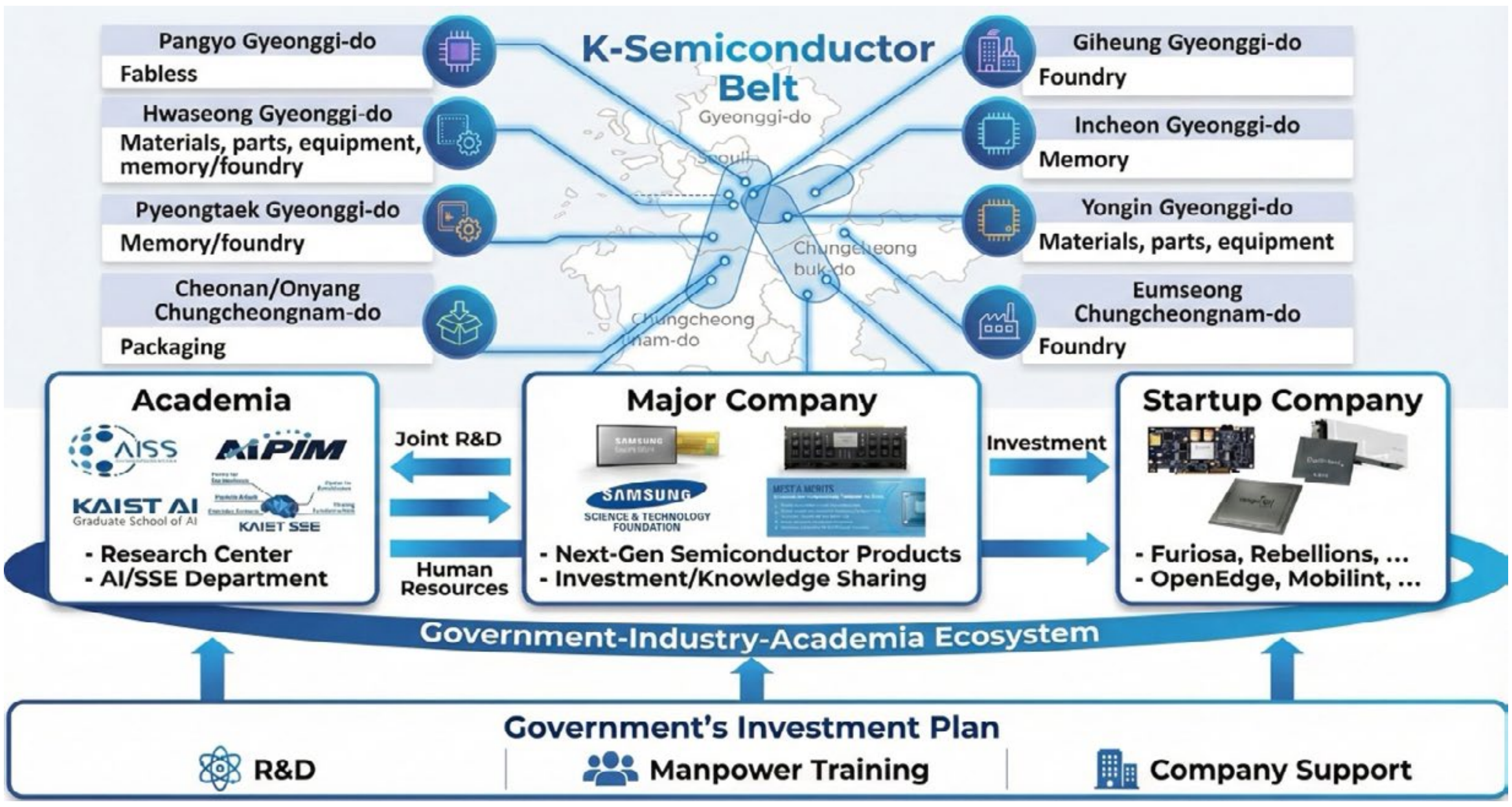
2023.

outsourced to leading foundries such as Samsung Foundry or TSMC. Rather than competing head-on with general-purpose CPUs or GPUs, these startups generally pursue narrow but high-value market niches, where performance efficiency, latency optimization, or workload specialization can offer a defensible competitive edge.

From a market-entry perspective, many of these Korean fabless startups regard the domestic market as a proving ground before expanding overseas. Korea's advanced IT infrastructure, dense deployment of digital services, and early adopter customer base provide a practical testbed for validating AI accelerator performance and use cases. While developed markets such as the United States and Europe remain primary targets for international expansion, firms are also increasingly exploring high-growth emerging markets, including India and Southeast Asia.[62]

In summary, Korea's government is pursuing an assertive, system-wide strategy for semiconductor development. Public capital is being deployed at scale, policies are being actively shaped, and an integrated ecosystem is being built that extends well beyond memory chips. Crucially, the strategy is not government-driven alone; it rests on the coordinated participation of academia, major corporations, and emerging startups, underscoring a comprehensive national mobilization rather than a single-sector policy initiative. The objective is not only to preserve existing advantages, but also to achieve broader semiconductor leadership, enhance supply-chain resilience, and secure strategic positioning in the AI era (Figure 52).

Figure 52. Korea's Nationwide Efforts for the AI Semiconductor Industry



Source: Ji-Hoon Kim, Sungyeob Yoo, and Joo-Young Kim, "South Korea's Nationwide Effort for AI Semiconductor Industry," Communications of ACM, July 1, 2023.

62 Ji-Hoon Kim, Sungyeob Yoo, and Joo-Young Kim, "South Korea's Nationwide Effort for AI Semiconductor Industry," Communications of ACM, July 1, 2023.

4. Updates in 2026 and Prospects

2026 Export Boom & Memory Supercycle

In early 2026, South Korea's semiconductor exports continued their strong momentum, hitting record monthly highs. Driven by expanding demand for AI servers and high-value-added memory, such as HBM and DDR5, semiconductor exports reached US$20.5 billion in January 2026, representing a 102.7% year-over-year increase. This figure further surged to US$25.2 billion in February, marking a 160.8% year-over-year increase. This data-center-driven high-premium market and memory supercycle are expected to extend until at least the third quarter of 2027.

The HBM4 Moment: A New Race for AI Memory Leadership

February 2026 is regarded as a milestone "HBM4 moment" for the Korean semiconductor industry, as SK hynix and Samsung Electronics almost simultaneously announced the start of mass production for the sixth-generation High Bandwidth Memory (HBM4). This iteration introduces a logic-process-based base die for the first time, blurring the boundary between memory and computing units. SK hynix showcased its 16-layer, 48GB HBM4 technology at CES 2026 and, leveraging its deep partnership with NVIDIA, is expected to secure about 70% of the memory orders for NVIDIA's next-generation "Vera Rubin" GPU architecture. Meanwhile, Samsung officially began shipping HBM4 to customers in 1Q 2026, announced a 70% capacity expansion, and is utilizing its vertical integration (IDM) advantage to negotiate customized HBM4 supply chain partnerships with tech giants like Google and Broadcom.

Foundry Battle at 2nm and Future Roadmap

Samsung confirmed it will initiate mass production of its second-generation 2nm process (SF2P) in the second half of 2026. Compared to the first-generation node, SF2P offers significant improvements in performance and power consumption. As of early 2026, Samsung's 2nm GAA process yield has reportedly reached 50%. Boosted by AI chip demand from clients like Tesla, Samsung expects its 2nm-related orders to grow by over 30% year-over-year in 2026. Looking ahead, Samsung announced that the development of its 1.4nm process is progressing on schedule, targeting mass production in 2029.

Semiconductor Special Act and Execution Gaps

The South Korean National Assembly officially passed the Semiconductor Special Act in January 2026, elevating the industry from a simple manufacturing sector to "strategic infrastructure". The Act provides legal backing and expedited administrative approvals for mega-clusters, such as the Yongin cluster, concerning power and water supply. The government also introduced highly competitive tax incentives, offering 20% tax credits for large enterprises' facility investments, 30% for SMEs, and up to 50% for R&D expenditures.

However, the policy's implementation in 2026 faces a transitional gap: the KRW 2 trillion "Semiconductor Special Account," intended as the Act's dedicated funding engine, has been delayed until 2027 due to pending amendments to the National Finance Act. Consequently, 2026 industry support will rely on dispersed general accounts. Furthermore, the industry-backed proposal to exempt semiconductor R&D personnel from the 52-hour workweek limit was excluded from the final legislation, highlighting unresolved friction between national tech competitiveness and domestic labor standards.

Geopolitical Buffer and Geographic Split

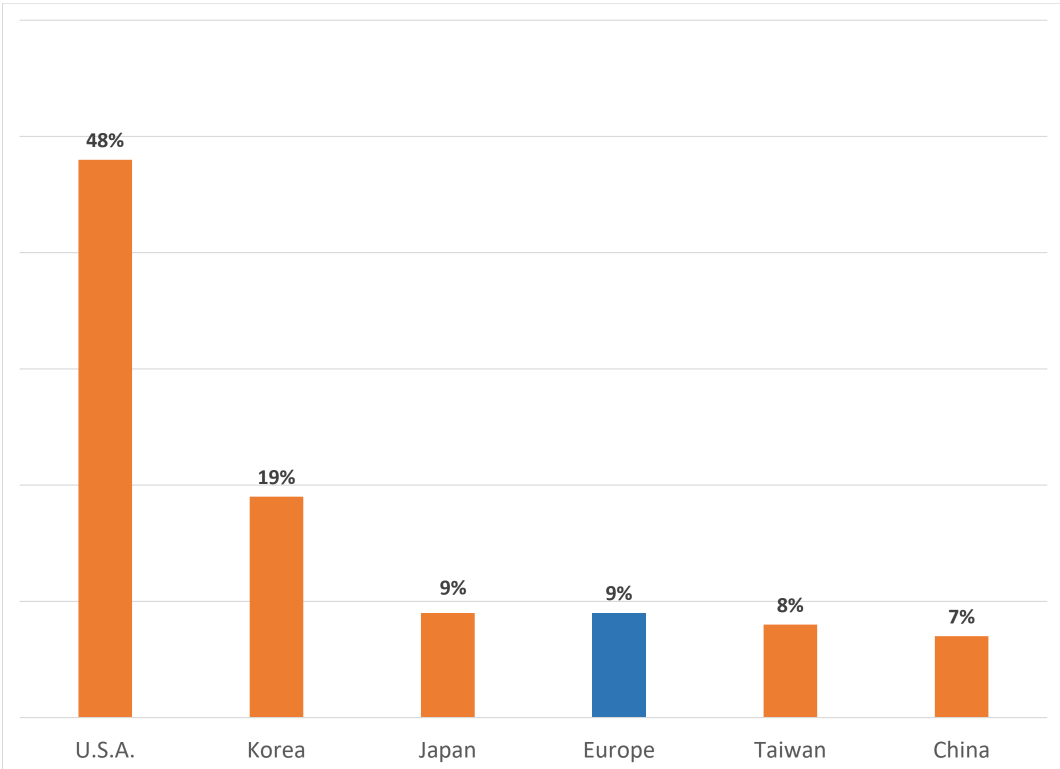
Navigating the US-China tech rivalry, the temporary trade agreement reached in late 2025 provided a buffer for Korean firms operating in China. The US agreed to suspend the implementation of the "BIS affiliate rule" until November 2026, allowing Samsung and SK hynix to temporarily maintain equipment and production lines at their Chinese fabs. Nevertheless, the long-term effects of export controls are forcing Korean companies into geographic capacity segmentation. Facilities in China are gradually transitioning to mature processes or older-generation memory products, while the most advanced HBM4 and 2nm production lines are strictly confined to South Korea and the United States.

VIII. The European Semiconductor Industry

1. Europe in the Global Semiconductor Supply Chain

Europe's share of global semiconductor revenue has experienced a decline over the years. In the 1990s, Europe held a substantial 20% share but stiff competition from North America and Asia (including Taiwan, South Korea, and Japan) has led to the decline in the market share of the European semiconductor industry. By 2022, Europe's share of global semiconductor revenue has fallen to 9% (see Figure 53).

Figure 53. Global Market Share: 2022



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Source: Semiconductor Industry Association, "State of Industry Report," July 27, 2023.

Despite Europe's relatively smaller global market share, it is still an important player in the global semiconductor supply chain. Europe has established itself as a leader in optoelectronics, producing components essential for communication technologies, healthcare and lighting solutions. In addition, European companies excel in developing sensors for automotive, industrial, and consumer applications.

In 2023, Europe's semiconductor industry generated US$ 55.8 billion, accounting for 10.6% of global semiconductor revenue. As the global market entered a strong rebound phase in 2024, WSTS data show that Europe moved in the opposite direction: its revenue declined to US$ 51.3 billion, and its global market share fell markedly to 8.1%. This sharp drop reflects Europe's limited exposure to the main drivers of the global upcycle, particularly advanced logic and memory linked to AI-related demand.

Looking ahead, WSTS estimates for 2025 suggest that while Europe's semiconductor revenue will recover to around US$ 54.69 billion, its global market share is nonetheless expected to decline further to approximately 7.0%. This indicates that Europe's growth, though positive, is insufficient to keep pace with the much faster expansion of the global market.

Furthermore, WSTS forecasts for 2026 point to a continuation of this trend. Even with Europe's market projected to grow to US$ 86.64 billion (a 58.4% increase), its global share is forecast to fall again, to about 6.2%. In other words, Europe is set to gain in absolute size while steadily losing relative ground.

Taken together, the WSTS statistics and forecasts underscore a structural challenge: Europe's semiconductor industry is recovering, but it is doing so within a rapidly expanding global market from which it is capturing an ever smaller share. The steady erosion of Europe's global position—from 10.6% in 2023 to a projected 6.2% by 2026—highlights the growing gap between Europe and the regions that dominate the core engines of semiconductor growth.

Moreover, European semiconductor companies have maintained a long-standing but evolving presence among the world's top semiconductor vendors. Philips ranked among the global top 10 for many years, including 1990 and 2000, reflecting Europe's earlier strength in vertically integrated electronics and consumer-oriented semiconductor production. However, this era came to a close when Philips spun off its semiconductor business in 2006, creating NXP Semiconductors as an independent company. While NXP has since established a strong position in automotive and industrial semiconductors, it has not ranked among the global top 10 vendors, underscoring the structural shift in Europe's semiconductor landscape.

In the post-Philips era, Europe's representation in the top tier has rested primarily on STMicroelectronics and Infineon, though with noticeable fluctuations. STMicroelectronics entered the global top 10 in 2010, dropped out in 2020, and then re-entered in 2023, reflecting the cyclical nature of automotive and industrial demand. Infineon, meanwhile, was absent from the top 10 in 2010, rose into the ranking by 2020, and then fell out again in 2023, highlighting both revenue volatility and intensifying global competition.

Taken together, these developments point to a clear pattern: Europe's leading semiconductor firms remain globally relevant, but their positions among the top vendors are intermittent rather than entrenched. Unlike U.S. and Asian peers that dominate scale-driven segments such as advanced logic and memory, European firms have carved out influence in automotive, power electronics, and industrial applications—areas where technological specialization and system integration matter more than sheer volume, but where sustained top-10 scale remains difficult to achieve (see Table 52).

Table 52. Top 10 Semiconductor Vendors by Revenue: 1990-2023

	1990	2000	2010	2020	2023
1	NEC (Japan)	Intel (U.S.)	Intel (U.S.)	Intel (U.S.)	Intel (U.S.)
2	Toshiba (Japan)	Toshiba (Japan)	Samsung (South Korea)	Samsung (South Korea)	Samsung (South Korea)
3	Hitachi (Japan)	NEC (Japan)	Toshiba (Japan)	SK Hynix (South Korea)	Qualcomm (U.S.)

4	Intel (U.S.)	Samsung (South Korea)	Texas Instruments (U.S.)	Micron (U.S.)	Broadcom (U.S.)
5	Motorola (U.S.)	Texas Instruments (U.S.)	Reneasas* (Japan)	Qualcomm (U.S.)	NVIDIA (U.S.)
6	Fujitsu (Japan)	Motorola (U.S.)	SK Hynix (South Korea)	Broadcom (U.S.)	SK Hynix (South Korea)
7	Mitsubishi (Japan)	STMicroelectronics (Europe)	STMicroelectronics (Europe)	NVIDIA (U.S.)	Advanced Micro Devices (U.S.)
8	Texas Instruments (U.S.)	Hitachi (Japan)	Micron (U.S.)	Texas Instruments (U.S.)	STMicroelectronics (Europe)
9	Philips (Europe)	Infineon (Europe)	Qualcomm (U.S.)	Apple (U.S.)	Apple (U.S.)
10	Matshishita (Japan)	Philips (Europe)	Elpida** (Japan)	Infineon (Europe)	Texas Instruments (U.S.)
	Dropped out of top 10:	Fujitsu Mitsubishi Matsushita	Motorola Hitachi Infineon Philips***	Renesas STMicroelectronics Elpida	Micron Infineon

Note: Ranking based on global semiconductor sales excluding pure-play foundries.
* Post NEC/Renesas merger.
** Combination of NEC, Hitachi, and Mitsubishi DRAM business.

Source: Ramiro Palma, Raj Varadarajan, Jimmy Goodrich, Thomas Lopez, and Aniket Patil, "The Growing Challenge of Semiconductor Design Leadership," Boston Consulting Group, November 30, 2022. P. 12; Gartner, Press Release: "Gartner Says Worldwide Semiconductor Revenue Declined 11% in 2023," January 16, 2024.

In addition, the world's 30 largest semiconductor companies accounted for approximately US$ 684.5 billion, or about 75% of global semiconductor and semiconductor manufacturing service revenue, in 2022, underscoring the high degree of concentration in the industry. Within this group, three European integrated device manufacturers (IDMs)—STMicroelectronics, Infineon, and NXP Semiconductors—ranked among the global top 30.

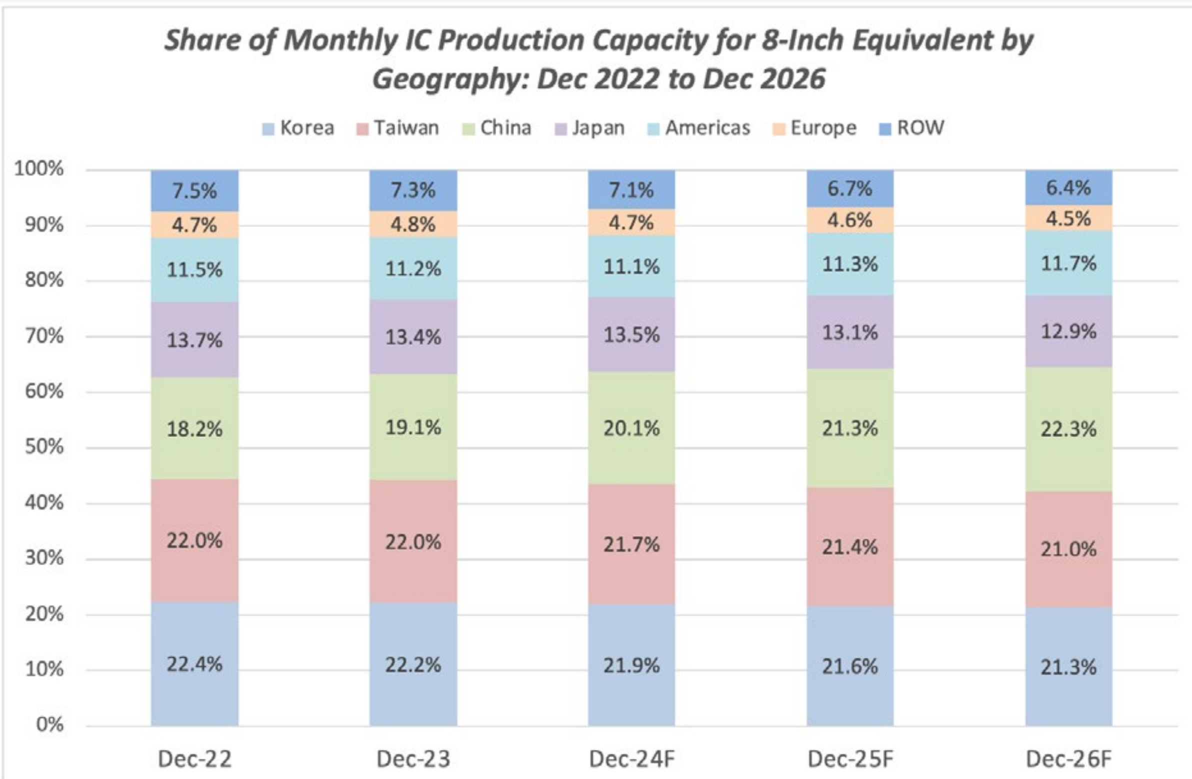
Together, these firms represented 6.6% of the revenue of the world's 30 largest semiconductor companies, generating a combined US$ 45.1 billion in 2022. While this confirms Europe's continued presence at the upper end of the global semiconductor value chain, it also highlights the relatively modest scale of its leading players compared with their U.S. and Asian counterparts.

A rebound in IC demand emerged in the latter part of 2023 and is expected to extend through 2024–2026, supported by a renewed global investment cycle. According to Knometa Research, worldwide wafer capacity for IC production is projected to grow by 4.5% year-over-year by December 2024, followed by faster expansion of 8.2% in 2025 and 8.9% in 2026.

Against this backdrop of accelerating global capacity growth, Europe's relative position remains broadly flat to slightly declining. Europe's share of global monthly IC production capacity (in 8-inch equivalent wafers) edged up marginally from 4.7% in December 2022 to 4.8% in December 2023, reflecting limited capacity additions during the early phase of the recovery. However, this uptick proves temporary. Forward-looking projections show Europe's share slipping back to 4.7% in December 2024, before declining further to 4.6% in 2025 and 4.5% by December 2026.

In other words, while Europe's IC manufacturing capacity continues to expand in absolute terms, it does so at a slower pace than the global average. As capacity additions accelerate elsewhere—particularly in Asia—Europe's share of global wafer capacity gradually erodes. The data thus suggest that Europe is participating in the upcycle, but not keeping pace with it, resulting in a steady, if modest, loss of relative manufacturing weight over the medium term (see Figure 54).

Figure 54. Share of Monthly IC Production Capacity for 8-Inch Equivalent by Geography: Dec 2022 to Dec 2026



Source: Knometa Research, Global Wafer Capacity 2024, February 29, 2024.

Figure 40 illustrates the global distribution of monthly 8-inch equivalent IC production capacity across pure-play foundries, IDMs, and other semiconductor firms by geography in 2023, distinguishing between production bases and headquartered bases.

Despite Europe's strong downstream demand—particularly from the automotive and industrial sectors—its manufacturing footprint in the global semiconductor landscape remains limited. In 2023, Europe accounted for less than 5% of global IC production capacity on both measures. Specifically, Europe represented about 4.8% of production-base capacity, reflecting fabs located within Europe regardless of ownership, and approximately 4.9% of headquartered-base capacity, which includes worldwide fabs operated by Europe-headquartered semiconductor companies.

This near parity between production-base and headquarters-based shares underscores a key structural characteristic of Europe's semiconductor industry: European firms tend to manufacture largely within Europe, but the overall scale of both domestic capacity and overseas manufacturing networks remains modest relative to Asia and the Americas. As a result, while Europe plays a critical role in high-value applications, its share of global wafer production capacity in 2023 remains small and broadly unchanged, reinforcing the gap between Europe's demand-side importance and its supply-side presence.

2. Strategy and Policies

As digitalization accelerates and global demand for chips continues to expand rapidly, semiconductors have moved to the centre of geostrategic competition and the global technological race. Recognizing both the economic and security implications of this shift, Europe has stepped up efforts to enhance its competitiveness and resilience within the global semiconductor supply chain. In recent years, the European Commission, together with national governments, has rolled out a series of ambitious strategies and investment programs aimed at strengthening semiconductor manufacturing capacity and research and development across the region.

Central to this effort is the European Chips Act, introduced in February 2022 and in force since September 2023. The Act mobilizes up to € 43 billion (US$ 47 billion) in targeted public support for Europe's semiconductor ecosystem and consolidates previously fragmented initiatives into a single, coherent framework built around three pillars.

The first pillar, the Chips for Europe Initiative, seeks to leverage Europe's existing strengths in research and innovation and translate them into new manufacturing capabilities. The second pillar establishes a new framework to secure supply, primarily by attracting investment and expanding production capacity within Europe. The third pillar introduces a coordination mechanism between the European Commission and Member States to monitor semiconductor supply, assess demand, and anticipate potential shortages.

Given the semiconductor industry's highly capital- and knowledge-intensive nature, the Chips Act—supported by the Chips Fund—aims to ease companies' access to financing, accelerate investment in advanced manufacturing technologies and chip design, and ultimately improve the security of supply across the value chain. As of July 2024, the initiative is reported to be on track to attract more than € 100 billion (US$ 108.4 billion) in private investment into Europe's semiconductor sector by 2030.

Following the launch of the Chips Act in 2022, a number of major semiconductor firms—including STMicroelectronics, GlobalFoundries, TSMC, Intel, onsemi, Infineon and Wolfspeed—have announced plans to build or expand chip manufacturing facilities in Europe. Together, these projects signal a concerted effort to reposition Europe as a more significant player in global semiconductor production, even as intense competition for investment and technological leadership continues worldwide (see Table 53).

Table 53. European Union's Semiconductor Policy

Guidance	**Target**	**Gain 20% of global semiconductor market share (in terms of revenue) by 2030.**
	Policy	**European Chips Act** Aims to strengthen Europe's semiconductor ecosystem. Five strategic objectives are: Strengthen research and technological leadership; Build and reinforce Europe's capacity to innovate in the design, manufacturing and packaging of advanced chips; Put in place an adequate framework to increase production by 2030; Address skills shortage and attract new talent; Develop an in-depth understanding of global semiconductor supply chains. **2030 Digital Compass** Sets the course for Europe's digital decade. Three goals specific to semiconductors are: Capacity Building: Increasing Europe's semiconductor production of cutting-edge and sustainable semiconductors, including processors. Innovation: Fostering technological advancements and innovation in semiconductor technologies. Resilience: Enhancing Europe's resilience in semiconductor supply chains .
Measures	**Key Incentive Amounts**	Up to € 43 billion (US$ 47 billion)
	Key Initiatives	• Grants and loans under EU Chips Act • Tax credits • Member State aid allowances

Outcome	**Announcements on Key Investments To Boost Domestic Production**	• **STMicroelectronics (Switzerland):** EU approval for a € 5 billion (US$ 5.4 billion) silicon carbide plant in Italy. • **STMicroelectronics (Switzerland) and GlobalFoundries (U.S.):** EU approval for a € 7.4 billion (US$ 8.0 billion) fab plant in Crolles, France by STMicroelectronics and GlobalFoundries. Targeted to reach full capacity by 2026, with up to 620,000 of 300mm diameter wafers per year of production at a size of 18 nm. • **TSMC (Taiwan):** Plans for € 7.4 billion (US$ 8.0 billion) fab plant in Dresden, Germany, together with car chip makers Robert Bosch, NXP, and Infineon. The plant is expected to have a monthly production capacity of 40,000 300 mm (12-inch) wafers on TSMC's 28/22 nm planar CMOS and 16/12 nm FinFET process technology. • **Intel (U.S.):** Plans for € 30 billion euros (US$ 32.5 billion), including US$ 11 billion in state aid, to develop two chip-making plants in Magdeburg, Germany. Intel's German fab is poised to be the most advanced in the world and make 1.5 nm chips. • **Onsemi (U.S.):** Plans to invest up to US$ 2 billion in expanding its operations to produce intelligent power semiconductors in the Czech Republic, pending EU approval. • **Infineon (Germany):** on track to complete a € 5 billion (US$ 5.4 billion) power chip plant in Dresden by 2026, despite not yet having EU aid approval. • **Wolfspeed (U.S.):** Plans to invest US$ 3 billion on a 200 mm silicon carbide (SiC) wafer fab and an R&D center with German automotive supplier ZF in Saarland, Germany. Automotive supplier ZF Friedrichshafen will invest US$ 185 million for a stake in the chip fab and will take a majority stake in the research centre.

Note:
() indicates headquarter location.
Currency Exchange Rate: US$ 1 = € 0.9224
The Table is updated until June 2024.

In July 2023, Germany's economy ministry announced the country's plans to invest around € 20 billion (US$ 22.15 billion) in the semiconductor industry in the coming years. With its big spending, Germany is expected to host the largest semiconductor factories. In Dresden, TSMC will set up its first European factory by 2027, in collaboration with Dutch NXP Semiconductors and German Infineon and Bosch. With German state subsidies, TSMC committed US$ 3.8 billion for the US$ 11 billion factory.

Likewise, Germany did not hesitate to subsidize U.S. Intel with another € 9.9 billion (US$ 11 billion) for a total investment of € 30 billion (US$ 33.2 billion) in Magdeburg. Intel's factory will be the largest semiconductor production facility in Europe and, if the construction and tool installation are expedited, is expected to be operational by late 2027 or early 2028.

After failing to convince Intel's then CEO Pat Gelsinger to invest in France, French President Emmanuel Macron, granted € 2.9 billion (US$ 3.1 billion) for the construction of a new semiconductor factory by STMicroelectronics near Grenoble. The total cost of this investment reaches € 7.4 billion (US$ 7.9 billion), with the remainder covered by U.S.-headquartered GlobalFoundries.

3. Updates in 2025-2026 and Prospects

Strategic Reassessment and the Transition toward "Chips Act 2.0"

By 2025–2026, Europe's semiconductor sector had reached a critical strategic inflection point. Early ambitions to rapidly expand manufacturing capacity were increasingly tempered by a more pragmatic recognition of Europe's structural position in the global semiconductor ecosystem. Rather than pursuing sheer production scale, policymakers have begun to emphasize ecosystem resilience, technological indispensability, and supply-chain security.

Market data illustrates the structural constraints facing Europe. According to estimates by the World Semiconductor Trade Statistics (WSTS), Europe's share of the global semiconductor market is expected to decline to roughly 7.0% in 2025 and could fall further to about 6.2% in 2026. These trends highlight the difficulty of achieving the original objective set in 2021–2022—namely, raising Europe's global market share to 20% by 2030. In its 2025 report, the European Court of Auditors explicitly characterized this target as "highly unlikely," projecting instead that Europe's share may reach only about 11.7% by the end of the decade.

Despite these structural limitations, Europe continues to occupy critical positions within the global semiconductor value chain. Companies such as ASML maintain near-monopoly leadership in advanced lithography systems, while European firms remain globally competitive in automotive, analog, and power semiconductors. These technological strengths have reinforced the growing perception among European policymakers that semiconductor capabilities are closely tied to economic sovereignty and industrial security.

Recognizing the gap between political ambition and industrial reality, the European Commission and member states began reassessing the implementation of the European Chips Act in 2025. Policy thinking gradually shifted away from crisis-driven capacity expansion toward a longer-term strategy focused on supply-chain resilience and strategic indispensability.

This reassessment culminated in proposals for a revised framework widely referred to as "Chips Act 2.0." Discussions intensified after the Semicon Coalition—comprising representatives from all 27 EU member states—released a policy manifesto in September 2025 advocating a new strategic orientation. Rather than focusing narrowly on achieving a specific market share target, the manifesto proposed three guiding principles: prosperity, indispensability, and resilience.

Public consultations conducted by the European Commission between September and November 2025 generated more than 200 stakeholder submissions. Four key policy directions emerged from this process:

1. shifting from a narrow self-sufficiency objective toward positioning Europe as a critical partner in global semiconductor value chains, particularly in automotive, industrial automation, and sensing technologies;

2. expanding policy support upstream to include chip design, intellectual property, RISC-V architectures, photonics, and other areas bridging the "lab-to-fab" gap;
3. broadening supply-chain security policies to include critical raw materials and industrial gases; and
4. improving implementation mechanisms through streamlined state-aid approval procedures, the creation of a dedicated semiconductor budget within the European Competitiveness Fund, and an expanded definition of "First-of-a-Kind" (FOAK) facilities to include equipment and materials suppliers.

The European Commission is expected to publish a formal evaluation report in early 2026, which will likely serve as the policy foundation for the next phase of the Chips Act.

Divergent Industrial Outcomes and Capacity Expansion

Industrial developments during 2025–2026 reveal a dual-track trajectory. On one track, investments focused on mature nodes and specialized technologies have progressed steadily, reinforcing Europe's traditional industrial strengths. On the other, several highly ambitious leading-edge projects have encountered significant obstacles.

One of the most prominent developments is the European Semiconductor Manufacturing Company (ESMC) in Dresden—a €10 billion joint venture led by TSMC in partnership with Bosch, Infineon, and NXP. Following groundbreaking in August 2024, construction advanced steadily through 2025. Equipment installation is expected to begin in the second half of 2026, with production scheduled for 2027. The facility will manufacture chips at the 28/22nm and 16/12nm nodes, which are essential for Europe's automotive and industrial sectors.

Additional investments have reinforced this industrial ecosystem. Infineon is building a €5 billion power-semiconductor fabrication plant in Dresden, while STMicroelectronics is expanding its integrated silicon-carbide (SiC) campus in Catania, Italy. Meanwhile, the €3.2 billion Silicon Box investment in Novara is establishing a major advanced packaging hub, reflecting the growing strategic importance of backend manufacturing for high-performance computing and AI applications.

In contrast, attempts to establish ultra-advanced logic manufacturing in Europe have faced substantial difficulties. Intel's planned €30 billion "megafab" in Magdeburg—once considered central to Europe's ambition to host leading-edge manufacturing—was canceled in mid-2025 due to financial constraints, market uncertainty, and concerns over global overcapacity. Similarly, Wolfspeed indefinitely suspended construction of its planned 200mm SiC wafer facility in Saarland, Germany, although the company later undertook a strategic restructuring agreement with Renesas in early 2026.

These developments have intensified debate within Europe regarding the appropriate balance between subsidizing advanced logic manufacturing and strengthening areas where Europe already holds competitive advantages (see Table 54).

Table 54. Progress of Semiconductor Investment and Production in Europe: 2025

Project / Company	Location	Technology / Focus	Investment	Status & Milestones
ESMC (TSMC, Bosch, Infineon, NXP)	Dresden, Germany	28/22nm & 16/12nm (Automotive/ Industrial)	€ 10 billion	Groundbreaking in 2024; structural construction in 2025; production starts 2027.
Infineon	Dresden, Germany	Power semiconductors	€ 5 billion	Set to open in 2026.
GlobalFoundries	Dresden, Germany	Capacity expansion	€ 1.1 billion	Complementary investment encouraged by ESMC project.
Silicon Box	Novara, Italy	Leading-edge packaging hub	€ 3.2 billion	Strategic for high-performance computing and AI applications.
STMicroelectronics	Catania, Italy	Silicon-carbide (SiC) campus	n.a.	Integrated facility (substrate to fabrication) for EV supply chain.
Intel	Magdeburg, Germany	Advanced manufacturing	€ 30 billion	Canceled (mid-2025) due to financial and market pressures.
GlobalFoundries	Crolles, France	Capacity expansion	n.a.	Progress slowed due to market condition adjustments.

Technological Frontiers: R&D Infrastructure and Advanced Packaging

Even as large-scale advanced logic manufacturing remains limited, Europe continues to consolidate its position as a global hub for semiconductor research, equipment development, and advanced manufacturing technologies.

A major milestone occurred on February 9, 2026, when imec inaugurated the NanoIC pilot line in Leuven, Belgium. Supported by approximately €700 million in EU funding and equipped with ASML's next-generation High-NA EUV lithography systems, NanoIC is designed to support sub-2nm and beyond-2nm research. The facility will also provide Process Design Kits (PDKs) to help European fabless companies and SMEs access advanced semiconductor design capabilities.

Complementing this initiative, the FAMES pilot line was launched on January 30, 2026 to provide 10nm and 7nm PDKs for ultra-low-power FD-SOI technologies. Together, these research platforms aim to bridge the gap between academic research and industrial manufacturing.

Advanced packaging has also emerged as a major policy priority. Technological progress in 2026 included imec's demonstration of hybrid bonding with a 20-micron pitch, Amkor's evaluation of glass substrates for AI and high-performance computing applications, and GlobalFoundries' development of Co-Packaged Optics (CPO) technologies in Dresden to reduce data-center latency.

In addition, STMicroelectronics entered high-volume production of its PIC100 silicon photonics platform in early 2026, enabling optical interconnect speeds of 800G and 1.6T for hyperscale AI data centers.

Structural Drivers: Automotive Electrification and AI Power Infrastructure

Europe's semiconductor demand remains closely tied to its industrial structure. The automotive sector continues to serve as the primary driver, particularly as vehicle architectures shift toward software-defined vehicles (SDVs) and 800-volt battery systems. These developments significantly increase demand for power semiconductors, especially silicon-carbide traction inverters.

While Europe does not dominate the design of advanced AI processors, it plays a crucial role in the power-management infrastructure supporting AI computing. Infineon, for example, is projected to generate approximately €1.5 billion in AI-related power-management revenue in 2026, driven largely by silicon-carbide modules used in hyperscale data-center power systems.

Meanwhile, the industrial sector is increasingly adopting "Physical AI" applications. Companies such as NXP have integrated neural-processing units (NPUs) into application processors like the i.MX 952 to enable real-time edge inference in factory automation and robotics.

Structural Vulnerabilities and Long-Term Outlook

Despite these strengths, Europe's semiconductor strategy faces persistent challenges. The most significant internal constraint is the shortage of skilled labor. Estimates suggest that Europe could face a shortfall of roughly 75,000 semiconductor professionals by 2030.

To address this gap, imec launched the CMOS 2.0 consortium in March 2026, bringing together 26 European universities to jointly fund doctoral training programs and share access to the NanoIC pilot line. Meanwhile, Dresden has introduced English-language vocational training programs aimed at attracting international talent.

Externally, geopolitical risks remain a major concern. Export restrictions by China on critical materials—including gallium, germanium, and graphite—highlight Europe's vulnerability in upstream supply chains. At the same time, persistently high energy prices continue to weigh on the economic viability of semiconductor manufacturing in Europe.

Nevertheless, Europe retains several strategic advantages. Its dominance in lithography equipment led by ASML, its world-class research institutions such as imec, and its deep industrial integration in automotive and power electronics provide a foundation for long-term competitiveness. Rather than pursuing unrealistic production targets, Europe is increasingly positioning itself as an indispensable technological partner within the global semiconductor value chain.

IX. Singapore's Semiconductor Industry

1. Singapore in the Global Semiconductor Supply Chain

In 2022, the distribution of value-added across the global semiconductor value chain underscored the concentration of technological and economic power in a handful of regions. The United States led decisively, accounting for 38% of total value-added, followed by Japan and South Korea at 12% each. Taiwan, the European Union, and China each contributed 11%, while the remaining 5% was attributed to the "Rest of the World" (ROW) category (see Table 18). Although comparatively small in aggregate terms, ROW economies—including Singapore, India, Israel, and Malaysia—play indispensable roles in specific segments of the semiconductor value chain, such as manufacturing, assembly, testing, and equipment-related activities.

Within this group, Singapore occupies a particularly notable position. According to the Singapore Economic Development Board (EDB), the city-state is "already an integral part of the global semiconductor supply chain," accounting for around 10% of all chips produced worldwide and approximately 20% of global semiconductor manufacturing equipment production, as reported in August 2024.[63] This highlights Singapore's outsized functional importance relative to its geographic and demographic scale.

Singapore is also the world's primary production base for NAND flash memory, with Micron producing 98% of its NAND chips in the country. To meet the long-term demand for advanced memory solutions, Micron recently announced an investment of over S$ 30 billion (approx. US$ 22.3 billion) to build its first dual-layer wafer fab in Singapore, which is expected to create 1,600 jobs and commence production in the second half of 2028. In addition, Taiwan's United Microelectronics Corporation (UMC) is set to begin mass production in Singapore, further elevating the country's wafer capacity and solidifying its position in the global AI supply chain.

Nonetheless, capacity-based indicators tell a more constrained story. Korea, Taiwan, and China dominate global 200 mm wafer capacity, each contributing roughly 20% of global monthly capacity between December 2022 and December 2026. Over this period, the Americas and China are projected to expand their shares further, while the ROW category—including Singapore, Israel, Malaysia, and India—is expected to experience a gradual decline in its share of global wafer capacity.

This trend is even clearer when measured in 8-inch equivalent IC production capacity. In December 2022, ROW accounted for 7.5% of global monthly capacity; by December 2026, this figure is projected to fall to 6.4%. Despite Singapore's technological sophistication and strong integration into global supply chains, its production scale—embedded within the ROW category—remains modest compared with the major semiconductor-producing regions of Korea, Taiwan, China, Japan, the Americas, and Europe. The

63 "What makes Singapore a prime location for semiconductor companies driving innovation?" Economic Development Board, August 20, 2024.

data thus highlight the growing challenge for smaller but advanced players to expand capacity share amid accelerating investment elsewhere (see Figure 51).

Looking further ahead, the global semiconductor industry is undergoing a rebalancing of fab capacity shares alongside overall capacity expansion. The United States is projected to increase its share of global semiconductor manufacturing capacity from 10% in 2022 to 14% by 2032, driven largely by policy support under the CHIPS and Science Act. South Korea is also expected to strengthen its position, with its share rising from 17% to 19% over the same period. In contrast, China, Taiwan, Japan, and the “Others” category are projected to see a relative decline in their shares of global capacity .

The implications for smaller economies are clear. The “Others” category—which includes Singapore, India, and Malaysia—accounted for about 7% of global monthly 8-inch equivalent semiconductor capacity in 2022, but this combined share is expected to decline to around 5% by 2032. These shifts underscore both the increasing concentration of manufacturing scale in policy-supported major economies and the structural constraints faced by smaller players, even those that remain strategically vital to the global semiconductor ecosystem (see Figure 29).

Singapore’s economy is highly open and trade-dependent, a structure that underpins its critical role in the global semiconductor supply chain as both a major importer and exporter. According to the McKinsey Global Institute, 6% of all finished chips traded globally in 2022 originated from Singapore, with a total trade value of approximately US$ 66 billion, ranking Singapore fifth worldwide, behind Taiwan, South Korea, China, and Malaysia (see Table 55).

Table 55. Total Value and Share of World’s Top 10 Sources of Finished Chips: 2022

Rank	Country/ Territory	Share (%)	Value (US$ billion)
1	Taiwan	31	364
2	South Korea	15	183
3	China	14	165
4	Malaysia	9	102
5	**Singapore**	**6**	**66**
6	Japan	5	61
7	United States	4	50
8	Philippines	3	36
9	Vietnam	3	32
10	Thailand	2	28

Source: "Top trading partners in components – chips in 2022," McKinsey Global Institute, Accessed September 12, 2024.

Singapore is equally significant as a destination within global semiconductor trade flows. In 2022, it ranked fourth among the top 10 export destinations for finished chips, accounting for 6% of global exports valued at around US$ 64 billion. This placed Singapore just behind China, Hong Kong, and Taiwan as a key hub for semiconductor trade and redistribution (see Table 56).

Table 56. Total Value and Share of World's Top 10 Export Destinations of Finished Chips: 2022

Rank	Country/Territory	Share (%)	Value (US$ billion)
1	China	33	356
2	Hong Kong SAR	18	197
3	Taiwan	7	78
4	Singapore	6	64
5	South Korea	5	58
6	Vietnam	5	50
7	Malaysia	4	47
8	United States	3	34
9	Japan	3	32
10	Germany	2	19

Source: "Top trading partners in components – chips in 2022," McKinsey Global Institute, Accessed September 12, 2024.

Within Southeast Asia's increasingly diversified semiconductor ecosystem, Singapore stands out as the region's most advanced and strategically indispensable node. It functions not only as a manufacturing base, but also as a centre for high-value production, research and development, and global supply-chain coordination for many of the world's leading semiconductor firms.

Major integrated device manufacturers (IDMs) such as Infineon Technologies, Micron Technology, and STMicroelectronics have established substantial operations in Singapore. Micron and Infineon operate advanced memory and power semiconductor facilities that encompass both front-end fabrication and back-end processing, while STMicroelectronics relies on its Singapore operations to support global production of analog and mixed-signal devices.

Although other ASEAN economies—most notably Malaysia and Vietnam—play important roles in the regional semiconductor supply chain, their strengths are largely concentrated in mature-node manufacturing, assembly, and testing. In contrast, the most complex, capital-intensive, and technologically demanding activities continue to gravitate toward Singapore, drawn by its reliable infrastructure, strong intellectual property protection, and deep engineering talent pool.

This comparative advantage extends to the assembly, testing, and packaging (ATP) segment. While Malaysia remains a global leader in semiconductor packaging, Singapore has carved out a critical niche in high-precision and premium packaging technologies. Companies such as ASE, JCET, and UTAC operate major facilities in Singapore, serving customers—particularly in the automotive and industrial sectors—

whose products require exceptionally high reliability and stringent quality standards. Singapore's capacity to support high-mix, high-complexity production distinguishes it within the regional ATP landscape.

Singapore's role is even more pronounced in the foundry segment. According to Mordor Intelligence, Singapore's semiconductor foundry market is valued at US$ 4.13 billion in 2025 and is projected to reach US$ 6.30 billion by 2030, expanding at an 8.9% CAGR. The market is heavily driven by mature nodes, with 28 nm processes holding a 31.3% revenue share, and 300 mm wafers accounting for 66.6% of the national output to meet robust automotive and industrial demand.[64]

Front-end wafer-fabrication capacity in ASEAN is overwhelmingly concentrated in Singapore, where GlobalFoundries operates one of its largest 300 mm fabs, alongside substantial wafer-fabrication operations by UMC. This position has been further reinforced by the establishment of VSMC, a joint venture between VIS and NXP Semiconductors, which is investing up to US$ 7.8 billion in a 300 mm specialty foundry in Singapore to serve automotive, industrial, and mixed-signal applications.

No other ASEAN country hosts foundry facilities of comparable scale, technological sophistication, or ecosystem depth. Collectively, these investments position Singapore as the indispensable hub for front-end semiconductor manufacturing in Southeast Asia—anchoring advanced logic and specialty process capacity while linking global foundry leaders with downstream regional and international demand.

Across ASEAN, semiconductor activities are widely distributed—Malaysia dominates packaging, Vietnam is rapidly expanding assembly capacity, and the Philippines occupies specialised ATP niches. Yet Singapore remains the region's technological anchor, uniquely capable of supporting the full spectrum of high-value manufacturing, advanced foundry operations, and premium packaging services. Its combination of industrial capability, institutional reliability, and strategic depth ensures that Singapore will continue to function as Southeast Asia's most critical semiconductor hub in the global semiconductor ecosystem (see Table 57).

Table 57. Major Semiconductor Manufacturers' Manufacturing Base in Southeast Asia

EXPERTISE	SEMICONDUCTOR COMPANY	MANUFACTURING BASE
Integrated Device Manufacturing	Infineon Technologies	Singapore, Malaysia, Indonesia
	Intel	Malaysia, Vietnam
	Micron Technology	Singapore, Malaysia
	Texas Instruments	Malaysia, Philippines
	STMicroelectronics	Singapore, Malaysia

64 "Singapore Semiconductor Market Size & Share Analysis - Growth Trends and Forecast (2025 - 2030)," https://www.mordorintelligence.com/industry-reports/singapore-semiconductor-market, accessed March 4, 2026.

EXPERTISE	SEMICONDUCTOR COMPANY	MANUFACTURING BASE
Assembly, Testing and Packaging	Advanced Semiconductor Engineering (ASE)	Malaysia, Singapore
	Jiangsu Changjiang Electronics Technology (JCET)	Singapore
	Amkor Technology	Malaysia, Philippines
	UTAC Holdings	Singapore, Thailand, Indonesia
Foundry	GlobalFoundries	Singapore
	United Microelectronics Corporation	Singapore
	VIS+NXP	Singapore

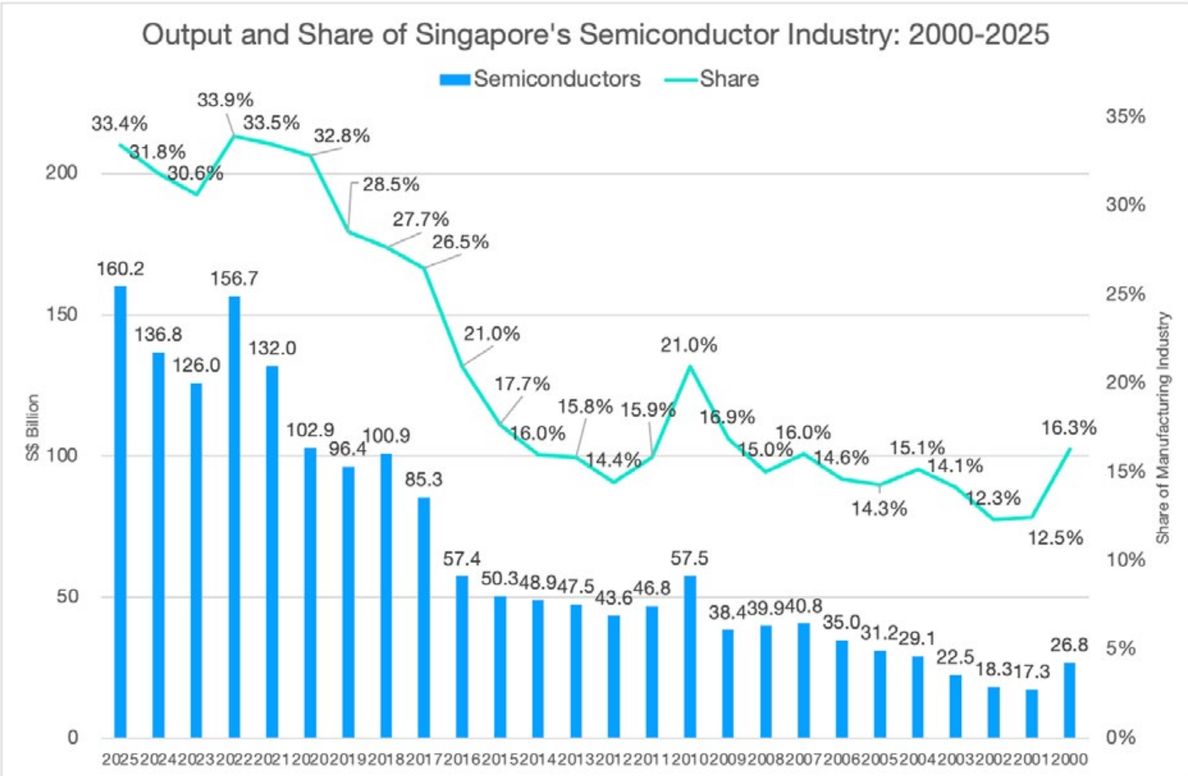
2. Current Status of Singapore's Semiconductor Industry

Amid recurring global semiconductor cycles and the ongoing restructuring of supply chains, Singapore's semiconductor industry has once again delivered strong performance. In 2025, the industry's output reached S$ 160.2 billion (about US$ 123 billion), representing a 17.1% increase from S$ 136.8 billion (about US$ 105 billion) in 2024. This rebound not only indicates that the sector has emerged from the previous downturn but also reaffirms the semiconductor industry's strategic role as a core pillar of Singapore's manufacturing sector.

From a long-term perspective, the growth of Singapore's semiconductor industry is far from a short-term phenomenon. Instead, it reflects steady expansion across multiple technology cycles Industry output rose from S$ 26.8 billion in 2000 to S$ 160.2 billion in 2025, expanding nearly sixfold over twenty-five years. During this period, the industry recorded a compound annual growth rate (CAGR) of 7.4% between 2000 and 2025. Even when focusing on the more volatile recent period, the CAGR from 2019 to 2025 reached 8.8%, highlighting the sector's resilience amid fluctuating global demand. This growth has been driven by sustained demand for electronics, telecommunications equipment, data centers, and increasingly, artificial intelligence applications.

Looking at the development trajectory, Singapore's semiconductor sector was of moderate size in the early 2000s but already held an important position within the country's manufacturing landscape. Over time, the rapid global adoption of electronic devices, expanding chip demand, and continued investment by multinational semiconductor firms in Singapore helped drive steady growth in industry output. In particular, since 2020, the acceleration of digital transformation and the surge in demand for cloud computing and high-performance computing have propelled the sector into a new expansion phase. Industry output climbed to S$ 156.7 billion in 2022, and by 2025 it had reached a new peak (see Figure 55).

Figure 55. Output and Share of Singapore's Semiconductor Industry: 2000-2025



Source: Economic Development Board (Singapore), March 7, 2026, https://tablebuilder.singstat.gov.sg/table/TS/M355171 .

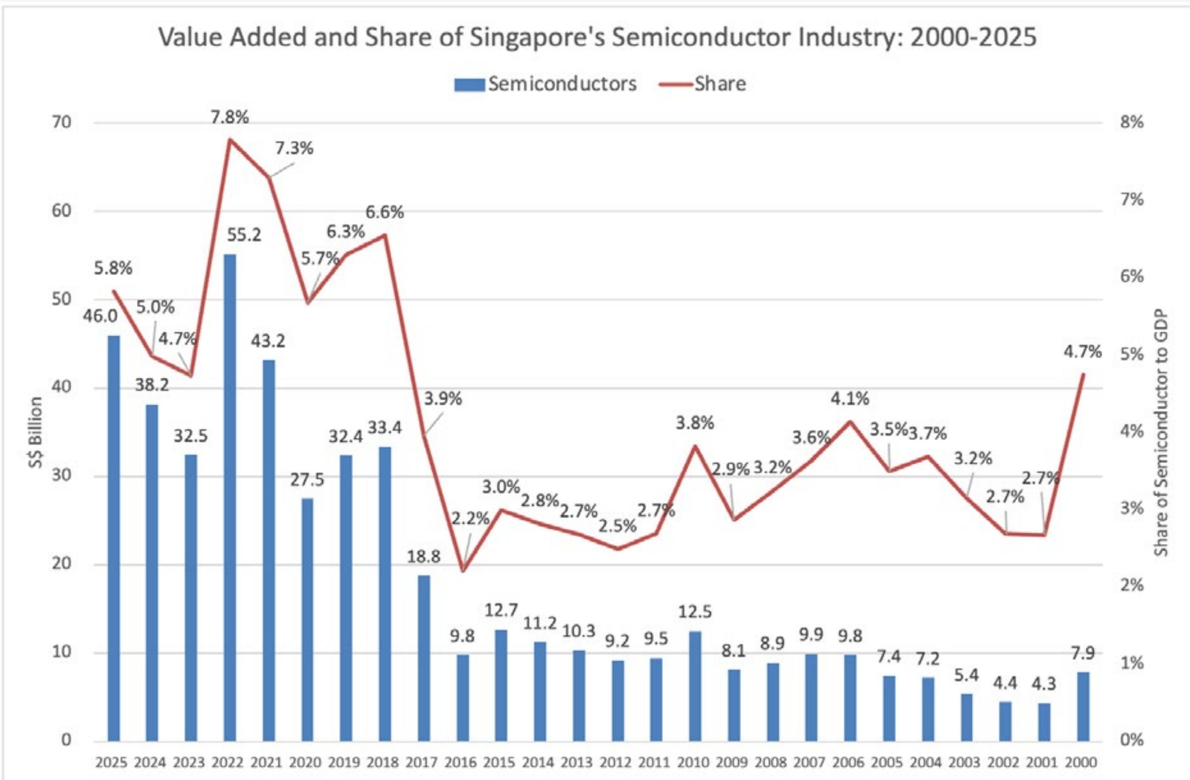
The semiconductor industry plays a particularly significant role in Singapore's overall economy. First, within the manufacturing sector, semiconductors account for a substantial share. In 2025, semiconductors represented 33.4% of Singapore's total manufacturing output, meaning that more than one out of every three dollars generated in manufacturing came from the semiconductor industry. Importantly, this is not an isolated occurrence in a single year. In recent years, the semiconductor sector has consistently accounted for around one-third of manufacturing output. The share reached 33.9% in 2022, 31.8% in 2024, and even during the global semiconductor downturn in 2023 it remained at 30.6%. This trend clearly indicates that semiconductors have become the central pillar supporting Singapore's high value-added manufacturing base.

Second, the sector's contribution to the broader economy is equally notable. In 2025, the semiconductor industry generated value added of S$ 46.0 billion, accounting for approximately 5.8% of Singapore's GDP. For an economy primarily driven by finance, logistics, and business services, a single manufacturing subsector contributing nearly 6% of GDP is highly significant. Historically, the semiconductor industry's share of GDP has fluctuated with the global technology cycle, but has generally ranged between 2% and 8%. The share rose to 7.3% in 2021 and peaked at 7.8% in 2022. Although it fell to 4.7% in 2023, it recovered to 5.0% in 2024 and further increased to 5.8% in 2025, underscoring the sector's sustained role in supporting Singapore's economic growth, exports, and industrial value creation.

Employment figures also highlight the importance of the semiconductor sector. In 2025, employment in Singapore's semiconductor industry reached 34,451 workers, slightly higher than 34,285 in 2024. Despite the industry's highly automated and technology-intensive nature, employment has continued to grow steadily, reflecting ongoing demand for engineers, manufacturing specialists, and research and development professionals. This trend underscores the sector's contribution not only to investment and exports but also to Singapore's broader industrial upgrading and talent development.

Overall, the strong rebound of Singapore's semiconductor industry in 2025 represents more than a cyclical recovery; it also reaffirms the sector's long-term competitiveness. With annual growth of 17.1% in 2025, a CAGR of 8.8% from 2019 to 2025, and 7.4% from 2000 to 2025, combined with its 33.4% share of manufacturing output and 5.8% contribution to GDP, semiconductors have clearly become one of Singapore's most strategically important industries (see Figure 56).

Figure 56. Value Added and Share of Singapore's Semiconductor Industry: 2000-2025



Source: Economic Development Board (Singapore), March 7, 2026, https://tablebuilder.singstat.gov.sg/table/TS/M355181 .

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3. Strategy and Policies

Key Government Agencies

Singapore's semiconductor industry is underpinned by a highly coordinated, whole-of-government approach, with the Ministry of Trade and Industry (MTI) and its statutory board, the Economic Development Board (EDB), playing central roles in shaping and guiding industrial development. As the lead agency responsible for economic and industrial strategy, MTI—through the EDB—supports the semiconductor sector by facilitating global industry linkages, providing market intelligence, and offering targeted government incentives to anchor and expand semiconductor investments in Singapore. Other public agencies, including Enterprise Singapore, JTC Corporation, the Agency for Science, Technology and Research (A*STAR), and the Ministry of Education (MOE), complement these efforts by supporting enterprise development, infrastructure provision, research and innovation, and talent formation.

While the EDB concentrates on attracting and anchoring global semiconductor investments, Enterprise Singapore, another agency under MTI, focuses on strengthening local enterprises and enhancing their international competitiveness. Through capability-building programs and partnership facilitation, Enterprise Singapore helps domestic semiconductor firms integrate into global value chains as solution providers, suppliers, or co-development partners to leading multinational companies.

JTC Corporation, also under MTI, serves as the government's industrial landlord and addresses the diverse infrastructure needs of semiconductor companies. JTC manages four wafer fabrication parks, covering a total of 374 hectares, which host 14 global semiconductor firms. To support smaller and emerging players, JTC has developed flexible, "plug-and-play" facilities such as JTC semiconSpace, where modular single-storey units can be combined, and JTC nanoSpace, a multi-tenant cleanroom development.

In July 2024, JTC announced plans to prepare 11% more land within Singapore's wafer fabrication parks, aiming to attract additional leading semiconductor players and capitalize on rising demand driven by artificial intelligence. This expansion is particularly important for meeting global demand for legacy chips, which remain critical for data centres, mobile devices, and automotive applications.

On the research and innovation front, the National Research Foundation (NRF) and the Research, Innovation and Enterprise 2025 (RIE2025) plan play pivotal roles in advancing Singapore's semiconductor R&D capabilities. Established in 2006 under the Prime Minister's Office, the NRF supports the Research, Innovation and Enterprise Council (RIEC) by coordinating national policies to strengthen research capacity, support economic growth, and address long-term national challenges. Over the period 2021–2025, the Singapore government committed to sustaining investment in research, innovation, and enterprise at around 1% of GDP, amounting to approximately S$ 25 billion (about US$ 18.3 billion).

In Budget 2024, the government announced an additional S$ 3 billion (US$ 2.2 billion) top-up to RIE2025, bringing total funding to about S$ 28 billion (US$ 20.4 billion) over five years. These resources support both public- and private-sector R&D, including collaborative projects between industry and research institutions. Semiconductor R&D—spanning chip design, manufacturing processes, and equipment development—remains a core priority within this framework.

Much of Singapore's semiconductor research activity is anchored at the Institute of Microelectronics (IME), founded in 1991 as part of A*STAR. Over the years, ASTAR has established extensive collaborations with global semiconductor firms. Notably, ASTAR and Applied Materials have partnered for more than a decade, most recently through the Applied Materials–A*STAR Joint Lab for Applied Process Equipment Accelerator (APEX). This initiative aims to advance semiconductor equipment capabilities while equipping small and medium-sized enterprises in Singapore with the technical expertise needed to produce high-quality, reliable semiconductor components.

Finally, the Ministry of Education (MOE) plays a critical supporting role by strengthening the talent pipeline through education and skills development. Through universities, polytechnics, and continuing education programs, MOE ensures a steady supply of engineers, researchers, and technicians, reinforcing Singapore's position as a globally competitive and resilient semiconductor hub.

Policy

The Economic Development Board (EDB) plays a pivotal role in shaping the strategic direction and policy framework that underpin the growth of Singapore's semiconductor industry, which is a cornerstone of the country's advanced manufacturing base, particularly within the broader electronics sector. Through long-term planning and close engagement with industry stakeholders, the EDB helps create a stable, competitive, and innovation-friendly environment for semiconductor investments.

One early example of this collaborative approach was the "Semiconductor Vision 2020" taskforce, a joint initiative between the EDB and leading industry players aimed at aligning public and private efforts to prepare Singapore for next-generation semiconductor manufacturing. Building on this foundation, the EDB has since articulated a more ambitious long-term strategy under its "Manufacturing 2030" plan. This initiative seeks to expand Singapore's manufacturing sector by 50% from its 2021 baseline of S$ 106 billion (US$ 80 billion) by 2030, while maintaining manufacturing's contribution at around 20% of GDP.[65]

To translate these objectives into concrete outcomes, Singapore has launched the Electronics Industry Transformation Map (ITM) 2025. The ITM provides a coordinated framework to drive productivity, innovation, skills development, and internationalization within the electronics and semiconductor industries, ensuring that Singapore remains well positioned to capture emerging opportunities in an increasingly competitive global semiconductor landscape (see Table 58).

65 Singapore Economic Development Board, 'Singapore Seeking Frontier Firms for 'Manufacturing 2030'', Economic Development Board, Singapore, 2 February 2021.

Table 58. Singapore's Semiconductor Policy

Guidance	**Target**	**Manufacturing 2030** • Grow Singapore's manufacturing sector by 50% of its value in 2021– valued at S$ 106 billion (US$ 80 billion) – while maintaining its share of about 20% of gross domestic product (GDP).
	Policy	**Electronics Industry Transformation Map (ITM) 2025** • Ambition for Singapore to be a critical global node for advanced Electronics manufacturing and innovation. » Anchor R&D and manufacturing capabilities from globally leading companies to enhance Singapore's leadership in key areas » Partner companies, Institutes of Higher Learning (IHLs) and the Singapore Semiconductor Industry Association to strengthen the local talent pipeline for growth areas. » Transform Singapore's electronics manufacturing into a low-carbon footprint sector.
Measures	**Key Initiatives**	**Tax Incentives** • **Corporate Income Tax Exemptions** » 10-year exemption for advanced technology process nodes (28nm and below). » 5-year exemption for 65nm and below nodes fabrication lines. » 2-year exemption for 130nm and below fabrication lines. • **Pioneer Certificate Incentive** » Tax exemptions on qualifying income for up to 15 years. • **Development and Expansion Incentive** » Reduced corporate tax rate on qualifying income for up to 10 years. • **International Headquarters (IHQ) Award** » Tax at concessionary rate of 5%, 10% or 15% on qualifying income in excess of base income. **Import Duty Exemptions:** • Exemptions for IC manufacturers to purchase imported semiconductor materials and equipment. **Investment in R&D:** • S$ 18 billion (US$ 13.7 billion) allocated between 2021 and 2025 to support innovation in the semiconductor sector. • S$ 112 million (US$ 85 million) investment to set up the National Gallium Nitride Technology Centre. This "boutique foundry" will serve as a shared resource and translation centre, focusing on the development and commercialization of gallium nitride (GaN) technologies. **Internship Opportunities:** • EnterpriseSG, EDB, Singapore Precision Engineering and Technology Association, Singapore Semiconductor Industry Association and various industry partners have created quality internship opportunities for students from Polytechnics and Institutes of Technical Education.

Outcome	**Announcements on Key Investments**	Feb 2022: **UMC (Taiwan)** announced plans to invest US$ 5 billion in the phase 3 expansion of its Fab12i, or Fab12i P3, in Singapore and also designated the new facility one of the most advanced semiconductor fabs in the country, set to roll out chips made on its 22 nm and 28nm processes. Jul 2023: **Silicon Box (Singapore)**, a semiconductor heterogenous integration startup unveiled its S$ 2 billion (US$ 1.5 billion) advanced semiconductor manufacturing foundry for chiplets. Sep 2023: **GlobalFoundries (U.S.)** officially opened its new S$ 5 billion (US$ 4 billion) wafer fab facility in Singapore focused on end-markets such as automotive, 5G mobility and secure devices. Mar 2024: **Advanced Substrate Technologies (AST) (Japan)**, a subsidiary of TOPPAN Holdings Inc., broke ground on a Singapore facility to produce high end substrates and develop advanced technologies to meet global demand. Jun 2024: **VisionPower Semiconductor Manufacturing Company (VSMC)**, a joint-venture between VIS (Taiwan) and NXP Semiconductor (Netherland), announced that it will build a S$ 10.5 billion (US$ 7.8 billion) wafer manufacturing plant in Singapore for automotive, industrial, consumer and mobile device markets. Jun 2024: **Siltronic (Germany)** opened its new S$ 2.9 billion (US$ 2.2 billion) production facility for 300mm wafers, making Singapore its largest production site globally. Jun 2024: **Pall Corporation (U.S.)**, opened a new S$ 202 million (US$ 150 million) state-of-the-art facility in Singapore to produce microelectronics filters for advanced node semiconductor manufacturing. Jun 2024: **MediaTek (Taiwan)** has committed to investing S$ 500 million (US$ 380 million) in Singapore over the next five years. This will go towards furthering R&D capabilities in next-generation System on Chip (SoC) technologies.

Note: () indicates headquarter location.

Incentives

To energize its semiconductor industry, Singapore has placed collaboration and ecosystem depth at the centre of its strategy, actively anchoring key players across the value chain. This includes major semiconductor equipment suppliers, wafer foundries, and integrated device manufacturers with substantial production bases in Singapore. As leading economies intensify efforts to secure control over chip production and critical technologies, competition to attract high-end semiconductor investments has become increasingly fierce, with large jurisdictions deploying massive subsidy packages to lure manufacturers. While Singapore cannot match the absolute scale of such subsidies, it compensates through highly targeted incentives and a set of structural advantages that sustain its competitiveness.

Singapore's investment framework combines tax incentives, direct financial support, and cost-reduction measures, including subsidies that lower land acquisition and development expenses. These are complemented by grants for talent development, as well as tax benefits linked to research and development activities and the registration of intellectual property. In parallel, the government has developed specialised industrial estates and science parks, enabling upstream and downstream suppliers to co-locate alongside fabs, thereby improving operational efficiency and supply-chain integration.[66]

To remain competitive against regional peers, Singapore also utilizes powerful fiscal tools such as the Refundable Investment Credit (RIC) announced in Budget 2024 and the Enterprise Innovation Scheme (EIS) announced in Budget 2023. The RIC provides up to 50% support for qualifying expenditures, which can offset corporate income taxes or be refunded in cash, while the EIS offers a 400% tax deduction on qualifying R&D and training expenditures.

According to an analysis by the U.S. Department of Commerce, Singapore's package of incentives and subsidies reduces the cost of facility ownership by an estimated 25–30%, a significant advantage in an industry where capital intensity is exceptionally high.[67]

Beyond financial measures, Singapore provides strong regulatory and administrative support, including streamlined processes for work visas and regulatory approvals, which materially improves project timelines and execution certainty for semiconductor firms. This combination of targeted incentives, ecosystem integration, and regulatory efficiency allows Singapore to remain an attractive destination for advanced semiconductor investments, even amid intensifying global subsidy competition.

4. Updates in 2025-2026 and Prospects

A Strategic Inflection Point amid Geopolitical Realignment

The year 2025 has marked a decisive turning point for Singapore's semiconductor sector powered by a surge of capital-intensive, high-value investments. Singapore is rapidly transforming from a traditional manufacturing base into a critical node for advanced manufacturing and advanced packaging, particularly for complex HBM and AI-related chips. According to Bloomberg Intelligence, driven by the broader application of AI chips, the global advanced packaging market is expected to grow sevenfold to US$ 80.5 billion by 2033, with a CAGR of 26%.

Micron Technology has designated Singapore as its global NAND Center of Excellence. In January 2026, Micron broke ground on a new advanced wafer fabrication facility located within its existing NAND manufacturing complex in Singapore. This represents a massive planned investment of approximately US$ 24 billion (S$ 31 billion) over 10 years, with wafer output scheduled to begin in the second half of 2028. This complements Micron's earlier announced US$ 7 billion High-Bandwidth Memory (HBM) advanced packaging facility, which is expected to begin operations in 2026.

66 "Incentives and Schemes for Businesses," Economic Development Board Singapore, at https://www.edb.gov.sg/en/how-we-help/incentives-and-schemes.html, Accessed on September 30, 2024.
67 The White House, "Building Resilient Supply Chains, Revitalizing American Manufacturing, and Fostering Broad-Based: 100-Day Reviews under Executive Order 14017," June 2021.

In the foundry segment, VisionPower Semiconductor Manufacturing Company (VSMC)—a joint venture between Taiwan's Vanguard International Semiconductor (VIS) and the Netherlands' NXP Semiconductors—celebrated breaking ground on a US$ 7.8 billion (S$ 10.5 billion) 300mm wafer manufacturing facility in December 2024.

In the advanced packaging sector, Singapore-based startup Silicon Box reached a significant milestone in October 2025 by shipping 100 million units, proving its advanced panel-level packaging is ready to scale for AI and high-performance computing applications.

Additionally, GlobalFoundries acquired Singapore's Advanced Micro Foundry (AMF) to accelerate its global leadership in silicon photonics. In line with the acquisition, GlobalFoundries plans to establish a silicon photonics research and development center of excellence in Singapore in partnership with A*STAR, focusing on next-generation materials for ultra-fast data transfer at 400Gbps speed. Marvell Technology also broke ground on its new regional headquarters in Singapore, expanding its IC design and test operations to serve its growing customer base.

On the regulatory front, in response to the tightening of global technology export controls and incidents of sanctions evasion, Singapore Customs and the Ministry of Trade and Industry issued a Joint Advisory on April 4, 2025 regarding "Export Controls on advanced semiconductor and artificial intelligence (AI) technologies". This advisory was issued following high-profile enforcement actions. Notably, in February 2025, authorities conducted a joint operation raiding 22 locations and arresting individuals linked to a S$ 500 million (US$ 390 million) scheme that used false representations to illicitly route servers containing highly advanced U.S. chips through Singapore. The advisory emphasizes the need for businesses to implement robust internal compliance programs and engage legal expertise to ensure they do not indirectly supply restricted entities, thus protecting Singapore's reputation as a trusted and neutral global hub.

From Manufacturing Hub to Innovation Platform

The launch of RIE2030 in December 2025 marked an historic investment in research, allocating S$ 37 billion—about US$ 28.5 billion—over 2026–2030, a 32 percent increase from the previous cycle. A defining innovation is the creation of "Flagship" programs that target national-level challenges, with the Semiconductor Flagship receiving a substantial share of a S$ 3 billion pooled allocation. In March 2026, the government announced a dedicated investment of S$ 800 million to establish the Research, Innovation and Enterprise (RIE) Flagship specifically focused on semiconductor research. The initiative reflects a strategic choice: rather than competing in ultra-leading-edge front-end logic dominated by TSMC, Singapore aims to build depth in advanced packaging, heterogeneous integration and photonics to enhance chip performance and reduce energy consumption.

Led jointly by A*STAR and the Economic Development Board, the Semiconductor Flagship aligns public research with industry needs, strengthens corporate R&D anchoring, and promotes venture creation to build domestic champions. The success of AMF—spun off from A*STAR and later acquired by GlobalFoundries—illustrates the model Singapore hopes to replicate. The initiative's talent strategy is equally central, prompting universities to redesign curricula and expanding fellowships and scholarships to cultivate expertise in packaging, photonics and AI-semiconductor integration.

Complementing the RIE2030 strategy is the Manufacturing 2030 vision, which aims to grow manufacturing value-add by 50 percent by decade's end. Budget 2025 supported this with a S$ 3 billion top-up to the National Productivity Fund and a dedicated S$ 1 billion for semiconductor infrastructure. Among the centerpiece projects is the National Semiconductor Translation and Innovation Centre (NSTIC), a S$ 500 million facility designed to bridge research and high-volume production, particularly in emerging materials such as Gallium Nitride, a key technology for next-generation power electronics.[68]

Under the newly announced RIE Flagship initiative, the various works under the NSTIC will be further integrated. Since the rollout of the RIE2025 plan, the NSTIC has already achieved multiple breakthroughs in advanced photonics—including high-speed data transmission and metalens manufacturing—while attracting over 10 industry partners and building a strong pipeline of commercialization projects. To solidify its position in emerging technologies, the government committed an additional S$ 60 million in March 2026 specifically for power electronics projects under the NSTIC, aiming to bolster Singapore's competitiveness in the next generation of power electronics.

Industry developments in 2024–2026 have reinforced this momentum. Micron's US$ 7 billion advanced packaging facility—the first dedicated HBM plant in Singapore—anchors the country inside the most critical bottleneck of the global AI hardware supply chain. The facility is expected to begin initial operations in 2026 and achieve meaningful capacity ramp-up in 2027. GlobalFoundries' acquisition of AMF solidifies Singapore's position in silicon photonics, with the establishment of a Silicon Photonics Center of Excellence ensuring that R&D capabilities remain rooted locally. The VIS–NXP joint-venture fab, valued at US$ 7.8 billion, has similarly accelerated construction to meet urgent global demand for diversified production of automotive and industrial chips (see Table 59).

Table 59. Progress of Semiconductor Investment and Production in Singapore: 2025

Company / Project	Technology / Focus	Investment	Status & Milestones
Micron	Advanced Packaging (HBM)	US$ 7 billion	First dedicated HBM plant in Singapore; initial operations in 2026; ramp-up in 2027.
VIS – NXP (Joint Venture)	Automotive & Industrial chips	US$ 7.8 billion	Construction accelerated to meet urgent global demand for diversified production.
GlobalFoundries	Silicon Photonics	n.a.	Acquired AMF; established a Silicon Photonics Center of Excellence for R&D.

68 Mordor Intelligence Research & Advisory, "Singapore Semiconductor Market Size & Share Analysis - Growth Trends And Forecast (2025 - 2030)," Mordor Intelligence, August 2025.

Next-Frontier Technologies and the Talent Constraint

Singapore's parallel push into silicon photonics and wide-bandgap materials demonstrates its intention to remain relevant by anticipating the next frontier of semiconductor innovation. Silicon photonics offers the only viable path to achieving data transfer speeds needed for hyperscale AI clusters, while GaN and SiC technologies are becoming indispensable for electric vehicles, renewable energy and high-voltage industrial systems. These domains remain technologically fluid, giving Singapore the opportunity to establish leadership before global standards fully consolidate.

Despite these advancements, talent remains the sector's most critical constraint. Southeast Asia faces a shortage of roughly 34,000 semiconductor engineers, and Singapore's tight labour market has intensified wage pressures and inter-firm poaching. Shortages are especially severe in fields such as photonics, data science and AI-integration engineering. The government's response includes enhanced visa pathways, the Global Founder Programme and expanded RIE2030 postdoctoral funding. Universities have modernized curricula, while industry associations have stepped up mid-career reskilling, successfully drawing workers from declining sectors into semiconductor roles.[69]

Together, these developments depict an ecosystem shaped by geopolitical realignment, technological ambition and policy continuity. Singapore's combination of trustworthiness, research intensity and industrial depth has positioned it not merely as a participant in the world's semiconductor expansion, but as one of the strategic centres helping to define its next phase.

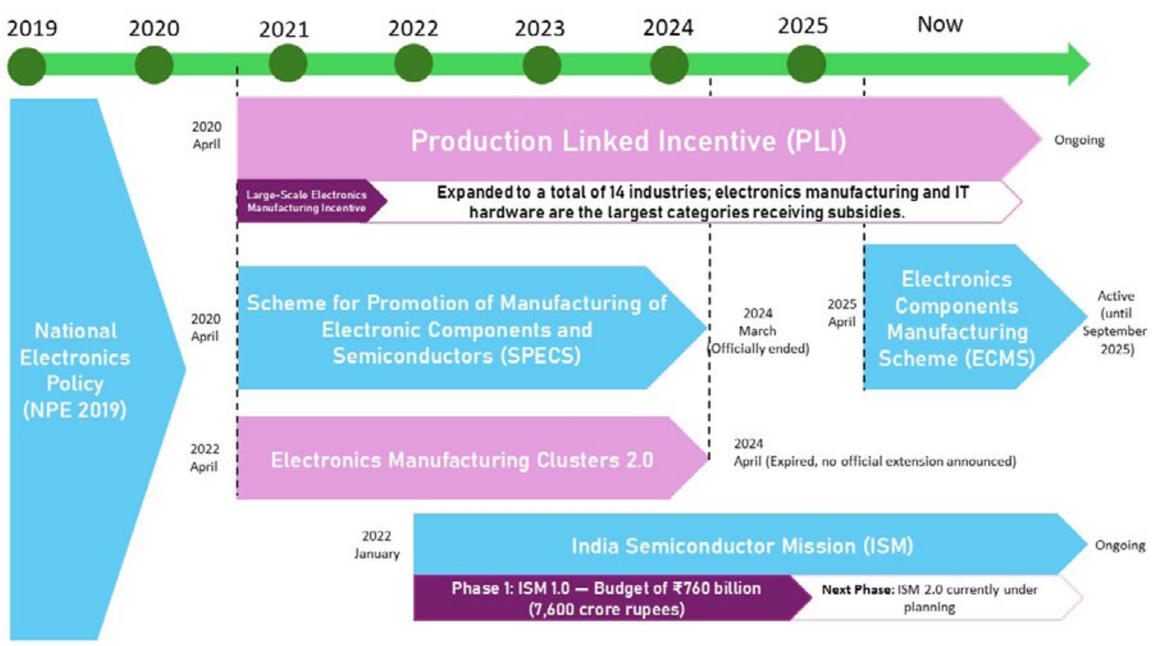
69 Mordor Intelligence Research & Advisory, "Singapore Semiconductor Market Size & Share Analysis - Growth Trends And Forecast (2025 - 2030)," Mordor Intelligence, August 2025.

X. India’s Semiconductor Policy

Since the release of the National Policy on Electronics 2019 (NPE 2019), India has continued to advance the upgrading of its electronics and semiconductor industries. The policy scope spans semiconductors, automotive electronics, ICT equipment, medical electronics, and more, with the core objective of positioning India as a global hub for Electronics System Design and Manufacturing (ESDM).

Building on this policy framework, the Indian government has, over the past six years, introduced a series of concrete incentive and subsidy programs. These include the Scheme for Promotion of Electronic Components and Semiconductors (SPECS), the Electronics Manufacturing Clusters Scheme (EMC 2.0), the Production-Linked Incentive (PLI) Scheme, and the latest Electronic Components Manufacturing Scheme (ECMS). In 2022, the government also officially launched the India Semiconductor Mission (ISM), forming a more comprehensive support architecture for the semiconductor sector (see Figure 57).

Figure 57. Major Milestones of India’s Electronics Manufacturing and Semiconductor Policies: 2019–2025



Source: Thomas Hsu, “Chips Amid Global Trade Conflicts: India’s Semiconductor Policy and Industry,” IEK, ITRI, October 22, 2025, p. 1.

1. Policy Priorities and Strategic Directions

NPE 2019 covers key areas such as semiconductor manufacturing and display production, while placing particular emphasis on semiconductor IC design, medical electronics, automotive electronics, and other strategic electronics industries. Its overarching aim is to strengthen the competitiveness of India’s ESDM value chain, increase domestic manufacturing content, expand export capacity, and develop India into a major global base for manufacturing and design.

Although NPE 2019 has not undergone major revisions since its release, related ministries have jointly pushed forward its implementation. A number of incentive-based programs have been launched over the past six years, serving as important tools for extending and deepening the policy. The major schemes are summarized below.

Scheme for Promotion of Electronic Components and Semiconductors (SPECS)

To enhance domestic capacity and value addition in electronic components, semiconductors, displays, materials, and manufacturing equipment, India introduced the SPECS program to build an autonomous and comprehensive electronics manufacturing ecosystem. The application window for SPECS closed in March 2024. Subsequent efforts to strengthen domestic component production are now carried forward through the PLI scheme and ECMS, while semiconductor-related subsidies have been taken over by the ISM scheme launched in 2022.

Electronics Manufacturing Clusters Scheme (EMC 2.0)

India implemented the first phase of the Electronics Manufacturing Clusters (EMC) Scheme between 2012 and 2017. However, due to rapidly growing demand for electronics and limited domestic production capacity, the government introduced EMC 2.0 in 2020. The upgraded scheme aims to improve infrastructure within electronics manufacturing parks and develop shared technical and public service platforms—including shared equipment, product testing, quality certification, R&D centres, and talent development facilities—to enhance manufacturing efficiency and attract greater investment into the electronics sector.

Production-Linked Incentive (PLI) Scheme

Launched in April 2020, the PLI scheme initially focused on large-scale electronics manufacturing. After successfully attracting major global smartphone manufacturers, the program was expanded to 14 strategic industries, including pharmaceuticals, telecom and networking equipment, food processing, home appliances, solar PV, advanced chemistry cell batteries, automobiles and components, textiles, and specialty steel. PLI has become a flagship initiative of the Modi government to upgrade manufacturing and attract foreign direct investment. It is widely recognized by international firms as a predictable and appealing incentive mechanism.

India Semiconductor Mission (ISM)

To strengthen semiconductor production capacity and supply chain resilience, the Indian government launched the Semicon India Programme at the end of 2021 and established the India Semiconductor Mission (ISM) as the central implementing agency. Under the Ministry of Electronics and Information Technology (MeitY), ISM oversees policy planning, funding allocation, project evaluation, and program monitoring. The first phase of ISM is budgeted at INR 760 billion (approximately US$ 9 billion), covering wafer fabs, assembly and test facilities, IC design, and supply chain integration, with the aim of increasing India's semiconductor self-reliance and global competitiveness.

Electronic Components Manufacturing Scheme (ECMS)

Approved in March 2025 and launched in April, the ECMS is a six-year program with a total central government budget of INR 229.19 billion (around US$ 2.8 billion). Its core objective is to strengthen weak links in the supply chain and reduce India's dependence on imported passive components—such as resistors, capacitors, and inductors—while raising domestic value addition from the current level of about 20% to roughly 40%. The scheme encourages both domestic and foreign firms to invest in electronic component manufacturing in India and aims to support deeper integration of Indian companies into global value chains.

2. India Semiconductor Mission

The India Semiconductor Mission (ISM), led and implemented by the Ministry of Electronics and Information Technology (MeitY), serves as the central body responsible for strategic planning and execution related to the semiconductor industry. Its mandate spans industrial strategy, manufacturing facility deployment, ecosystem development, supply chain security and localization, technology transfer and international collaboration, R&D and innovation capacity building, promotion of industry–academia–research linkages, and the formation of semiconductor clusters.

The following provides an analysis of the four major incentive programs under ISM, along with an overview of their implementation progress to date.

Semiconductor Fabs

The objective is to attract both global and domestic companies to invest in wafer fabrication facilities in India, thereby strengthening local manufacturing capabilities. The central government provides up to 50% of capital expenditure support, with several state governments offering additional incentives. Eligible technologies include logic, memory, digital ICs, analog ICs, mixed-signal ICs, and system-on-chips (SoCs).

Display Fabs

This program aims to draw major global display manufacturers to establish production facilities in India and develop a complete display manufacturing value chain. The central government offers up to 50% capital expenditure support, complemented by additional state-level incentives. Supported technologies include TFT-LCD, AMOLED, and other advanced display production lines.

Compound Semiconductors / ATMP / Sensors

This category focuses on building high-value semiconductor manufacturing and assembly–test capabilities, and has become one of India's most vigorously promoted areas. The government provides up to 50% capital expenditure support for projects involving compound semiconductors (e.g., GaN, SiC), silicon photonics, various sensors (including MEMS), and assembly, testing, marking, and packaging (ATMP/OSAT). The goal is to strengthen India's semiconductor supply chain and enhance indigenous technical capabilities.

Design Linked Incentive (DLI)

The DLI program aims to bolster India's IC design sector, enhancing innovation capacity and global competitiveness. Incentives include reimbursement of up to 50% of design-related expenditures (capped at INR 150 million), or a 4%–6% financial incentive over five years for products that have entered the sales or deployment stage (capped at INR 300 million). Supported activities include EDA tools, prototyping, R&D support, and infrastructure development. DLI serves as a key policy instrument for nurturing India's domestic IC design companies.

3. Policy Outcomes

(1) Ten Semiconductor Manufacturing Projects Approved

India's IC design sector is relatively mature, with many global IDMs and fabless companies having established R&D centers in the country. To strengthen the manufacturing segment and build deeper indigenous capabilities, the Indian government has provided substantial subsidies to attract international semiconductor leaders for technology partnerships, forming a "government funding + corporate investment + international technology collaboration" model.

In August 2025, ahead of Prime Minister Modi's visit to Japan and the SEMICON India 2025 event, the Union Cabinet approved four additional semiconductor projects. With these new approvals, the total number of sanctioned semiconductor manufacturing projects has reached ten (see Table 60). The key details are as follows:

Table 60. Ten Approved Investment Projects under the India Semiconductor Mission

No	Company	Location	Investment Size	Type	Approval Date
1	Micron Technology (US)	Sanand, Gujarat	US$ 2.75 B (INR 225.1 B)	IDM ATMP Facility	2023.6
2	Tata Electronics + PSMC (TW)	Dholera, Gujarat	US$ 10.9 B (INR 915.2 B)	Wafer Fab (Fab)	2023.6
3	Tata Semiconductor Assembly Test	Marigaon, Assam	US$ 3.26 B (INR 271.2 B)	OSAT Facility	2024.2
4	CG Power + Renesas (JP) + Stars (TH)	Sanand, Gujarat	US$ 920 M (INR 76.0 B)	IDM ATMP Facility	2024.2

5	Kaynes Semicon	Sanand, Gujarat	US$ 400 M (INR 33.0 B)	OSAT/ATMP Facility	2024.9
6	HCL + Foxconn (TW)	Jewar, Uttar Pradesh	US$ 440 M (INR 37.0 B)	OSAT Facility	2025.5
7	SiCSem + Clas-SiC (UK)	Bhubaneswar, Odisha	US$ 233 M (INR 20.66 B)	IDM ATMP Facility	2025.5
8	3D Glass Solutions (US)	Odisha	US$ 220 M (INR 19.43 B)	IDM ATMP Facility	2025.8
9	Continental Device India	Mohali, Punjab	US$ 13 M (INR 1.17 B)	IDM ATMP Facility	2025.8
10	ASIP + APACT (KR)	Andhra Pradesh	US$ 53 M (INR 4.68 B)	OSAT Facility	2025.8

Source: Thomas Hsu, "Chips Amid Global Trade Conflicts: India's Semiconductor Policy and Industry," IEK, ITRI, October 22, 2025, p. 4-5.

Micron Technology (United States)

Micron Technology is investing approximately US$ 2.75 billion to establish a new assembly and test facility in Sanand, Gujarat. Partial production is scheduled to begin in 4Q 2025, focusing on packaging and testing of DRAM, NAND, and other memory products.

The project received a combined 70% construction subsidy from the central and state governments, making it one of India's most significant achievements in attracting a top global semiconductor company. It not only brings advanced manufacturing capability to the region but also enhances India's talent development and technical expertise in semiconductor assembly and testing.

Tata Electronics in partnership with Taiwan's Powerchip Semiconductor Manufacturing Corp. (PSMC)

Tata Electronics is investing about US$ 10.9 billion to build a 12-inch wafer fab in Dholera, Gujarat—the only wafer fabrication project among the ten ISM-approved investments, and the first major fab led by an Indian conglomerate. PSMC will provide mature-node technologies and guidance on fab construction, including 28 nm, 40 nm, 55 nm, 90 nm, and 110 nm processes, as well as support in establishing quality management systems and operational workflows. The fab is designed for a monthly capacity of 50,000 wafers, producing PMICs, display driver ICs, MCUs, and logic chips for high-performance computing, with volume production expected to begin in 2026. To address talent shortages, Tata has been sending engineers to Taiwan for professional training since 2025.

Tata Semiconductor Assembly Test (TSAT)

The Tata Group is setting up TSAT, an OSAT facility in Marigaon, Assam, with a total investment of around US$ 3.26 billion, in partnership with Test Pvt Ltd. Production is expected to begin by mid-2025, with an annual capacity of 48 million units. The plant will utilize advanced packaging technologies such as flip-chip and will mainly supply automotive electronics, electric vehicles, and consumer electronics—boosting India's autonomy and technological depth in assembly and test.

CG Power in joint venture with Renesas Electronics (Japan) and Stars Microelectronics (Thailand)

CG Power, one of India's major industrial equipment manufacturers, is investing about US$ 920 million to build an assembly and test facility in Sanand, Gujarat, in partnership with Renesas Electronics and Stars Microelectronics. CG Power holds a 92.3% equity stake. The project has secured 50% capital expenditure support from the central government and is scheduled for completion in October 2027. With an annual capacity of 15 million units, the facility will produce semiconductors for consumer, automotive, and energy applications and is expected to become a flagship example of foreign collaboration in India's advanced packaging segment.

Kaynes Semicon

Kaynes Semicon, a subsidiary of India's leading EMS company Kaynes Technology, is investing roughly US$ 400 million to establish a packaging and testing facility in Sanand, Gujarat. Approved in September 2024, the plant is expected to begin production in 1Q 2026, with an initial annual capacity of 200 million units, targeted to expand to 1 billion units within five years. Its products will support diverse markets including industrial electronics, automotive, EVs, communications, consumer electronics, and mobile devices—signaling the growing capabilities of domestic Indian firms in advanced semiconductor packaging.

HCL and Foxconn (Taiwan) Joint Venture

Indian IT and engineering group HCL, together with Taiwan's Foxconn, will establish an OSAT plant in Jewar, Uttar Pradesh, with an investment of about US$ 440 million. Approved in May 2025, it will be the state's first semiconductor facility. The project received a combined 70% subsidy from central and state governments, along with additional tax incentives. The plant will focus on wafer-level packaging and display driver ICs, with a planned capacity of 20,000 wafers per month and an annual output of about 36 million units—strengthening India's footprint in mobile, laptop, and automotive semiconductor supply chains.

In February 2026, the joint venture officially held its groundbreaking ceremony in Greater Noida. During the event, Indian Prime Minister Narendra Modi emphasized via video address that "Made in India" domestic chip production is crucial for India's self-reliance and its goal of becoming a developed nation, citing the supply chain vulnerabilities exposed during the COVID-19 pandemic. Scheduled to commence full production in 2028, the facility is expected to create 3,500 direct and indirect jobs while attracting ecosystem partners to build a localized semiconductor supply chain.

SiCSem and Clas-SiC (United Kingdom) Joint Venture

SiCSem and the UK-based Clas-SiC Wafer Fab Ltd. are jointly building India's first commercial SiC compound semiconductor fab in Info Valley, Bhubaneswar, Odisha. Planned annual capacity includes 60,000 SiC wafers and 96 million packaged units.

The products will serve applications across missile systems, defense equipment, electric vehicles, rail transportation, fast-charging solutions, data centers, consumer appliances, and solar inverters—marking a significant advancement in India's high-voltage and high-efficiency semiconductor capabilities.

3D Glass Solutions (3DGS), United States

U.S.-based 3DGS plans to establish a vertically integrated advanced packaging and glass substrate manufacturing facility in Odisha's Info Valley. Annual output will include 69,600 glass panel substrates, 50 million assembly units, and 13,200 3DHI modules. Its technologies will support defense, high-performance computing, AI, RF systems, automotive electronics, photonics, and co-packaged optics—introducing advanced materials and packaging capabilities currently absent in India.

Continental Device India Ltd (CDIL)

CDIL is expanding its discrete semiconductor manufacturing operations, adding new production lines for power devices such as MOSFETs, various transistors, and both silicon- and SiC-based high-power components. Post-expansion, annual capacity will reach 158 million units, supplying markets including electric vehicles, charging infrastructure, renewable energy systems, industrial equipment, and communications infrastructure—strengthening India's position in the power semiconductor domain.

ASIP in collaboration with South Korea's APACT

Indian OSAT company ASIP will partner with South Korea's APACT to establish a semiconductor manufacturing facility with an annual capacity of 96 million units. Key application markets include mobile phones, set-top boxes, automotive electronics, and various consumer electronic products. The project will enhance India's system-in-package (SiP) capabilities and support greater self-reliance across diverse semiconductor applications.

Despite the Modi administration's strong policy push and the active efforts of various state governments to attract semiconductor investment through fiscal incentives and subsidies, India still faces significant challenges in building a comprehensive semiconductor ecosystem. In recent years, several proposed projects have been delayed or suspended due to concerns about market conditions, financing risks, and policy uncertainties—highlighting the institutional and structural hurdles that remain in India's semiconductor development trajectory.

(2) Major Semiconductor Investment Projects Put on Hold in India

Kaynes Semicon (India) and Aptos Technology (Taiwan)

In February 2024, Aptos Technology announced a partnership agreement with Kaynes Semicon covering training and know-how licensing in assembly and test technologies. However, Aptos declared bankruptcy in June 2025, leading to the termination of the collaboration before bankruptcy proceedings commenced.

Zoho (India)

In May 2024, the Indian IT firm Zoho proposed investing US$ 700 million to build a compound semiconductor fabrication facility in Tamil Nadu. After nearly a year of evaluation, Zoho suspended the plan in May 2025 due to the absence of a suitable technology partner, insufficient fiscal incentives, and high capital expenditure risks.

Adani Group (India) and Tower Semiconductor (Israel)

In 2024, Adani Group and Tower Semiconductor submitted a US$ 10 billion joint venture proposal to establish a mature-node wafer fab. Although the project received state cabinet approval in September 2024, Adani announced the suspension of the partnership in April 2025, citing uncertainties related to market demand, financing conditions, and supply chain dynamics.

Vedanta (India) and Foxconn (Taiwan)

Initially announced in September 2022 as a US$ 19.5 billion joint venture to build India's first 12-inch wafer fab, the project faced a major setback when Foxconn withdrew in July 2023, prompting Vedanta to seek new technology partners (see Table 61).

Table 61. Four Deferred Investment Cases in India's Semiconductor Projects

No	Investment / Partner Companies	Project Timeline	Reason for Suspension
1	Kaynes Semicon (India) / Aptos Technology (Taiwan)	2024.2–2025.6	Partnership collapsed
2	Zoho (India)	2024.5–2025.5	Zoho announced project suspension
3	Adani Group (India) / Tower Semiconductor (Israel)	2024.9–2025.4	Adani suspended cooperation after evaluation
4	Vedanta (India) / Foxconn (Taiwan)	2022.9–2023.7	Foxconn announced withdrawal from joint venture operation

Source: Thomas Hsu, "Chips Amid Global Trade Conflicts: India's Semiconductor Policy and Industry," IEK, ITRI, October 22, 2025, p. 7.

At the same time, Indian firms have begun adopting more proactive strategies to narrow the technological gap with global semiconductor leaders. These efforts increasingly involve overseas acquisitions and technology-driven mergers. Such developments indicate that industry stakeholders recognize that relying solely on domestic fab construction and government subsidies is insufficient to reach international competitiveness. Instead, integrating external technology and expanding globally have become critical pathways for accelerating capability development.

(3) Indian Firms Building Semiconductor Capabilities through Acquisitions

June 2025 – L&T Semiconductor Technologies and Kaynes Semicon acquire Fujitsu General Electronics' power module business

India's L&T Semiconductor Technologies and Kaynes Semicon jointly acquired the power module business of Japan's Fujitsu General Electronics for approximately US$ 13.8 million. The production lines are expected to be gradually relocated to Kaynes Semicon's facilities within 12–18 months.

August 2024 – Polymatech Electronics acquires U.S.-based Nisene Technology Group

Polymatech Electronics acquired California-based Nisene Technology Group, a semiconductor packaging and test equipment manufacturer recognized for its expertise in IC design and silicon carbide (SiC) wafer testing, with more than 50 core patents.

2025 – Tata Electronics explores acquisitions in Malaysia

Tata Electronics initiated discussions with several Malaysian semiconductor and OSAT companies, including X-Fab, SilTerra Malaysia, and Globetronics Technology, with the aim of acquiring mature-node fabrication and packaging capacity to accelerate its global expansion.

4. Updates in 2026 and Prospects

In 2026, India's semiconductor development entered a new phase, shifting from an earlier stage focused primarily on policy formulation and investment attraction toward tangible progress in multi-node manufacturing and pilot production. A milestone was reached on February 28, 2026, when Micron Technology officially began commercial operations at its ATMP facility in Sanand, Gujarat. This marked India's first commercial semiconductor packaging output and a symbolic step forward in establishing a domestic semiconductor supply chain.

At the policy level, the government launched the India Semiconductor Mission 2.0 (ISM 2.0) in February 2026. With an initial allocation of approximately US$ 96–120 million for FY2026–27, the program represents a strategic shift from simply subsidizing fabrication facilities toward strengthening upstream capabilities. The initiative emphasizes the localization of semiconductor manufacturing equipment, specialized materials, domestic intellectual property, and talent development.

In parallel, the government expanded the Electronic Components Manufacturing Scheme (ECMS), increasing its budget to roughly US$ 480 million to support the localization of printed circuit boards (PCBs) and passive components, thereby reinforcing the broader electronics manufacturing ecosystem.

Front-end manufacturing also made visible progress. The Tata Electronics–PSMC joint 12-inch wafer fab in Dholera reached approximately 45–50 percent completion of civil construction by the first quarter of 2026. The project aims to produce its first "Made in India" wafer tape-out by late 2026, with mass production planned for 2027.

In the back-end segment, the HCL–Foxconn OSAT joint venture held its groundbreaking ceremony in Greater Noida in February 2026. Full-scale production is expected by 2028, further expanding India's semiconductor packaging and testing capacity.

With these developments, the government's Semicon India Programme has expanded to ten approved projects, attracting a cumulative investment of roughly US$ 19.3 billion.

To cultivate domestic innovation and design capabilities, the "Chips to Start-up" (C2S) program was expanded to 500 academic institutions in March 2026, enabling large-scale training in integrated circuit design and providing free access to industry-grade EDA tools.

Meanwhile, under the Digital India RISC-V initiative, the domestically developed 64-bit microprocessor DHRUV64 entered the prototype validation stage in 2026, representing another step toward India's ambition of achieving "silicon sovereignty."

On the international front, India reinforced its alignment with trusted technology supply chains by formally joining the U.S.-led "Pax Silica" initiative on February 20, 2026. The framework integrates cooperation in semiconductors, critical minerals, and artificial intelligence infrastructure within a broader economic security architecture.

XI. Conclusion

1. Semiconductors in the Age of AI Competition

Semiconductors—often described as the "oil" of the twenty-first century—have now fully assumed their role as the indispensable infrastructure of the global digital economy. As this book demonstrates through data-driven analysis and comparative policy assessment, the industry has entered a decisive phase in which artificial intelligence, national industrial strategies, and intensifying geopolitical competition are jointly reshaping the global semiconductor landscape. The advance toward a trillion-dollar market by 2027 therefore represents not merely an expansion in scale, but a profound structural transformation in how technology, power, and economic value are organized at the global level.

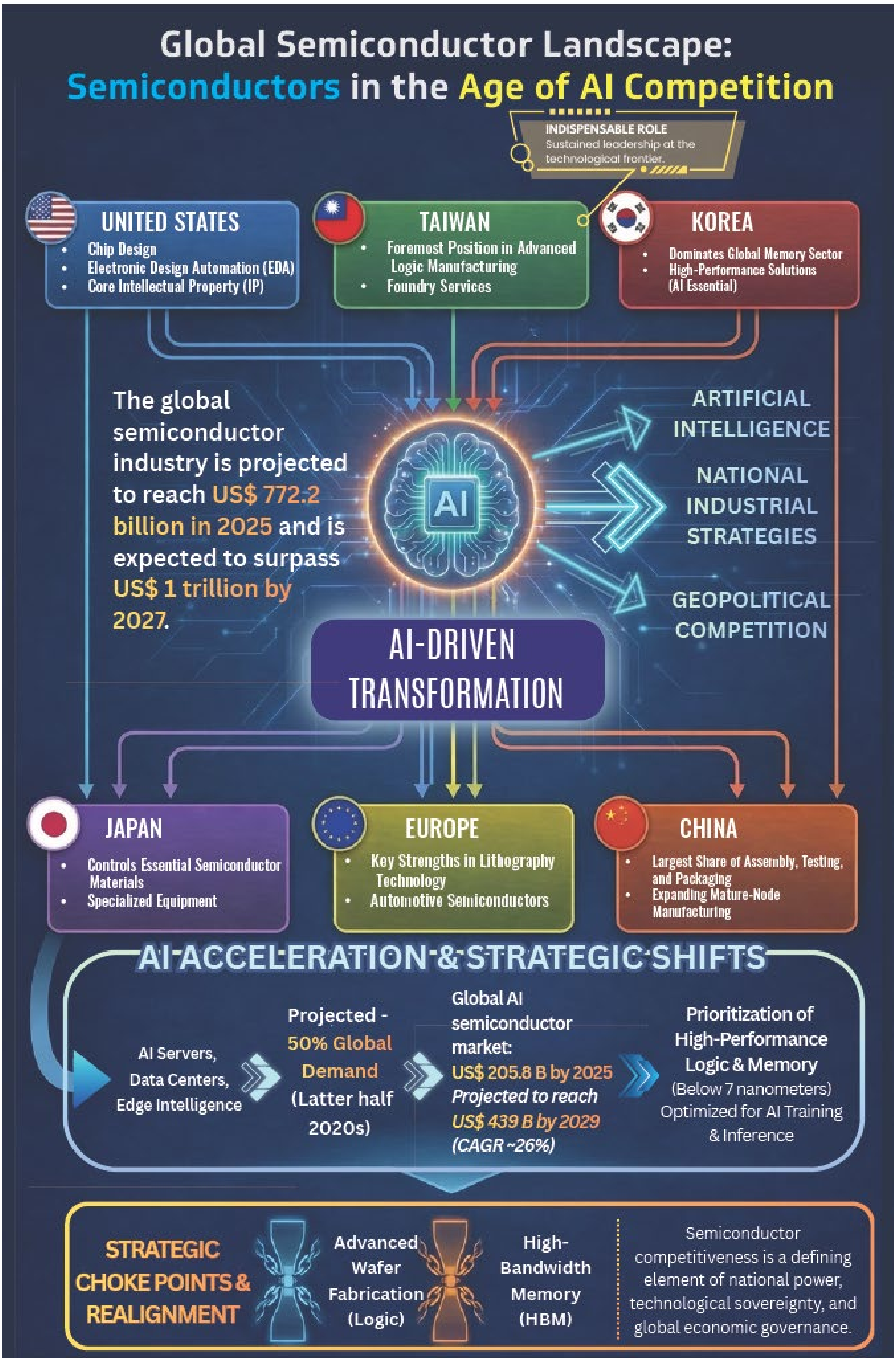
This transformation is closely intertwined with a reconfiguration of the global division of labor across the semiconductor value chain. Major economies occupy distinct yet interdependent positions: the United States leads in chip design, electronic design automation, and core intellectual property; Taiwan holds the world's foremost position in advanced logic manufacturing and foundry services; Korea dominates the global memory sector, particularly in high-performance solutions essential for AI; Japan controls essential semiconductor materials and specialized equipment; Europe retains key strengths in lithography technology and automotive semiconductors; and China accounts for the largest share of assembly, testing, and packaging in terms of value-added, while rapidly expanding its mature-node manufacturing capacity.

As the semiconductor landscape continues to realign amid geopolitical frictions, this complex division of labor has not diminished interdependence. On the contrary, it has elevated certain nodes—most notably advanced wafer fabrication and high-bandwidth memory—to strategic choke points. In this context, Taiwan's role remains indispensable, not by accident of scale, but by sustained leadership at the technological frontier.

The rise of artificial intelligence has further accelerated this structural shift and introduced a new industrial logic. By the latter half of the 2020s, AI servers, data centers, and edge intelligence applications are projected to account for nearly half of global semiconductor demand. AI-oriented semiconductors alone are forecast to exceed US$ 430 billion in annual output by 2029, growing at a compound annual growth rate of approximately 26 percent. This surge has fundamentally altered not only the volume but also the composition of demand, prioritizing high-performance logic and memory chips optimized for AI training and inference.

As a result, advanced-node manufacturing—particularly logic and memory chips below 7 nanometers—has emerged as a strategic bottleneck. These technologies have become focal points of capital expenditure, industrial policy, and geopolitical concern. The industry's center of gravity is no longer defined primarily by production volume or cost efficiency, but by the ability to sustain leadership at the technological frontier under conditions of extreme capital intensity, rapid innovation cycles and strategic global realignment. In this AI-driven super-cycle, semiconductor competitiveness is no longer merely an industrial matter; it is a defining element of national power, technological sovereignty and global economic governance (see Figure 58).

Figure 58. Global Semiconductor Landscape: 2025



2. Taiwan: Anchoring the AI-Driven Semiconductor Era

Taiwan's central role in the global semiconductor industry is not a short-term phenomenon driven by temporary market fluctuations, but the outcome of long-term structural consolidation, clearly supported by empirical data. In wafer foundry services, Taiwan's global market share rose steadily from 69.0 percent in 2011 to 79.7 percent in 2021, before easing to 75.2 percent in 2023 amid cyclical adjustment. By 2024, Taiwan's share rebounded to 78.1 percent, and the Industrial Technology Research Institute (ITRI) projects a further increase to 78.6 percent in 2025, underscoring the durability of its competitive position.

By contrast, Taiwan's relative share in assembly, testing, and packaging has trended downward under intensifying regional competition, yet it remained a substantial 48.1 percent of global market share in 2025. This continued scale highlights Taiwan's enduring importance in backend manufacturing, even as capacity diversifies geographically. Meanwhile, Taiwan's IC design sector—despite pronounced cyclical volatility—accounted for 18.7 percent of global market share in 2025, reflecting sustained competitiveness in high-value design capabilities alongside its manufacturing leadership.

At the core of this structural dominance lies the geographic concentration of advanced manufacturing. By keeping the most advanced processes in Taiwan, maintaining the vast majority of advanced production capacity in Taiwan, and anchoring high-end technology R&D centers in Taiwan, the island's competitive advantage remains absolute. Despite the outward expansion of production footprints, Taiwan remains the immovable center of TSMC's manufacturing gravity. TSMC's dominance in the foundry sector reached historic highs, capturing 71.0 percent of the global market in the third quarter of 2025. TrendForce further forecasts that in the fourth quarter of 2025, TSMC will control approximately 69 percent of global advanced-process capacity, far surpassing Samsung's 21 percent and Intel's 10 percent. As of late 2025, more than 90 percent of TSMC's total production capacity—and an even higher proportion of its advanced-node output—continues to be located in Taiwan. In the AI era, where performance, yield learning, and time-to-scale are decisive, this clustering effect has become a strategic asset rather than a vulnerability.

TSMC's overseas fabs, by design, play complementary rather than substitutive roles. Facilities in Arizona contribute to U.S. supply-chain resilience and customer proximity; Kumamoto is closely integrated into Japan's materials and equipment ecosystem; and Dresden supports Europe's automotive and industrial semiconductor base. Taken together, these investments form a diversified yet asymmetrical global network—one that expands TSMC's operational reach and geopolitical alignment without displacing the technological and manufacturing core anchored in Taiwan.

This structural asymmetry is expected to persist through the next technology cycle. According to ITRI estimates based on publicly announced construction schedules and planned capacities—and assuming full-scale mass production of 2nm to 6nm nodes by 2029—Taiwan's share of global advanced-node capacity is projected to reach 61 percent. The United States would account for 16 percent, South Korea 11 percent, Japan 7 percent, Ireland 4 percent, and China only 1 percent. Even amid deliberate geographic diversification, the AI-driven semiconductor ecosystem remains firmly centered in Taiwan.

From 2021 to early 2026, Taiwan–U.S. semiconductor relations evolved from a transactional buyer–supplier relationship into a structurally integrated strategic partnership. This shift was driven by sustained capital investment, supply-chain restructuring, and intensified policy coordination amid rising geopolitical risks and AI-driven demand. While commercial logic remains central, cooperation has increasingly reflected shared goals in supply-chain resilience, advanced manufacturing security, and long-term technological competitiveness.

A core element of this partnership has been the gradual transfer of Taiwan's "ecosystem-first" development logic to the United States. Bilateral dialogues emphasized that semiconductor competitiveness depends not only on individual fabs but on dense, well-coordinated industrial clusters integrating suppliers, infrastructure, R&D institutions, and workforce pipelines. This "Taiwan Model" informed the development of emerging clusters in Arizona and Texas, anchored respectively by TSMC and GlobalWafers, alongside related AI server and materials supply chains. Early supplier investments, though partial, signal the extension of Taiwan's supply-chain architecture into the U.S. manufacturing environment.

Institutionally, cooperation was reinforced through platforms such as the Taiwan–U.S. Economic Prosperity Partnership Dialogue (EPPD) and culminated in a comprehensive consensus reached on January 15, 2026. Key outcomes included reduced reciprocal tariffs, most-favored treatment under potential Section 232 measures, exemptions for critical inputs, and large-scale investment commitments. These arrangements facilitated up to US$ 250 billion in Taiwanese private-sector investment, supported by an additional US$ 250 billion in government-backed credit guarantees, while the United States committed to enabling land access, infrastructure, incentives, and talent mobility.

In conclusion, the period from 2021 to early 2026 marked the consolidation of a deeply interdependent Taiwan–U.S. semiconductor partnership. Rather than decoupling, both sides pursued strategic coupling—linking U.S. market demand, R&D strengths, and equipment supply with Taiwan's advanced manufacturing and ecosystem expertise. This alignment not only preserves Taiwan's technological leadership while expanding U.S. production capacity, but also lays the foundation for a resilient, globally competitive AI and semiconductor ecosystem in the decades ahead.

3. The United States: Strategic but Selective Reindustrialization

From a policy perspective, the United States has leveraged the CHIPS and Science Act to direct substantial subsidies toward firms targeting 7-nanometer and more advanced nodes, with the explicit aim of rebuilding leading-edge manufacturing capabilities on U.S. soil. Recent developments indicate that this strategy has begun to generate tangible outcomes, albeit in an uneven and highly differentiated manner.

On the manufacturing front, TSMC's progress in Arizona has been the most emblematic. In early 2025, the first fab of Fab 21 in Phoenix entered volume production using the 4-nanometer process, reportedly achieving yield rates roughly four percentage points higher than comparable fabs in Taiwan.

Building on this foundation, TSMC confirmed plans for a six-fab "Gigafab" cluster in Arizona with total investment of approximately US$ 165 billion. If fully realized, the campus could account for more than 30 percent of TSMC's global sub-2-nanometer capacity, highlighting the deepening alignment between Taiwan's technological core and U.S. industrial policy.

By contrast, Intel's front-end manufacturing expansion has progressed less smoothly, with its Ohio project now deferred into the early 2030s. Intel's relative strength has instead emerged in advanced packaging, as its New Mexico facilities remain the only U.S. sites capable of large-scale 3D packaging. The company's 18A node is scheduled for gradual ramp-up from 2026, supported by a revised ownership structure that includes direct U.S. government equity participation alongside major private investors.

Other industry players illustrate distinct adjustment paths. Samsung's Texas fab is nearing construction completion but continues to face uncertainty regarding customer commitments and production timing. Micron has pivoted decisively toward AI-driven memory, with high-bandwidth memory emerging as its primary growth engine. GlobalFoundries, meanwhile, has focused on stabilizing domestic supply for mature-node applications through a differentiated foundry strategy.

Taken together, U.S. semiconductor reindustrialization is real but selective. Advanced capacity is returning, yet unevenly across firms, technology nodes, and timelines, reinforcing supply-chain resilience rather than displacing established global centers of excellence.

4. China: Ambition and the Limits of Semiconductor Self-Reliance

China's semiconductor strategy offers one of the clearest illustrations of the gap between policy ambition and industrial reality. Under the original Made in China 2025 framework, Beijing set explicit targets to raise domestic semiconductor content to 40 percent by 2020 and 70 percent by 2025. These targets proved unattainable and were revised in 2019, shifting policy emphasis toward aggregate output—US$ 305 billion in semiconductor production by 2030—and meeting 80 percent of domestic demand.

Measured by headline indicators, progress is evident. China's semiconductor self-sufficiency rate reached 23.3 percent in 2023 and is projected to rise to 26.6 percent by 2027. Yet these figures substantially overstate genuine technological autonomy, as they include output from foreign-invested fabs operating in China. When adjusted for ownership and technological capability, China's real self-sufficiency rate remains in the single-digit range, at approximately 6.2 percent in 2023.

Structurally, China's expansion has pivoted toward legacy-node manufacturing, with capacity growth concentrated above 28 nanometers. TrendForce projects that China's share of global mature-node manufacturing capacity will surge from 26 percent in 2022 to 45 percent by 2027 and 53% by 2030. However, despite this aggressive expansion in volume, Chinese foundries' global revenue share has stagnated, dropping from 9.6 percent in 2022 to 8.6 percent in the third quarter of 2025, as intense price competition in legacy nodes limits value capture. Despite notable engineering ingenuity, China's most advanced logic production remains effectively at the 7-nanometer class, achieved through complex multi-patterning rather than true next-generation scaling.

The absence of EUV, reliance on DUV multi-patterning, dependence on foreign EDA and core IP, and persistent cost and yield pressures constitute structural challenges. True leadership in semiconductors is not defined by the possession of a single critical tool, but by the mastery of an integrated industrial ecosystem; catching up requires time, institutional depth, and systemic accumulation that rarely compress on command.

Financial performance reinforces these structural constraints. SMIC recorded record revenue of US$ 8.0 billion in 2024, yet net margins compressed to 6.1 percent, compared with TSMC's 40.5 percent. Full-year data from 2025 confirm that this divergence is structural rather than cyclical: while SMIC achieved a record revenue of US$ 9.33 billion, its net margin remained constrained at 7.3 percent. In stark contrast, TSMC reached a record revenue of US$ 122.42 billion and sustained an overwhelming net margin of 45.1 percent. China's semiconductor drive has therefore increased autonomy in quantity, but not in quality, profitability, or technological leadership.

5. Korea: The Memory Superpower in the AI Era

South Korea remains the undisputed leader of the memory sector, yet its role is evolving from a volume supplier into a strategic linchpin of the AI era. Accounting for roughly 12 percent of the global semiconductor value chain and about 60 percent of the memory market, Korea's strength is most pronounced in high-bandwidth memory (HBM), a critical bottleneck for AI accelerators. SK hynix and Samsung Electronics command an estimated 80–90 percent of global HBM supply, elevating Korea from a commodity producer to a co-architect of the AI computing ecosystem alongside logic leaders such as NVIDIA.

Although HBM represents a relatively small share of total DRAM bit output, its value contribution is expanding rapidly. TrendForce projects that HBM will generate over 30 percent of total DRAM revenue by 2025, reflecting its premium pricing and strategic importance. Looking ahead, the global HBM market is expected to grow more than eightfold by 2034, supported by a compound annual growth rate of around 26 percent, further reinforcing Korea's central position in AI-driven semiconductor markets.

To defend this lead amid intensifying competition and geopolitical uncertainty, Korea has unveiled the "K-Semiconductor Vision and Strategy in the AI Era." The plan commits approximately KRW 700 trillion (US$ 520 billion) through 2047 to strengthen the domestic ecosystem, anchored by a semiconductor supercluster in Gyeonggi Province. This initiative aims to build 16 new fabs and establish the world's largest integrated complex, targeting monthly capacity of 7.7 million wafers by 2030.

The strategy is comprehensive and strongly state-backed. It seeks to lock in memory dominance while expanding system semiconductor capabilities, including neural processing units, to reduce exposure to cyclical markets. Generous incentives—tax credits of up to 25 percent for facility investment and 30 to 50 percent for R&D—are complemented by a plan to train 150,000 semiconductor professionals by 2030.

While Korea may not match Taiwan's foundry scale or the U.S. design ecosystem, its grip on AI-critical memory ensures it remains an indispensable pillar of the global digital economy.

6. Japan and Europe: Divergent Paths in Semiconductor Reindustrialization

Advanced economies increasingly frame semiconductors as a pillar of economic security, yet Japan and Europe exemplify two sharply contrasting approaches—and outcomes—in state-led reindustrialization.

Japan has pursued one of the most ambitious and coherent semiconductor revival strategies among advanced economies. Between 2021 and 2023, the Japanese government allocated approximately US$ 25.7 billion—about 0.71 percent of GDP—to semiconductor support, with cumulative assistance projected to approach US$ 67 billion by 2030. This scale of commitment reflects a clear strategic consensus on the sector's economic and technological importance.

Japan's policy architecture follows a disciplined dual-track approach. It prioritizes supply-chain resilience at mature nodes through the TSMC-led Kumamoto cluster, while selectively advancing frontier technologies via Rapidus, emphasizing speed, precision, and high-value applications over sheer production scale. TrendForce identifies three regional semiconductor hubs under this framework: Kyushu, anchored by TSMC and Sony; Tohoku, centered on Renesas and PSMC; and Hokkaido, home to the Rapidus project.

At the core of Japan's near-term supply strategy is the Kumamoto cluster. The government has committed over US$ 6.67 billion in subsidies to support two fabs operated by Japan Advanced Semiconductor Manufacturing (JASM). Fab 1 reached stable mass production in 2025, while Fab 2—targeting 6–7nm nodes—broke ground in October 2025 and is scheduled to enter production in late 2027. This arrangement secures domestic access to critical nodes for automotive and industrial applications, sectors where Japan maintains strong downstream competitiveness.

Concurrently, Japan is pursuing a longer-term technological leap through Rapidus, reflecting its ambition to re-enter the advanced logic frontier. Backed by substantial public funding and partnerships with IBM and Imec, Rapidus announced the successful fabrication of a 2nm gate-all-around prototype transistor in mid-2025. Japan's policy reach extends across the value chain, including support for memory producers such as Micron and Kioxia, as well as advanced packaging for AI-related applications.

Europe's trajectory, by contrast, has been marked by ambition outpacing industrial reality. The European semiconductor strategy unveiled in 2021–2022 set a headline goal of doubling Europe's global market share to 20 percent by 2030. Market trends, however, point in the opposite direction. According to WSTS estimates, Europe's share is expected to fall to around 7.0 percent in 2025 and further to approximately 6.2 percent in 2026. In April 2025, the European Court of Auditors concluded that Europe is "very unlikely" to meet its target, projecting a rise to only about 11.7 percent by 2030.

Industrial outcomes reflect these constraints. The most credible new anchor project is the European Semiconductor Manufacturing Company (ESMC) in Dresden, a € 10 billion joint venture led by TSMC with Bosch, Infineon, and NXP. Focused on 28/22nm and 16/12nm nodes, the fab will reinforce Europe's automotive and industrial semiconductor base but does not materially alter its position at the leading edge of logic manufacturing. Other flagship initiatives have struggled, most notably Intel's Magdeburg megafab, which was canceled in mid-2025, highlighting the difficulty of sustaining large-scale greenfield investments.

Europe has made comparatively greater progress in backend manufacturing and specialty segments, including advanced packaging and power electronics, which align more closely with its existing industrial structure. At the same time, tighter regulatory regimes—particularly Dutch export controls—have drawn Europe into closer alignment with U.S.-led technology governance frameworks, while constraining strategic autonomy. Overall, Europe retains important industrial capabilities but continues to struggle to reverse its relative decline in leading-edge logic manufacturing.

In sum, Japan and Europe illustrate two distinct models of semiconductor reindustrialization shaped by divergent industrial legacies and policy environments. Japan has adopted a focused, dual-track strategy combining near-term supply security with selective long-term technological bets, while Europe has pursued a broader approach centered on automotive, industrial, and specialty strengths. Both cases underscore the complexity of rebuilding semiconductor capabilities in a highly capital-intensive and globally interconnected industry, where progress is incremental and depends on sustained coordination between public policy and private investment.

7. Singapore and India: Strategic Nodes in a Fragmented System

Beyond the major semiconductor powers, Singapore and India have emerged as strategically significant nodes within an increasingly fragmented yet interdependent global supply chain. Their roles differ markedly: Singapore operates as a trusted, high-value anchor within advanced segments, while India offers long-term scalability and diversification potential.

Singapore stands at a strategic inflection point amid accelerating geopolitical realignment. Accounting for roughly 10 percent of global semiconductor production and about 20 percent of equipment manufacturing, it has leveraged the "China-Plus-One" shift to attract capital-intensive investments in advanced packaging, mature-node production, and regional headquarters.

Recent investments signal a qualitative shift. Micron's dedicated high-bandwidth memory assembly plant, GlobalFoundries' acquisition of Advanced Micro Foundry, and the accelerated US$ 7.8 billion VIS–NXP joint-venture fab have embedded Singapore directly within critical AI and automotive supply bottlenecks. Market estimates value of the semiconductor sector at US$ 10.16 billion in 2025, with growth toward US$ 14.15 billion by 2030, led by AI-centric applications.

Beyond manufacturing, Singapore is repositioning itself as an innovation platform. The RIE2030 program commits S$ 37 billion to research from 2026–2030, with a dedicated Semiconductor Flagship focused on advanced packaging, heterogeneous integration, photonics, and wide-bandgap materials. Complemented by Manufacturing 2030 and the National Semiconductor Translation and Innovation Centre, this strategy prioritizes depth and integration over competing directly in ultra-leading-edge logic.

India, by contrast, is a late entrant with substantial strategic optionality and demographic scale. Through the India Semiconductor Mission, India has mobilized over US$ 10 billion in fiscal incentives, including up to 50 percent capital subsidies, to seed a domestic ecosystem. Ten major projects have been secured, notably a commercial wafer fab by Tata Electronics and PSMC (US$ 10.9 billion), and a flagship OSAT facility by Micron (US$ 2.75 billion), signaling credible initial momentum.

India's strategy is deliberately incremental. It prioritizes mature technology nodes, advanced packaging, and labor-intensive back-end manufacturing to establish operational depth before pursuing leading-edge fabrication. Parallel investments in infrastructure, streamlined regulatory processes, and semiconductor-specific talent programs are intended to lower execution risk and improve long-term scalability.

While India is unlikely to emerge as a near-term competitor at the advanced frontier, its strategic value lies elsewhere. A vast domestic electronics market, a large and trainable workforce, and geopolitical alignment with U.S.-led technology frameworks position India as a critical diversification platform. Over time, these attributes enable India to contribute meaningfully to global supply-chain resilience and to serve as a potential secondary manufacturing pole as the industry continues to regionalize.

8. Safeguarding Resilience and Peace

The global semiconductor industry is entering a new phase defined by concentrated interdependence. While manufacturing footprints are gradually becoming more geographically diversified, technological leadership—especially in AI-enabling, angstrom-class nodes—remains highly concentrated. No single country commands the full semiconductor value chain, and no realistic pathway toward comprehensive self-sufficiency exists without incurring prohibitive economic costs

Within this structurally interdependent system, Taiwan occupies a uniquely central position. Its importance derives not only from scale, but from sustained leadership in advanced-node manufacturing. As chips penetrate virtually every sector of production and serve as foundational enablers of artificial intelligence, the stability of Taiwan's semiconductor ecosystem has become inseparable from global economic stability. Any major disruption to Taiwan's semiconductor supply chain would be catastrophic, with consequences extending far beyond the immediate region.

On January 8, 2026, Singapore's Senior Minister Lee Hsien Loong, speaking at the Regional Outlook Forum, drew international attention to the Taiwan Strait. He stated candidly: "if there is trouble Cross-straits, that is trouble not just for Taiwan and China, or the US and China, but for the whole region and for the world. And so we believe that it is important that there is peace in the Taiwan Strait."

This remark underscores a core reality long obscured by the noise of geopolitics: in a highly digitalized and deeply specialized modern world, peace and stability in the Taiwan Strait are no longer merely security concerns, but a necessary condition for sustaining the global economic lifeline.

The link between stability in the Taiwan Strait and the global economy is not an abstract security concept, but a clear causal chain. The global economy is rapidly advancing toward an era defined by AI and comprehensive digitalization. The core enabler of this transformation—advanced computing chips—will, for the foreseeable future, remain highly concentrated in Taiwan.

Entering 2025, as the semiconductor industry moves toward the Angstrom Era, Taiwan has not been replaced; on the contrary, it has further consolidated its position as the global hub of semiconductor manufacturing. Data show that by the third quarter of 2025, TSMC's share of the global foundry market had climbed to a historic high of 71.0%.

The truly decisive factor lies in the "asymmetric advantage" created by advanced process technologies. According to TrendForce estimates, by the fourth quarter of 2025, TSMC will control roughly 69% of global advanced-node capacity, far exceeding Samsung's 21% and Intel's 10%. This means that the AI chips and high-performance processors powering companies such as NVIDIA, Apple, and AMD will, in overwhelming majority, still need to pass through Taiwan's cleanrooms before they can come into existence.

Long-term projections by Taiwan's Industrial Technology Research Institute (ITRI) further reveal the structural nature of this dependence. Even as countries actively promote localized production through subsidies, Taiwan is still expected to command 61% of global sub-6-nanometer advanced manufacturing capacity by 2029. By comparison, the United States would account for about 16%, South Korea 11%, Japan 7%, Europe 4%, and China only around 1%. When more than 60% of the world's advanced computing power is manufactured in Taiwan, Taiwan's stability directly determines whether the global technology industry can continue to function.

Senior Minister Lee's remarks remind the international community of a clear yet often overlooked truth: peace in the Taiwan Strait is a globally shared public good. Therefore, preserving peace and stability in the Taiwan Strait has long transcended the logic of geopolitical power politics. It has become a necessary condition for ensuring supply-chain resilience, sustaining technological innovation, and safeguarding global economic prosperity.

International assessments are increasingly converging on this conclusion. The United States has explicitly framed peace and stability in the Taiwan Strait as a shared global interest. Antony J. Blinken, then U.S. Secretary of State, observed on July 14, 2023, that approximately half of global commercial shipping transits the Taiwan Strait each day, and that around 70 percent of the world's semiconductors are manufactured in Taiwan. From this perspective, opposition to unilateral changes to the status quo is not merely a political position, but a recognition of Taiwan's centrality to global trade flows and technological continuity.

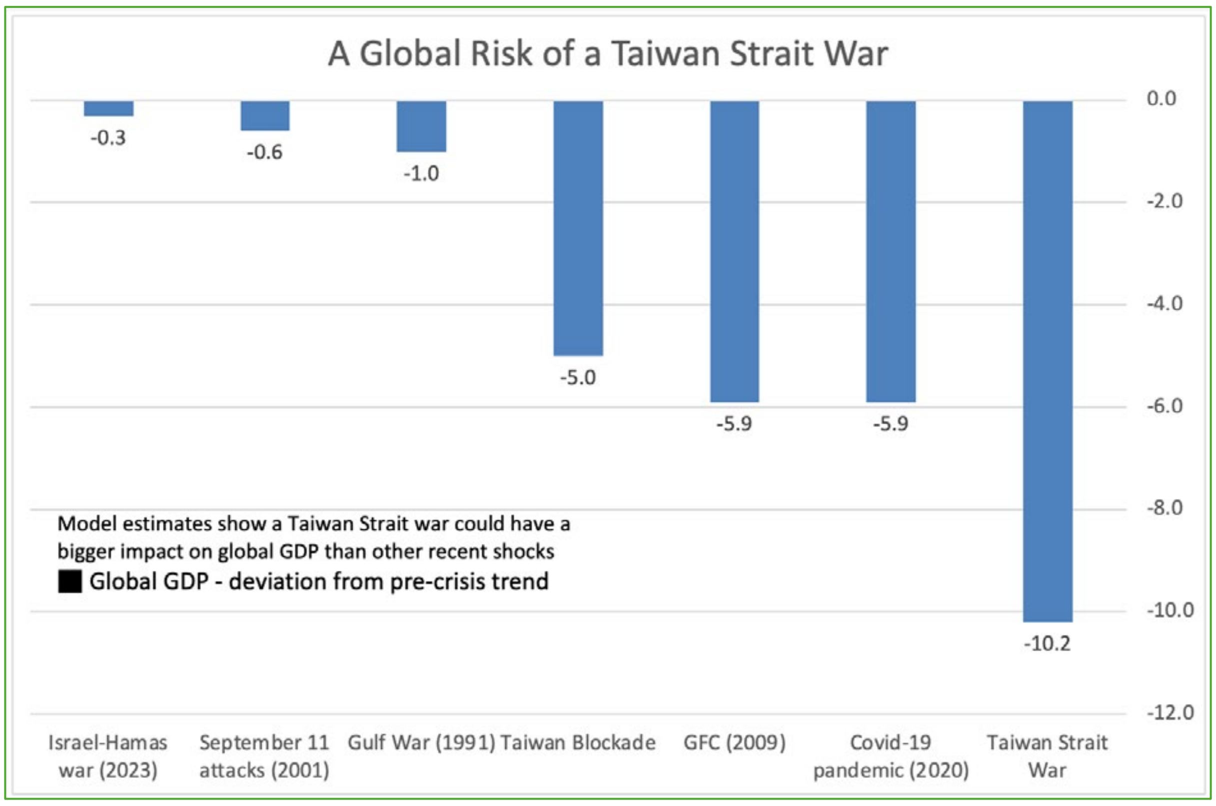
This assessment has since been echoed at the highest levels of U.S. economic policymaking. Speaking at the World Economic Forum in Davos on January 21, 2026, U.S. Secretary of the Treasury Scott Bessent warned: "I would say that the single biggest threat to the world economy, the single biggest point of single failure, is that 97 percent of high-end chips are made in Taiwan. If that island were blockaded, or that capacity were destroyed, it would be an economic apocalypse."

From an intelligence and economic standpoint, the risks are equally stark. The Director of U.S. National Intelligence has testified that advanced chips produced by TSMC are embedded in roughly 90 percent of electronic devices across almost every category worldwide. A sudden halt in TSMC's production, she estimated, could inflict an ANNUAL global economic loss of between US$ 600 billion and US$ 1 trillion during the initial years—underscoring the degree to which Taiwan's semiconductor output has become deeply embedded in the global economic bloodstream.

European leaders have reached similar conclusions. The United Kingdom's foreign secretary has warned that any disruption—such as a blockade across the Taiwan Strait—would have "calamitous" consequences for the global economy, potentially exceeding even the economic shock experienced during the COVID-19 pandemic.

These concerns are reinforced by independent economic assessments. According to Bloomberg Economics' model estimates, the economic cost of a major conflict in the Taiwan Strait could reach approximately US$ 10 trillion, representing a 10.2 percent deviation from the global pre-crisis GDP trend—a magnitude that would eclipse the impact of most modern global crises, including the Covid-19 pandemic (-5.9%), the Global Financial Crisis in 2009 (-5.9%), the 1991 Gulf War (-1.0%), the September 11 attacks (-0.6%), and the 2023 Israel-Hamas war (-0.3%) (see Figure 59).

Figure 59. A Global Risk of a Taiwan Strait War

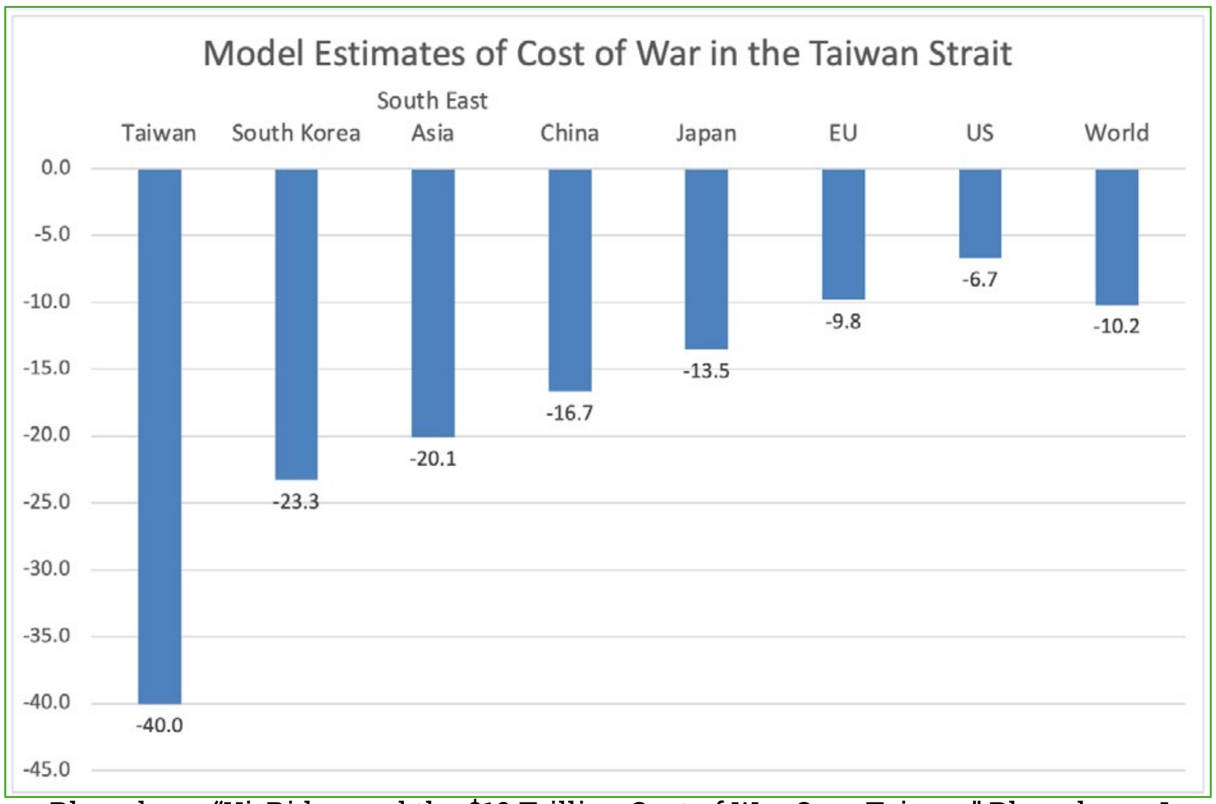


Source: Bloomberg, "Xi, Biden and the $10 Trillion Cost of War Over Taiwan," Bloomberg, January

8, 2024.

Even a Taiwan Strait blockade scenario would trigger a severe 5.0 percent drop in global GDP. The shockwaves of a Taiwan Strait war would devastate economies across the globe. According to the same Bloomberg Economics model, Taiwan's GDP would be decimated by 40.0 percent. Neighboring manufacturing and trade hubs would also suffer catastrophic contractions, with South Korea's GDP plunging by 23.3 percent, South East Asia by 20.1 percent, China by 16.7 percent, and Japan by 13.5 percent. Major Western economies would not be spared, as the EU and the US are projected to face GDP declines of 9.8 percent and 6.7 percent, respectively (see Figure 60).

Figure 60. Model Estimates of Cost of War in the Taiwan Strait



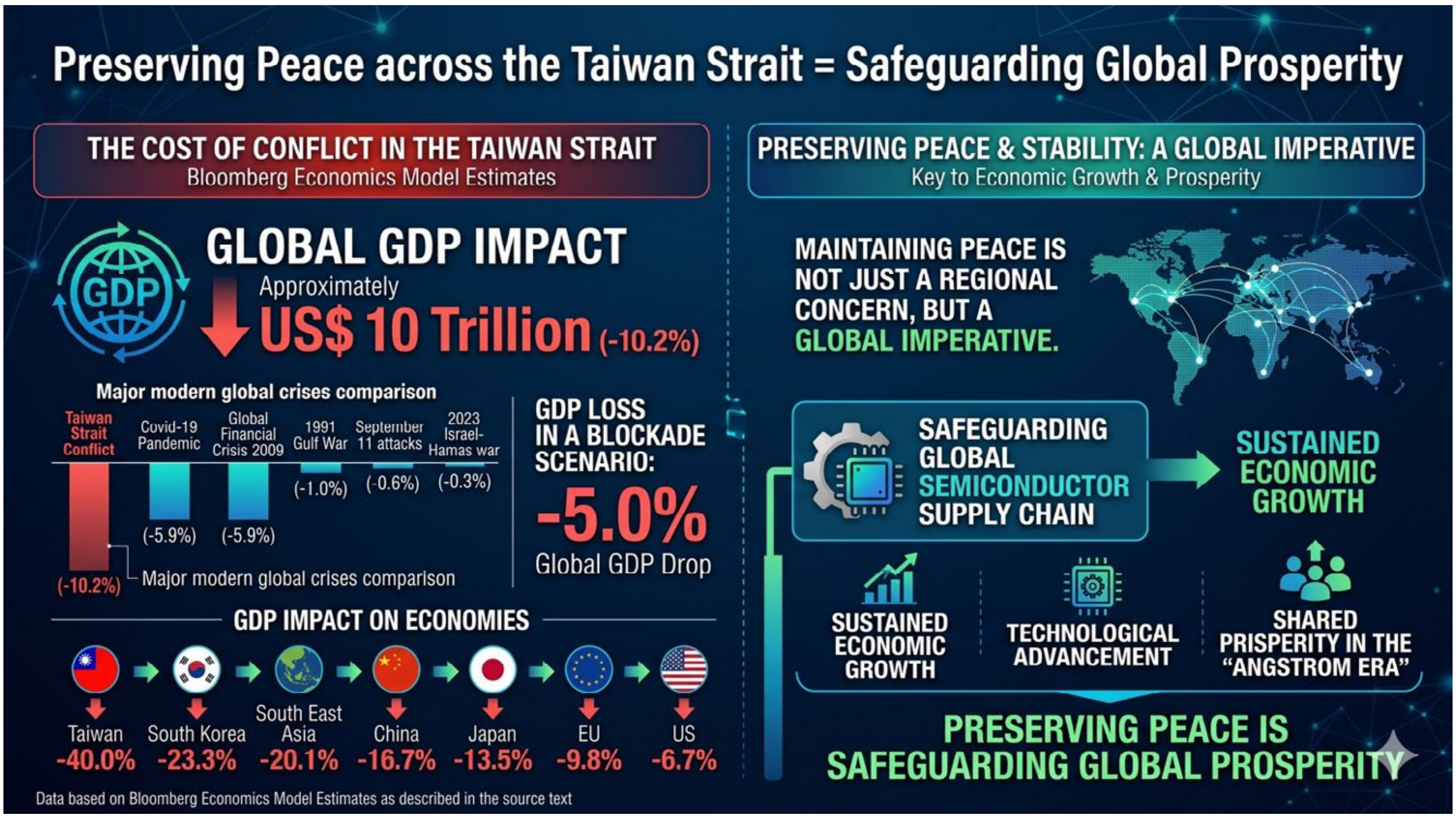
Source: Bloomberg, "Xi, Biden and the $10 Trillion Cost of War Over Taiwan," Bloomberg, January 8, 2024.

Furthermore, according to the report published by the International Institute for Strategic Studies in June 2026, if a one-year conflict breaks out across the Taiwan Strait, it could lead to a maximum 50% reduction in global trade, while Malaysia's economic losses could reach up to an estimated 41% of its GDP[70].

Taken together, these assessments reinforce a central conclusion: preserving peace and stability across the Taiwan Strait is not merely a regional concern, but a global imperative. Countries committed to sustained economic growth, technological advancement, and shared prosperity in the "Angstrom Era," all have a vital stake in safeguarding the resilience of the global semiconductor supply chain—and, inseparably, in maintaining peace and stability across the Taiwan Strait. In short, preserving peace in the Taiwan Strait is nothing less than safeguarding global prosperity. (see Figure 61).

70 Marc Foo, Meia Nouwens and Dr Maria Shagina, "The Impact of a Taiwan Strait Crisis or Conflict on the Malaysian Economy: Possible Scenarios," International Institute for Strategic Studies, June 2026.

Figure 61. Preserving Peace Across the Taiwan Strait



Antony J. Blinken, US Secretary of State (July 14, 2023)

The United States also seeks to maintain peace and stability in the Taiwan Strait, which is in the interest of all nations. Fifty percent of global commerce goes through that strait every single day. Some 70 percent of the semiconductors made for the world are made in Taiwan. We continue to oppose unilateral changes to the status quo by either side.

Source: US Department of State, Press Release: "Secretary Antony J. Blinken at a Press Availability", July 14, 2023.

David Cameron, UK's foreign secretary (March 21, 2024)

Former British prime minister David Cameron has warned the world is currently a "more dangerous" place than it has been for many years, citing conflicts around the globe and China's expansive plans, especially in relation to Taiwan. "The lights on the global dashboard are flashing red, so it is a much more dangerous, difficult, uncertain world." "We don't want to see any unilateral action to change the situation between China and Taiwan. There's no doubt that were there to be something like a blockade it would have an absolutely calamitous effect, not just on Taiwan, but on the global economy. We've had recent evidence of a calamitous event with COVID. I think if that were to happen with Taiwan, it would be more significant."

Source: Paul Johnson, "Former British prime minister David Cameron warns China conflict with Taiwan would be 'calamitous' as world enters 'dangerous' era," ABC News, March 21, 2024.

Avril Haines, U.S. Director of National Intelligence (May 5, 2023)

Director Haines presented what she called a "general estimate" during testimony before the US Senate Armed Services Committee. She noted that the advanced semiconductor chips produced by Taiwan Semiconductor Manufacturing Company Ltd (TSMC) are used in 90 percent of "almost every category of electronic device around the world." If a Chinese invasion stopped TSMC from producing those chips, " it will have an enormous global financial impact that I think runs somewhere between [US]$ 600 billion to [US]$ 1 trillion on an annual basis for the first few years," she said.

Source: Reuters, "Taiwan chip production would be 'enormous' global economic blow", May 5, 2023.

Lee Hsien Loong, Senior Minister of Singapore (January 8, 2026)

Senior Minister Lee, "if there is trouble Cross-straits, that is trouble not just for Taiwan and China, or the US and China, but for the whole region and for the world. And so we believe that it is important that there is peace in the Taiwan Strait."

Source: "SM Lee Hsien Loong at the Regional Outlook Forum 2026 Dialogue," Prime Minister Office, Singapore, January 8, 2026.

Scott Bessent, US Secretary of the Treasury (January 21, 2026)

Scott Bessent, "I would say that the single biggest threat to the world economy, the single biggest point of single failure is that 97% of the high-end chips are made in Taiwan. If that island were blockaded, that capacity were destroyed, it would be an economic apocalypse."

Source: "Conversation with Scott Bessent, US Secretary of the Treasury | WEF Annual Meeting 2026," January 21, 2026."

9. Forging Strategic Partnership with Taiwan

Taiwan's semiconductor sector represents far more than an attractive investment destination; it offers a durable foundation for long-term strategic partnership in shaping the future of the global digital economy. International capital has already recognized this reality—not merely by investing in Taiwan, but by aligning itself with Taiwan's industrial trajectory and long-term technological roadmap.

A compelling example is Singapore's sovereign wealth fund, GIC, whose disciplined, long-horizon investment approach reflects confidence not only in financial returns, but in Taiwan's enduring centrality to the global semiconductor ecosystem. In 2024, GIC became the second-largest shareholder of TSMC, holding 3.15%, second only to Taiwan's National Development Fund. Within a single year, GIC generated NT$ 405.1 billion (US$ 12.9 billion) in returns from its TSMC investment—clear evidence that strategic alignment with Taiwan delivers both resilience and performance.

This confidence is grounded in Taiwan's irreplaceable position at the heart of the global semiconductor industry. Between 2021 and 2025, global semiconductor capital expenditures consistently exceeded US$ 150 billion annually, with foundries accounting for a rapidly expanding share. By 2025, foundries represented nearly one-third of global semiconductor CapEx, up from roughly one-quarter in 2021. Within this transformation, Taiwan's role is not peripheral—it is decisive.

TSMC alone accounted for approximately 25% of global semiconductor capital expenditures in 2025, rising from about 19–20% during 2021–2024. In absolute terms, TSMC's annual capital spending reached US$ 40.9 billion, rivaling the combined CapEx of many second-tier global players. Moving forward in 2026, TSMC expects a capital budget of US$ 52 – 56 billion. This is not cyclical exuberance; it reflects a structural reality: Taiwan is underwriting the future manufacturing capacity and technological progression of the global semiconductor industry.

Crucially, Taiwan continues to anchor its most advanced capabilities at home. More than 90% of leading-edge process technologies, advanced packaging solutions, and forward-looking R&D activities remain located in Taiwan. This concentration has created a uniquely efficient ecosystem in which high-end research, pilot production, and large-scale manufacturing coexist in close proximity—maximizing execution speed, accelerating yield learning, and enhancing innovation efficiency. The result is sustained global leadership in advanced logic chips and manufacturing services.

For this reason, forging a strategic partnership with Taiwan is not simply about accessing manufacturing capacity. It is about co-investing in innovation, co-developing next-generation technologies, and co-managing systemic risks in an increasingly fragmented global environment. Global semiconductor equipment leaders—ASML, Applied Materials, Lam Research, and Tokyo Electron—have all significantly expanded their operations in Taiwan, from next-generation wafer metrology to advanced etching, deposition, and integrated R&D facilities. Their deep integration reinforces Taiwan's ecosystem, while TSMC's unparalleled scale provides unmatched access to the global value chain.

Unsurprisingly, this environment has made Taiwan the partner of choice for leading ICT and IC design firms such as Apple, NVIDIA, AMD, Broadcom, and Qualcomm. These companies rely on Taiwan not only for wafer fabrication, but increasingly for advanced R&D, advanced packaging and heterogeneous integration—the backbone of AI, HPC, and chiplet-based architectures. While TSMC's overseas fabs in the United States, Japan, and Europe enhance geographic diversification, they complement rather than replace Taiwan's central role. The most advanced nodes remain firmly rooted at home: 2-nanometer technology entered mass production in 2025, with 1.4-nanometer processes already under active preparation. Taiwan continues to push the boundaries of physics.

Recognizing semiconductors as the foundation of the digital economy, Taiwan's government is actively deepening international partnership through three strategic pillars: integration into Taiwan's core industrial cluster, participation in the expanding semiconductor materials market, and the establishment of regional operational and innovation centers.

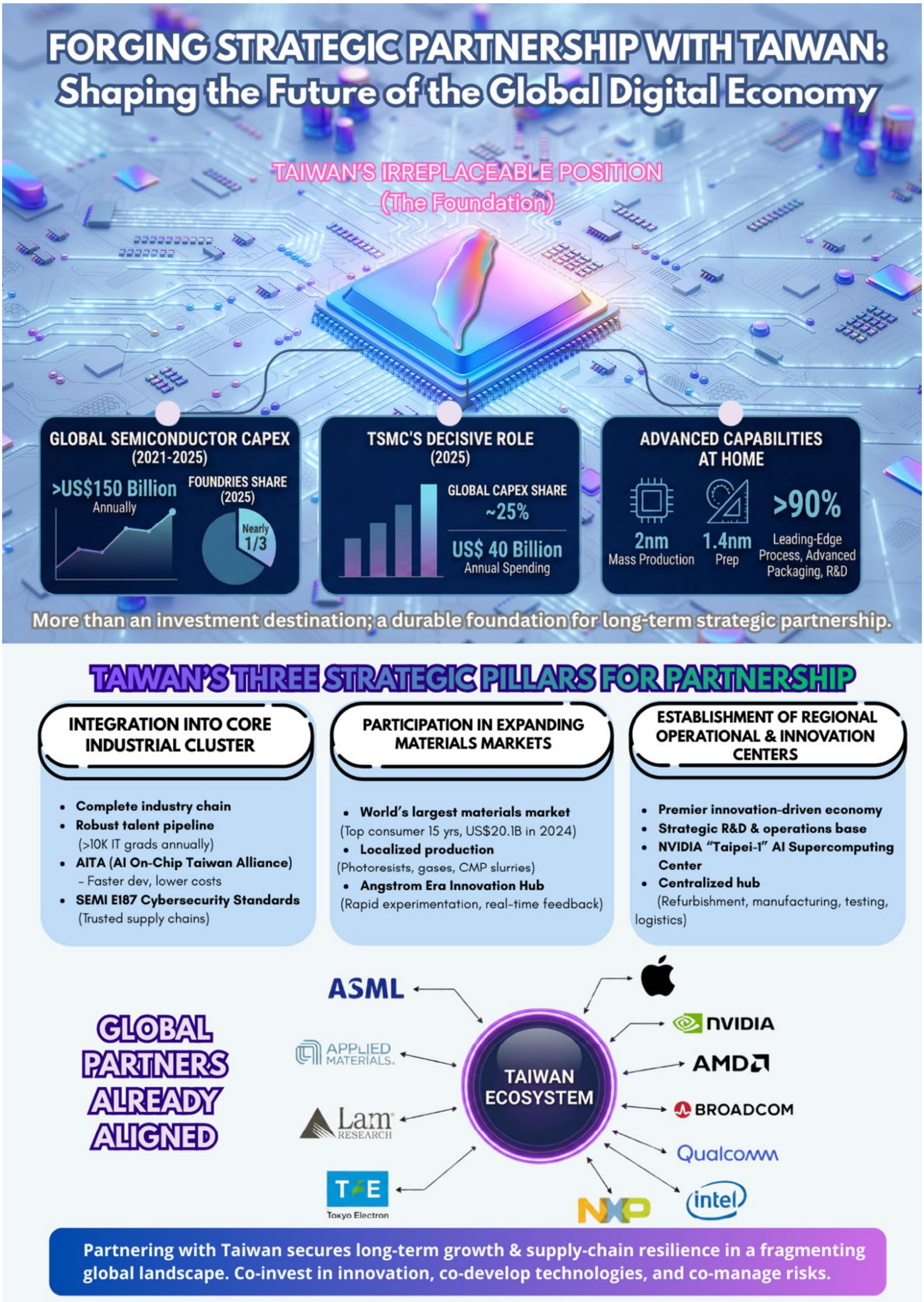
First, Taiwan offers foreign partners a uniquely complete industry chain, supported by a robust talent pipeline of over 10,000 IT-related graduates annually and reinforced by specialized semiconductor colleges across thirteen universities. Initiatives such as the AI on Chip Taiwan Alliance (AITA) shorten development cycles and reduce R&D costs, while Taiwan's leadership in publishing the SEMI E187 cybersecurity standards underscores its commitment to secure, trusted, and resilient supply chains.

Second, the explosive growth of Generative AI, HPC, and HBM has reinforced Taiwan's status as the world's largest semiconductor materials market. In 2024, Taiwan ranked as the top global consumer of semiconductor materials for the fifteenth consecutive year, with annual spending reaching US$ 20.1 billion. This sustained demand creates strong incentives for international suppliers to localize the production of advanced photoresists, electronic specialty gases, and next-generation CMP slurries. As the industry transitions toward the "Angstrom Era," Taiwan offers a uniquely efficient environment for rapid experimentation, real-time feedback, and iterative innovation—advantages that few ecosystems can replicate.

Finally, Taiwan's evolution into a premier innovation-driven economy has made it an increasingly attractive base for regional operations and strategic R&D. Global leaders such as Intel, NXP, AMD, and especially NVIDIA have expanded their presence to leverage Taiwan's dense concentration of semiconductor and AI expertise. NVIDIA's establishment of the "Taipei-1" AI supercomputing center and its large-scale AI R&D operations reflects a broader shift toward deep integration of software, hardware, and manufacturing capabilities. Taiwan provides a centralized hub for equipment refurbishment, advanced manufacturing, testing, logistics, and R&D integration.

In a world where semiconductors define economic security and technological sovereignty, partnering with Taiwan is a strategic option. By strategically aligning with Taiwan's unmatched capital intensity, technological leadership, and industrial coherence, international firms can secure long-term growth and supply-chain resilience within an increasingly fragmenting global semiconductor landscape (see Figure 62).

Figure 62. Forging Strategic Partnership with Taiwan



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