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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 Semiconductor Reports

The Taipei Representative Office in Singapore provides monthly reports related to Taiwan and the global semiconductor supply chains.

We warmly welcome you to join the **WhatsApp community - "Taiwan Semiconductor Reports"** to receive updates and reports on a monthly basis.

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Taiwan at the Core

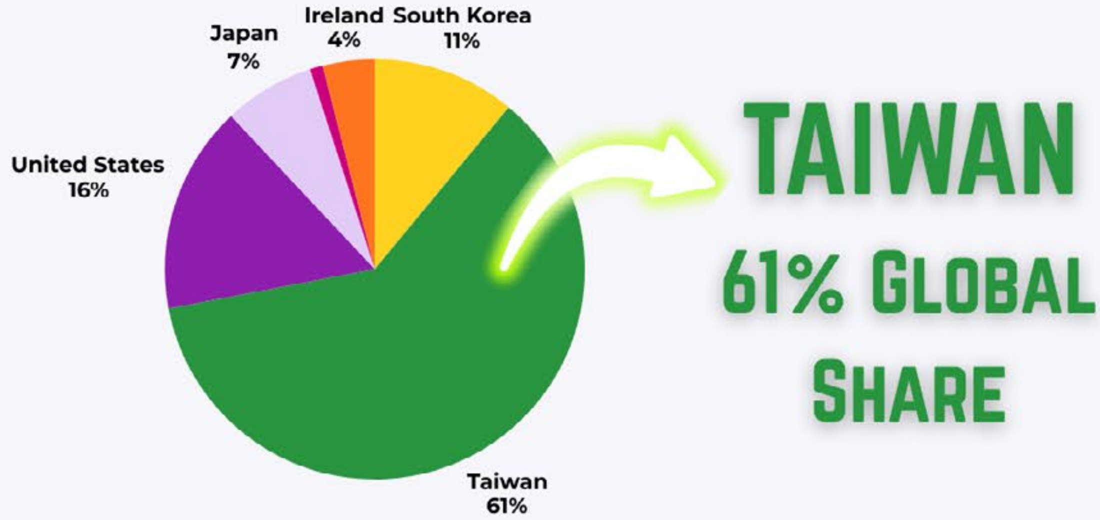
Global Shares and Rankings of Taiwan IC Industry: 2025(p)

IC Design
Taiwan's Global Share
18.7%
Rank: No.2
2025 production value
US$ 47.1 billion

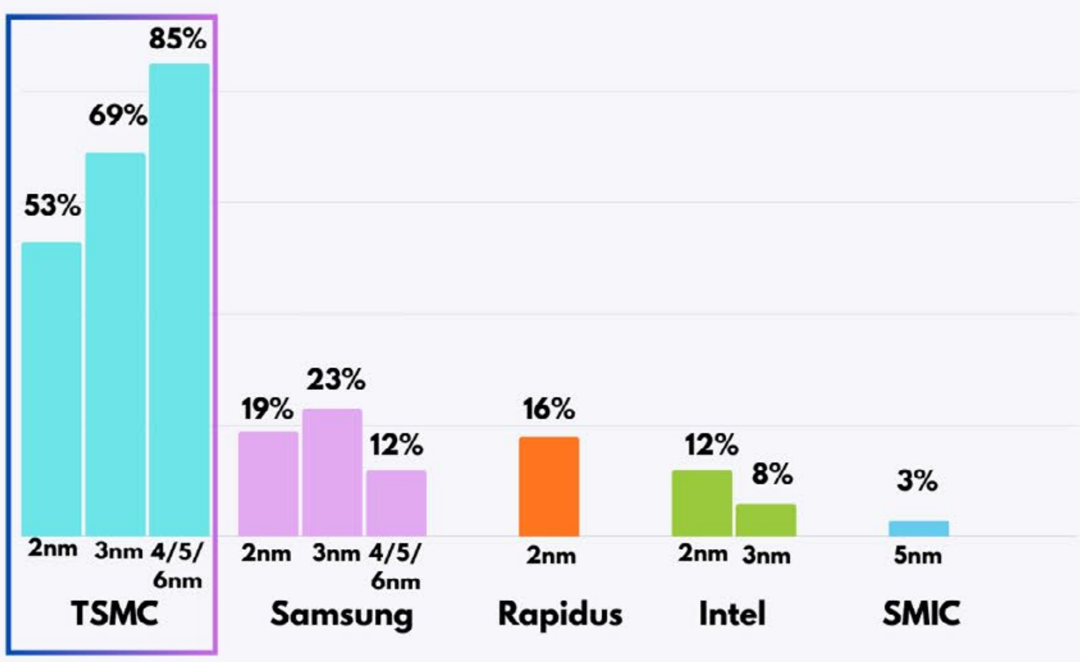
Wafer Foundry
Taiwan's Global Share
78.6%
Rank: No.1
2025 production value
US$ 142.8 billion

IC Packaging and Testing
Taiwan's Global Share
48.1%
Rank: No.1
2025 production value
US$ 23.4 billion

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



Global Sub-6nm Node Capacity Share: 2029



TAKE THE ANALYSIS HOME

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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.

Looking ahead to 2025, the semiconductor industry is projected by the WSTS to experience a robust expansion, with global revenue expected to rise to US$ 772,243 million, marking 22.5% year-over-year growth. This surge is driven primarily by the continued recovery in memory pricing, the acceleration of AI-related investment, and sustained demand for advanced logic devices supporting cloud infrastructure

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.

and edge intelligence. IC revenue alone is forecast to grow to US$ 677,852 million, a strong 25.6% increase from 2024, demonstrating that ICs will remain the engine of industry momentum. All major geographic markets—particularly the Americas and Asia Pacific—are expected to contribute significantly to this expansion.

By 2026, the growth trajectory by the WSTS is set to strengthen further as the global semiconductor market reaches an estimated US$ 975,460 million, representing 26.3% 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$ 874,291 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 1).

Table 1. Global Semiconductor Market: 2024-2026

	Amounts in US$ M			Year on Year Growth in %		
	2024	2025	2026	YoY 2024	YoY 2025	YoY 2026
Americas	195,123	251,926	338,574	45.2	29.1	34.4
Europe	51,250	54,127	60,429	-8.1	5.6	11.6
Japan	46,739	44,835	50,164	0.0	-4.1	11.9
Asia Pacific	337,437	421,354	526,293	16.4	24.9	24.9
Total World - US$ M	630,549	772,243	975,460	19.7	22.5	26.3
Discrete Semiconductors	31,026	30,900	33,436	-12.7	-0.4	8.2
Optoelectronics	41,095	42,597	45,020	-4.8	3.7	5.7
Sensors	18,923	20,894	22,713	-4.1	10.4	8.7
Integrated Circuits	539,505	677,852	874,291	25.9	25.6	29.0
Analog	79,588	85,552	91,988	-2.0	7.5	7.5
Micro	78,633	84,839	96,620	3.0	7.9	13.9
Logic	215,768	295,892	390,863	20.8	37.1	32.1
Memory	165,516	211,568	294,821	79.3	27.8	39.4
Total Products - US$ M	630,549	772,243	975,460	19.7	22.5	26.3

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

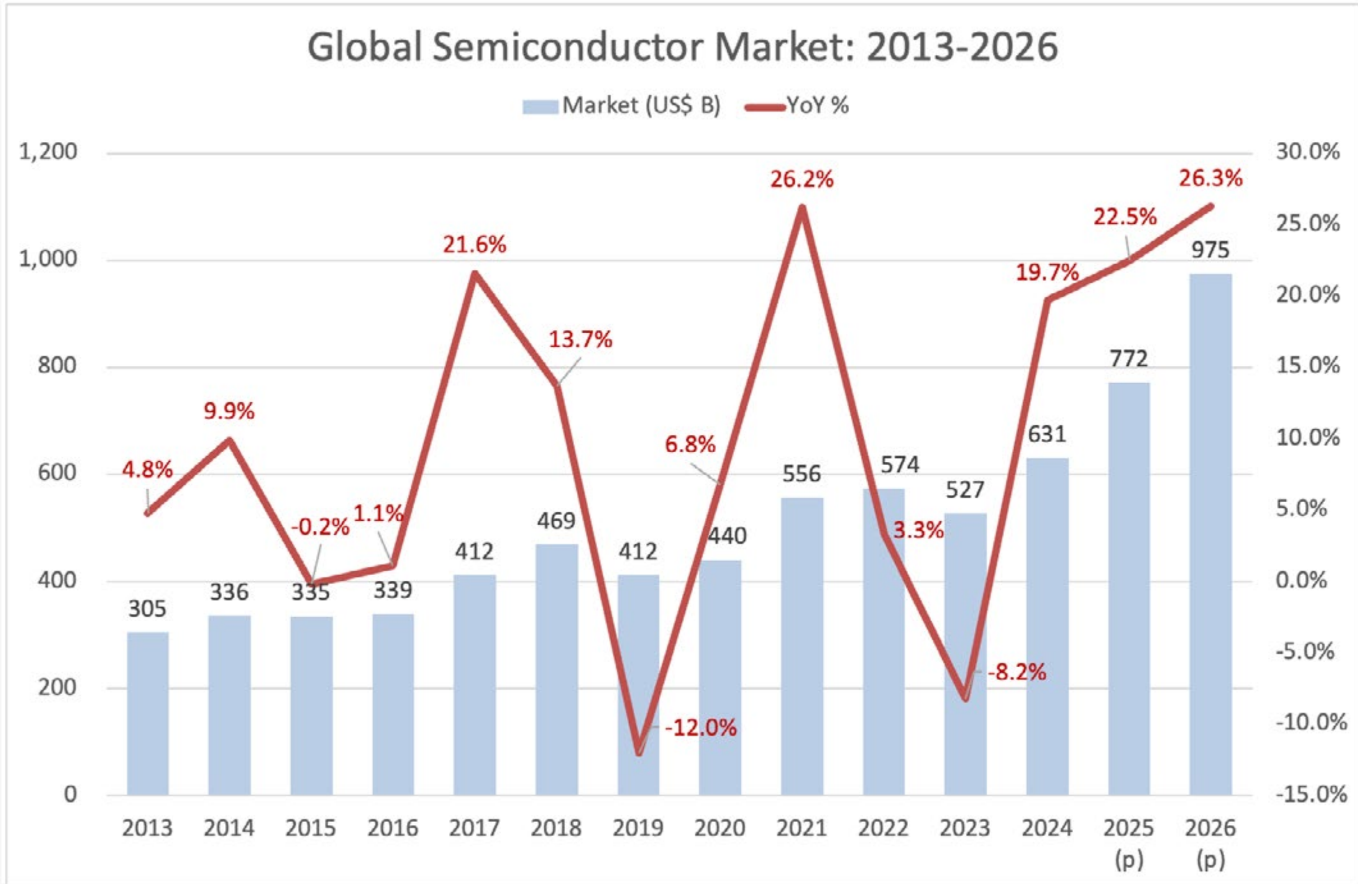
From 2013 to 2024, the global semiconductor market experienced multiple cycles shaped by technology transitions, demand fluctuations, and macroeconomic pressures. The market expanded from US$ 305 billion in 2013 to US$ 631 billion in 2024, more than doubling over the 12-year period. Early in the decade, growth was moderate, with the market rising steadily in 2013–2014, before flattening between 2015 and 2016. A strong upcycle emerged in 2017 (21.6%) and 2018 (13.7%), driven by memory pricing strength and expanding data-center and mobile demand. However, 2019 recorded a sharp -12.0% contraction, reflecting a downturn in memory markets.

A renewed growth phase unfolded from 2020 to 2022. The market rebounded in 2020 (6.8%), followed by significant expansion in 2021 (26.2%) as pandemic-driven digitalization fueled record demand for computing, cloud infrastructure, and consumer electronics. Growth moderated to 3.3% in 2022, before the sector entered another correction in 2023 (-8.2%) due to inventory adjustments, macroeconomic slowdown, and weakening end-market demand. The market returned to expansion in 2024, reaching US$ 631 billion with a 19.7% year-over-year increase, primarily supported by the recovery of memory prices and the acceleration of AI-related investment.

According to the WSTS Autumn 2025 forecast, the global semiconductor market is expected to maintain strong momentum through mid-decade. In 2025, the market is projected to reach US$ 772 billion, representing 22.5% annual growth. This expansion is supported by continued AI-led demand for advanced logic, high-bandwidth memory, and specialized accelerators, alongside the normalization of inventories across major end markets.

The upward trajectory by the WSTS is expected to continue into 2026, with the global market forecast to rise to US$ 975 billion, marking an even stronger 26.3% year-over-year increase. This reflects structural growth drivers such as wide adoption of generative AI, increasing semiconductor content in electric and autonomous vehicles, and expanding deployment of cloud and edge computing infrastructure. At this pace, the industry is on track to approach—or potentially exceed—US$ 1 trillion in annual revenue by 2027 (see Figure 1).

Figure 1. Global Semiconductor Market: 2013-2026



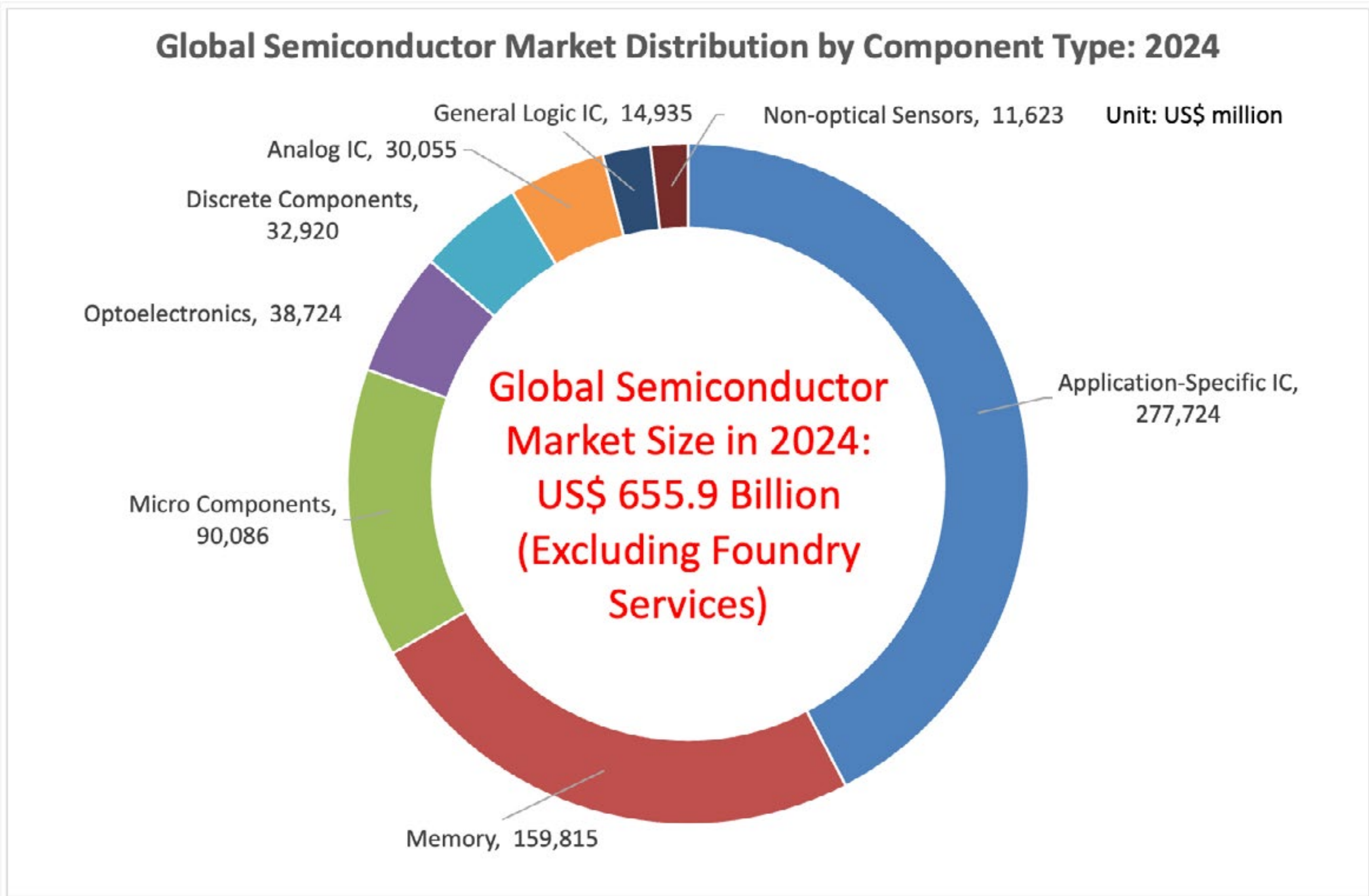
Source: World Semiconductor Trade Statistics, "Global Semiconductor Market Approaches USD 1 Trillion in 2026," December 2, 2025.

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

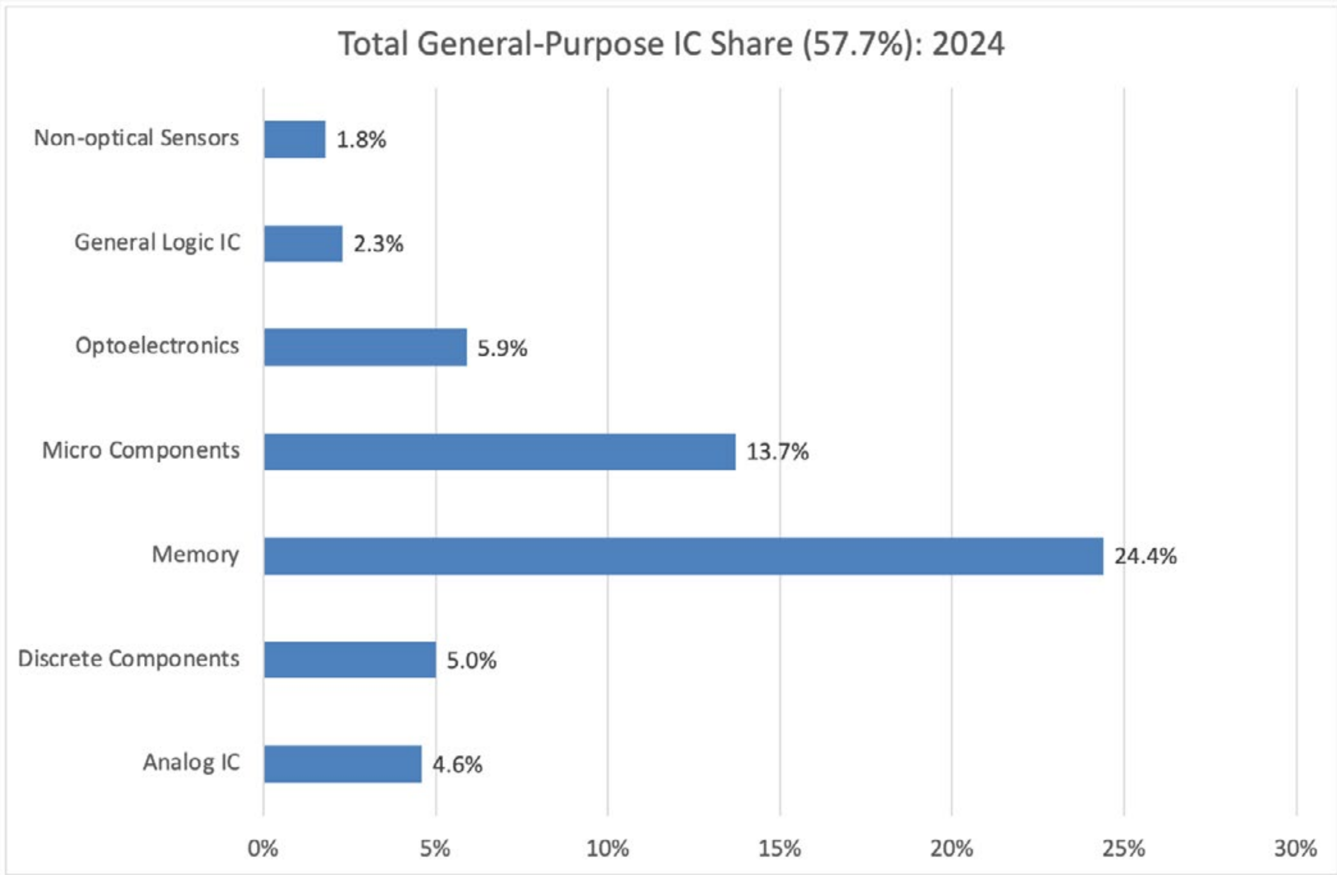


Source: Sayumi Chung, "Market and Technology Trends in AI Semiconductors and IC Design," ITRI, October 28, 2025, p. 7.

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

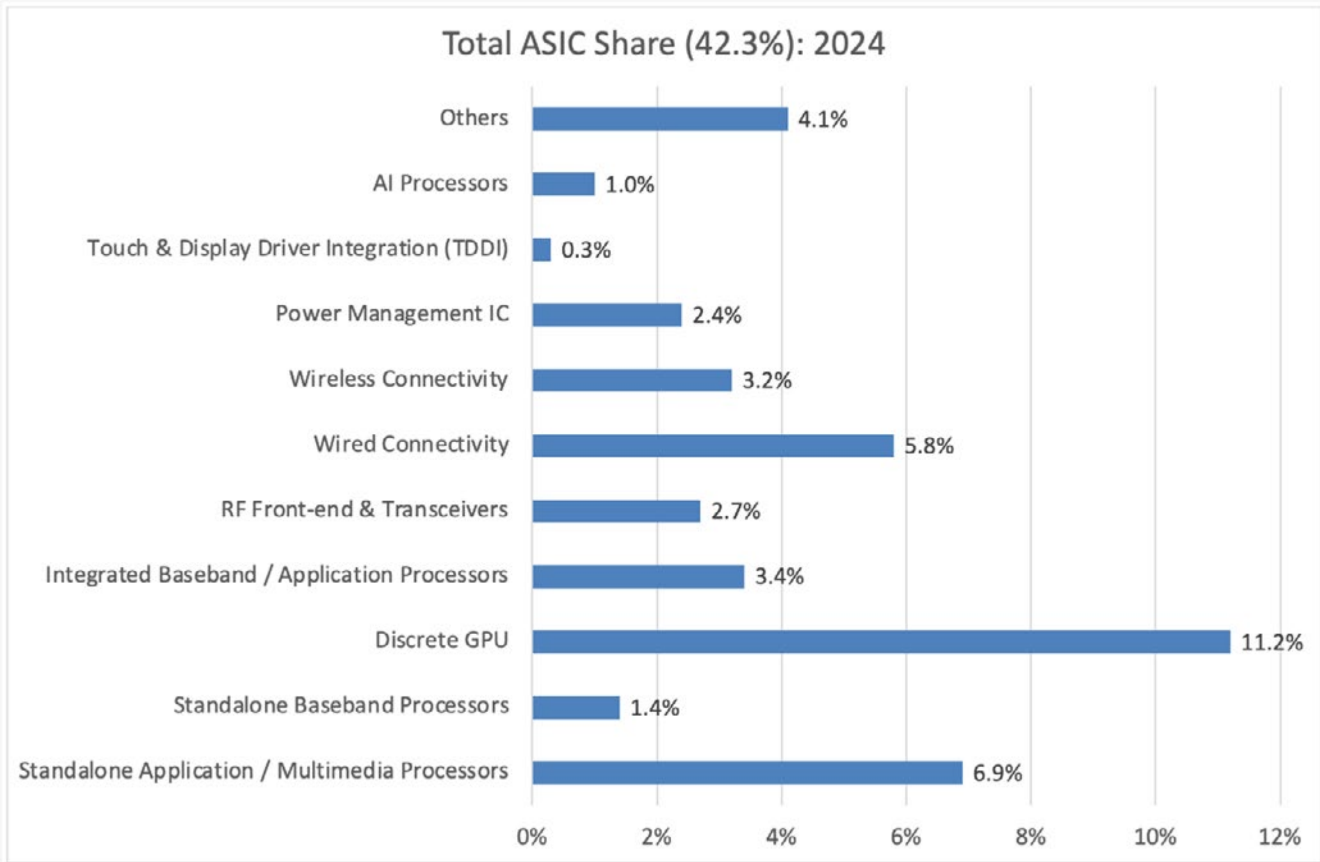


Source: Sayumi Chung, "Market and Technology Trends in AI Semiconductors and IC Design," ITRI, October 28, 2025, p. 7.

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

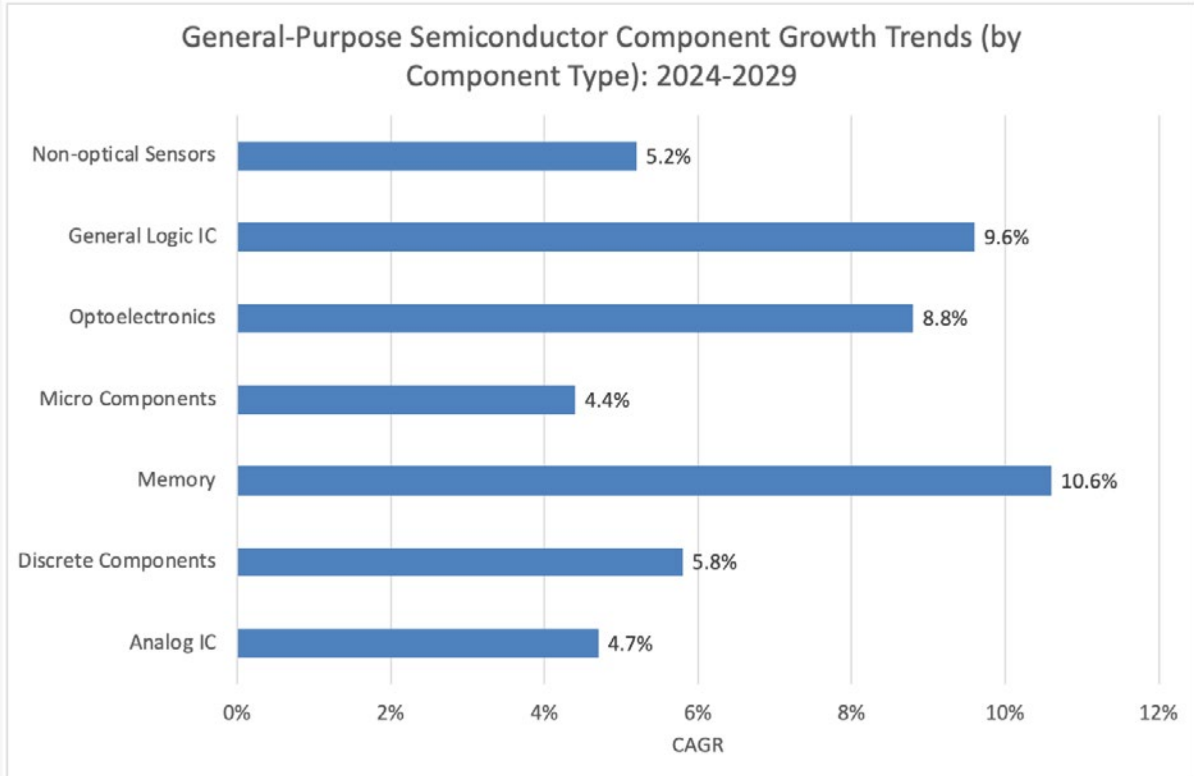


Source: Sayumi Chung, "Market and Technology Trends in AI Semiconductors and IC Design," ITRI, October 28, 2025, p. 7.

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.

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



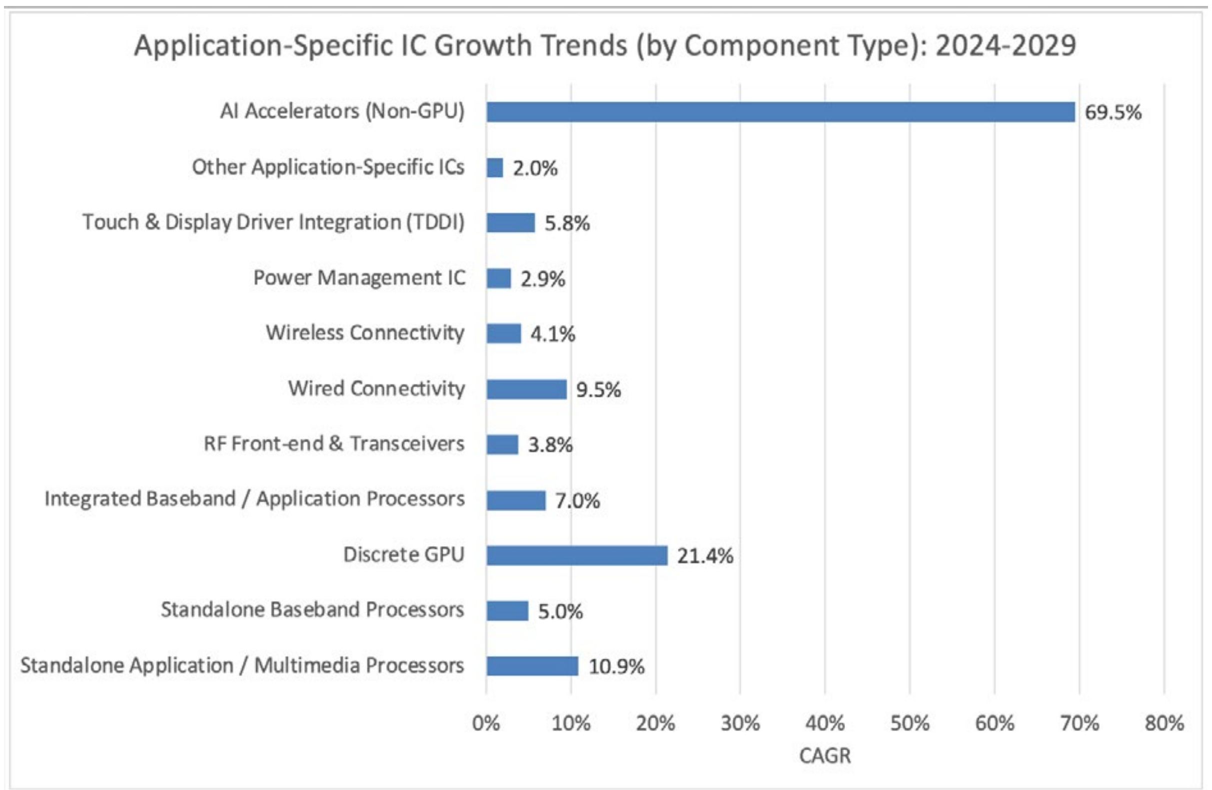
Source: Sayumi Chung, "Market and Technology Trends in AI Semiconductors and IC Design," ITRI, October 28, 2025, p. 8.

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

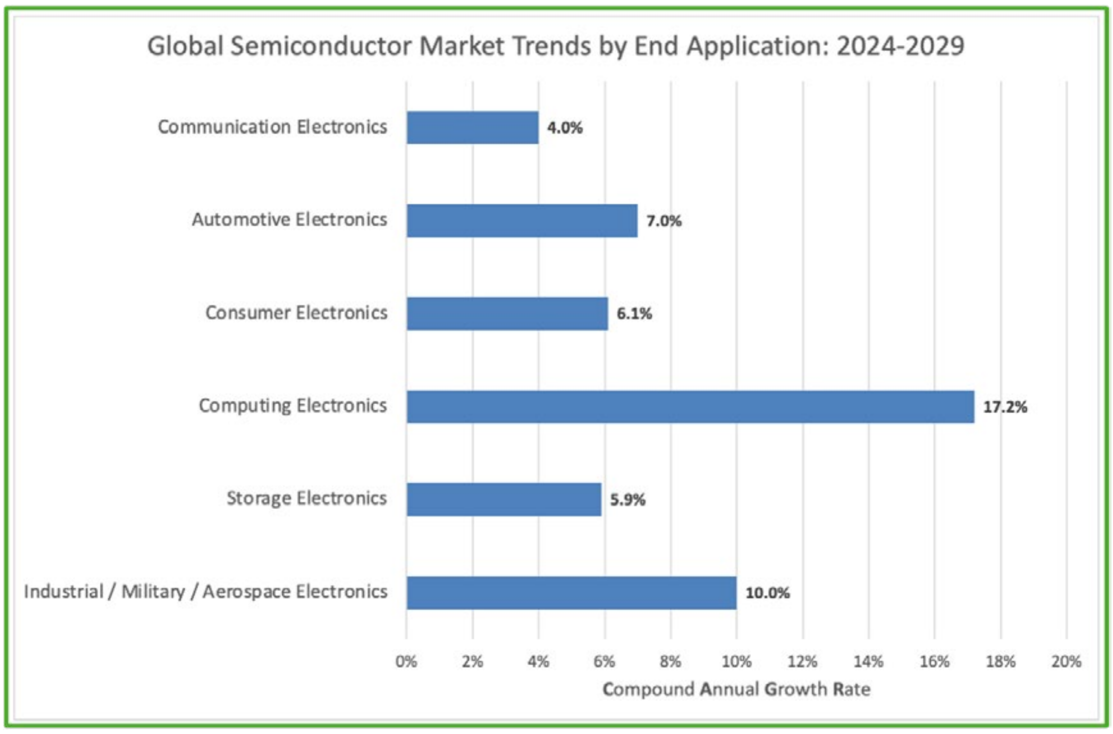


Source: Sayumi Chung, "Market and Technology Trends in AI Semiconductors and IC Design," ITRI, October 28, 2025, p. 8.

3. End Application

On the end-application of the global semiconductor supply chain, 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



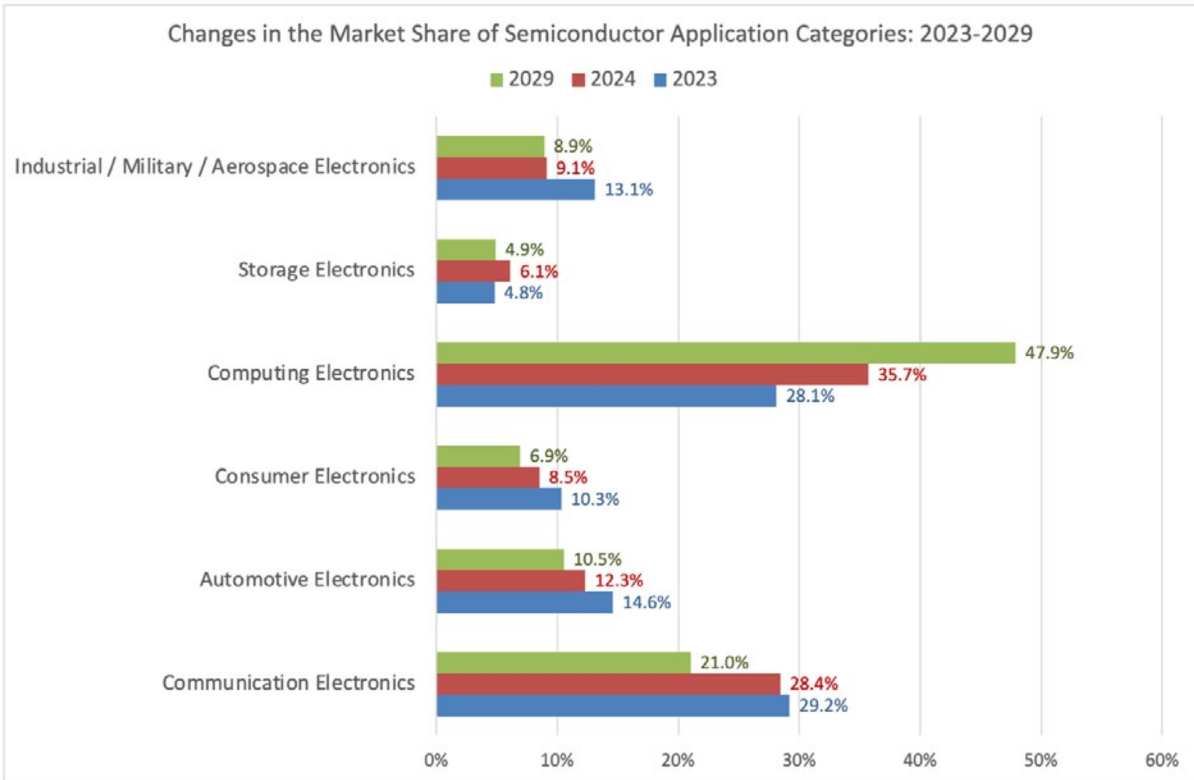
Source: Sayumi Chung, "Market and Technology Trends in AI Semiconductors and IC Design," ITRI, October 28, 2025, p. 3.

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 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).

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.

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

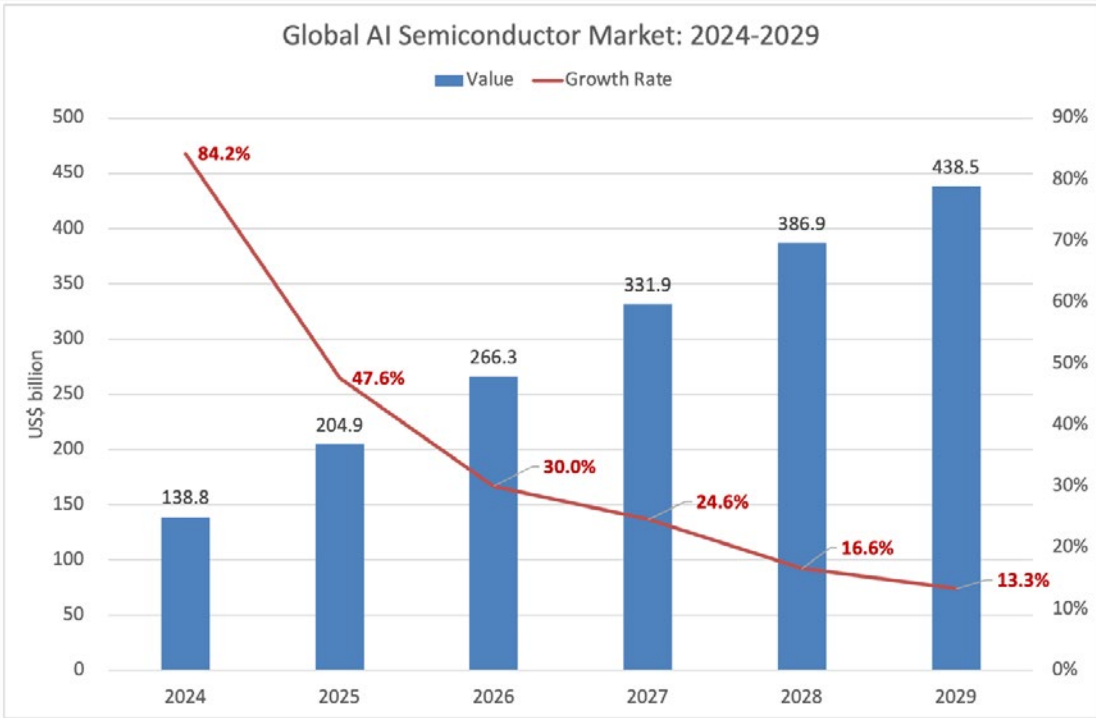


Source: Sayumi Chung, "Market and Technology Trends in AI Semiconductors and IC Design," ITRI, October 28, 2025, p. 4.

4. AI-oriented Semiconductors

AI-oriented semiconductors have emerged as the primary engine powering the rapid expansion of the global semiconductor market. In 2024, the global AI semiconductor market reached US$ 138.8 billion. According to estimates from ITRI's Industrial Economics and Knowledge Center (IEK), an explosive surge in AI demand in 2024 will eventually stabilize into a more sustained growth phase. In 2025, the global AI semiconductor market is expected to expand to US$ 204.9 billion, representing a 47.6% increase. Looking toward the medium and long term, driven by continued expansion in edge AI, AI servers, and data-center deployments, the global AI semiconductor market is projected to reach US$ 438.5 billion by 2029. Over the period from 2024 to 2029, the CAGR is expected to remain as high as 25.9% (see Figure 9).

Figure 9. Global AI Semiconductor Market: 2024-2029



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

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.

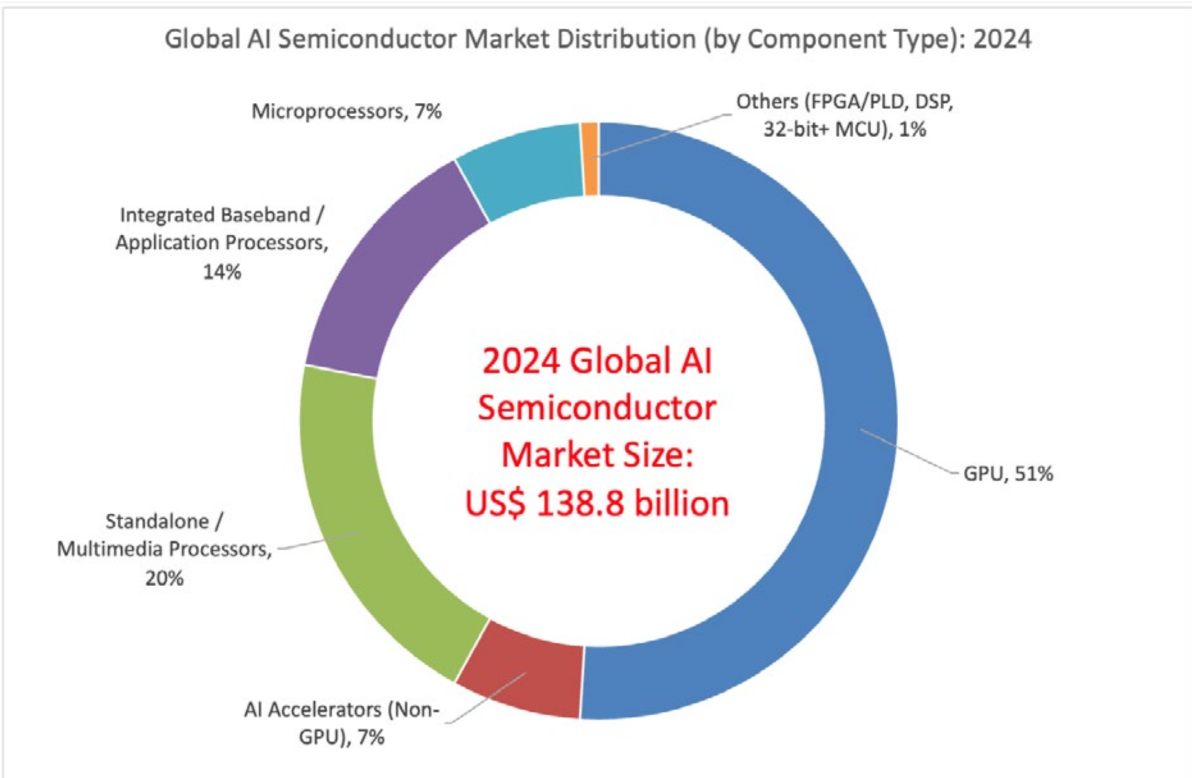
The most striking structural change comes from AI accelerators (non-GPU). Their market share surges from 7% in 2024 to 21% in 2029, elevating them to the second-largest segment in the AI semiconductor market. This expansion is underpinned by an exceptional 2024–2029 CAGR of 55.5%, far outpacing all other 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.

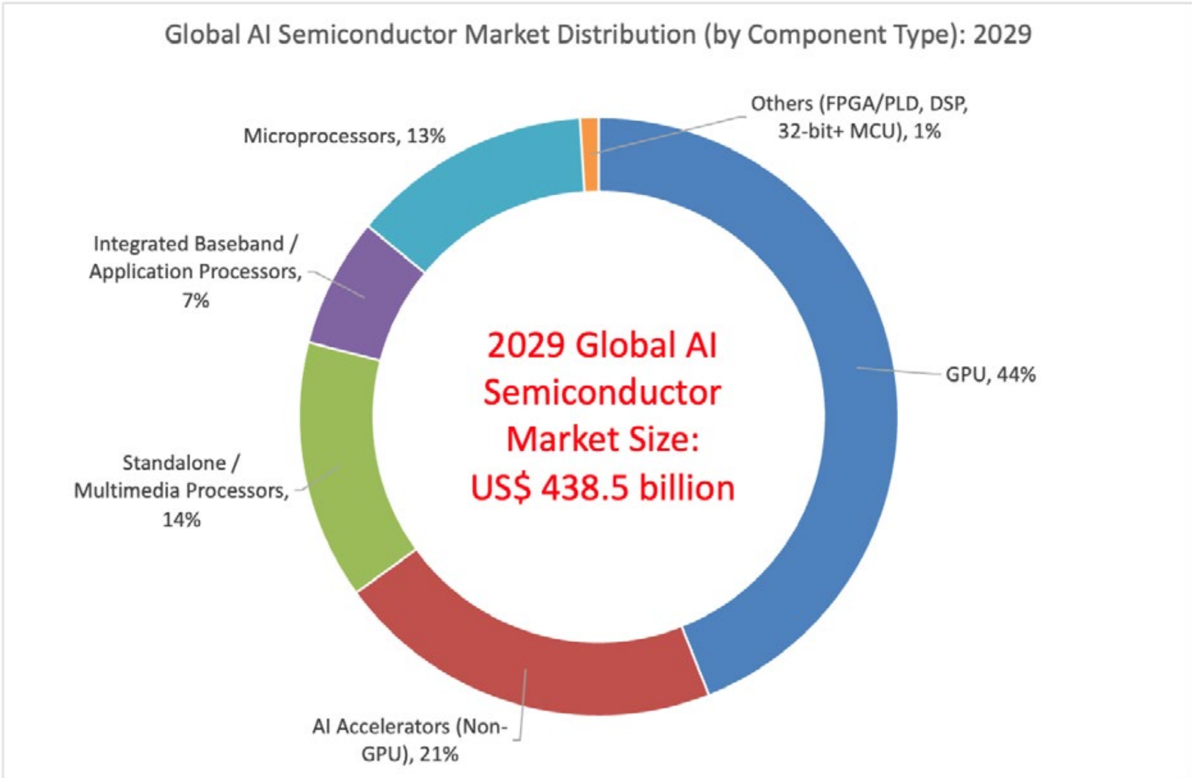
Taken together, the numerical evidence shows a market in which GPUs continue to dominate in absolute scale, AI ASICs rapidly close the gap through explosive growth, and integrated processors sustain healthy double-digit expansion despite relative share erosion. Rather than a zero-sum transition, the 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



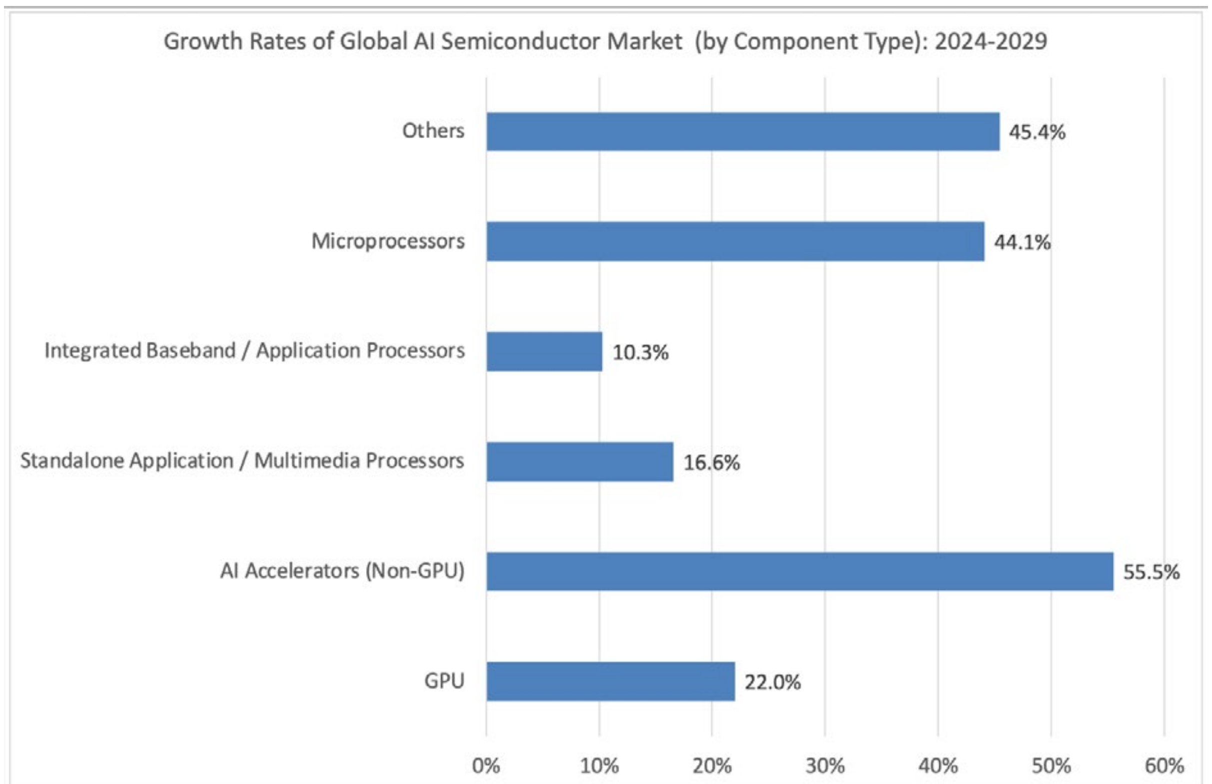
Source: Sayumi Chung, "Market and Technology Trends in AI Semiconductors and IC Design," ITRI, October 28, 2025, p. 20.

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.

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.

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.

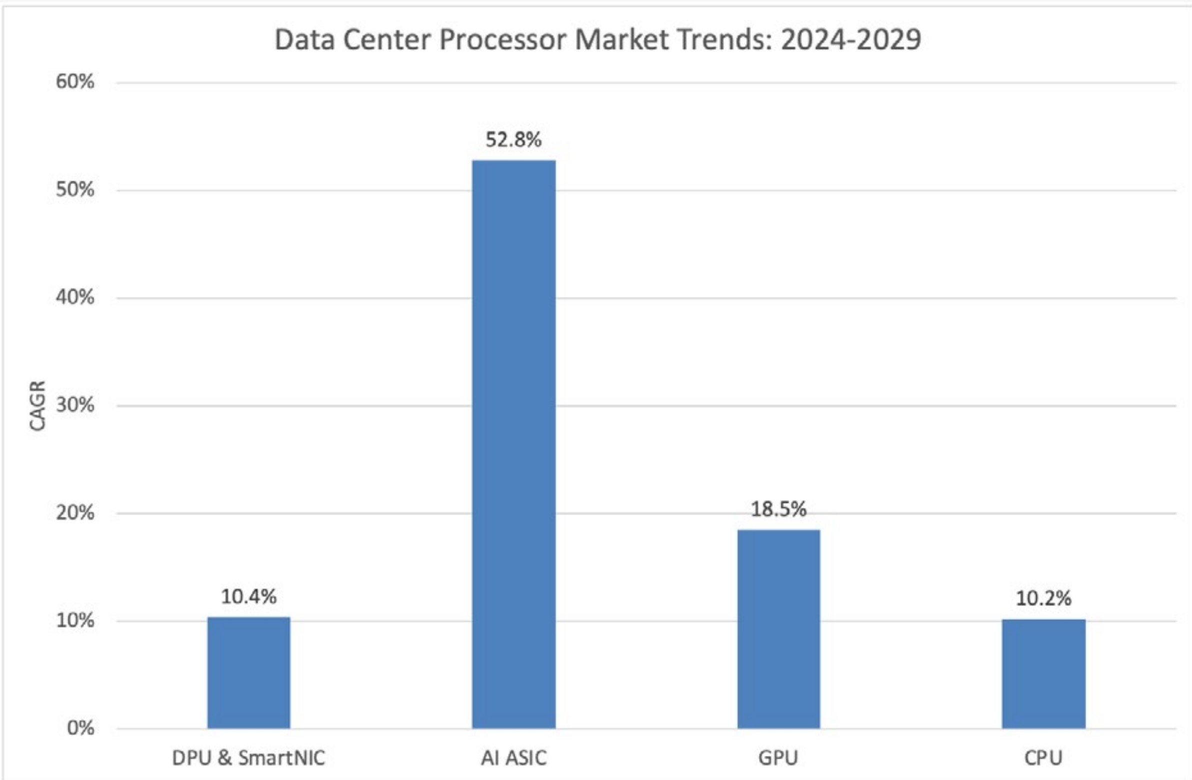
Within this broader shift, the AI ASIC market is expanding at an exceptional pace. Total market value is projected to exceed US$ 25 billion by 2027, reflecting the strategic pivot by major cloud platforms toward proprietary, workload-optimized silicon. In 2025, the AI ASIC market alone is estimated to 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.

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 2 and 3).

Table 2. 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 3. 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 4).

Table 4. 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	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

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.

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.

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 5).

Table 5. 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 6).

Table 6. 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

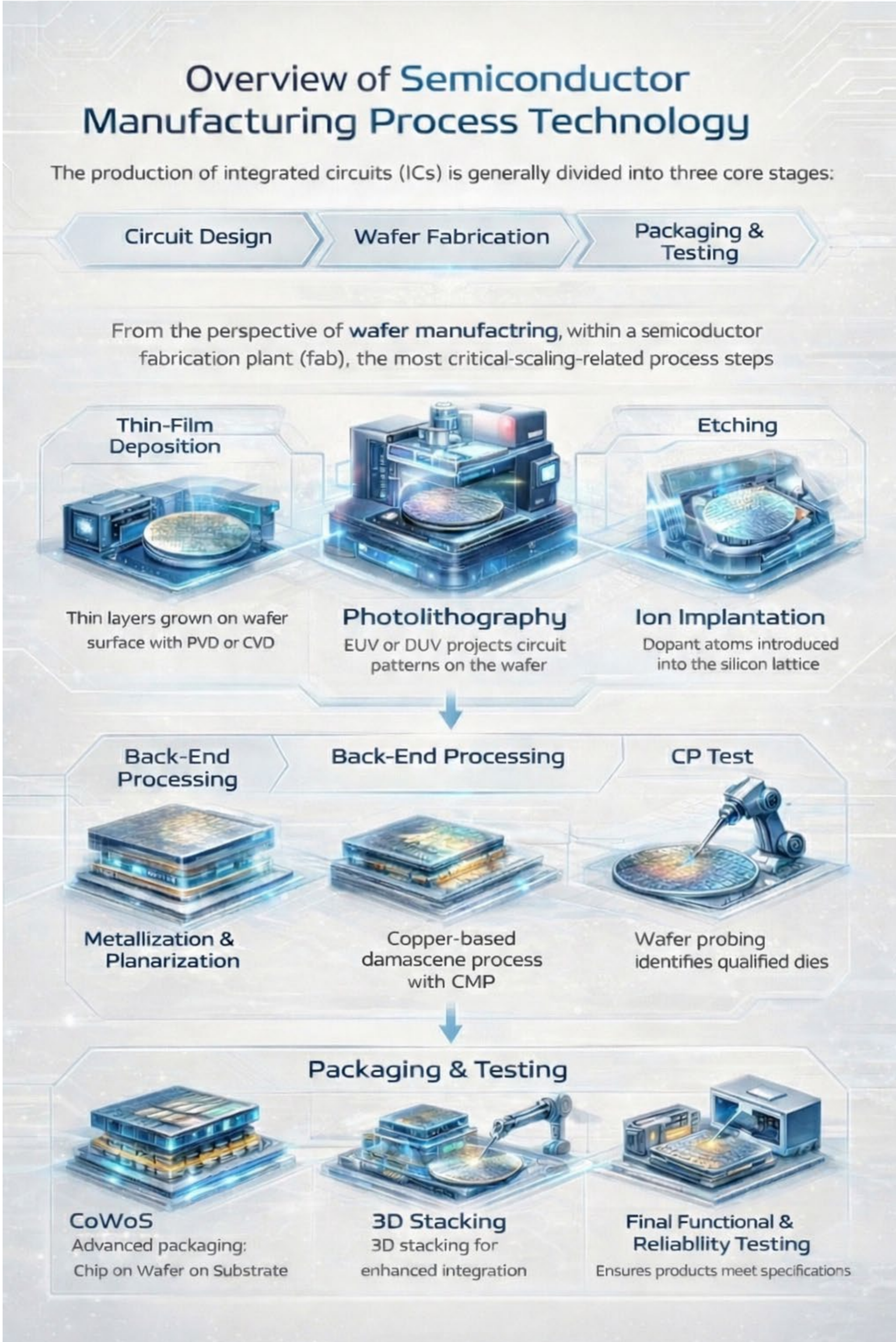
The production of integrated circuits (ICs) is generally divided into three core stages: circuit design, wafer fabrication, and packaging and testing.

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. Finally, the packaged products undergo comprehensive functional and reliability testing to ensure compliance with design specifications before shipment (see Figure 14).

Figure 14. Overview of Semiconductor Manufacturing Process Technology

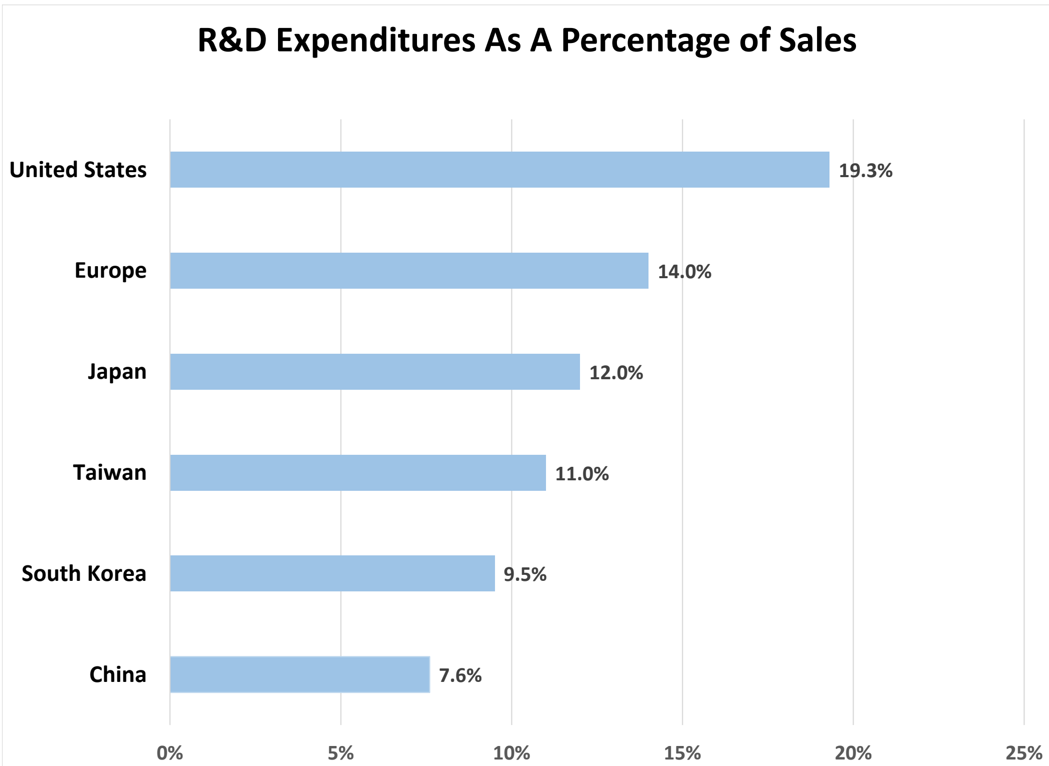


2. Research and Development

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 15).

Figure 15. 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.

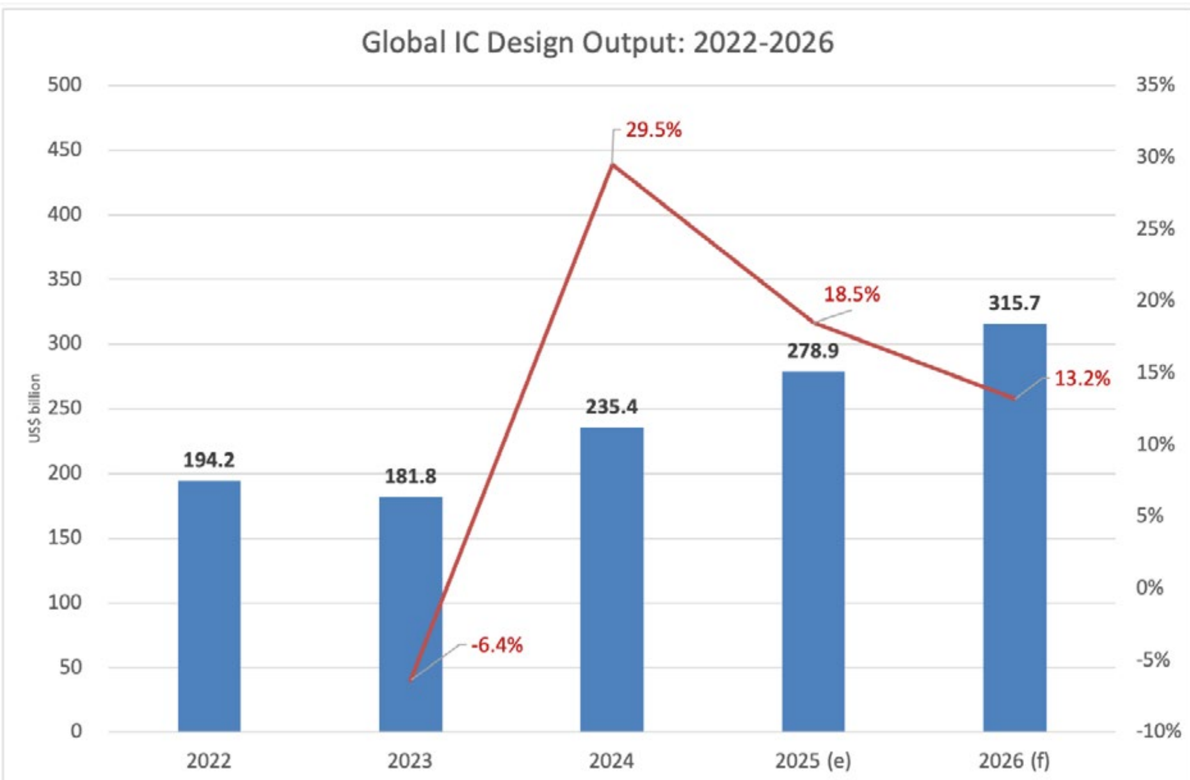
Chip design is carried out by fabless companies and IDMs. Fabless companies focus on designing semiconductor chips and partner with other companies (foundries) for the manufacturing phase while IDMs design and manufacture their own chips in their own fabs.

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]

In 2024, the global IC design industry reached a total production value of US$ 235.4 billion, representing a robust 29.5% increase from the previous year. According to projections by ITRI's IEK, the strong growth momentum seen in 2024 will continue into 2025. Benefiting from surging demand for generative AI–related chips, the global IC design industry is expected to maintain a high growth rate of 18.5% in 2025.

Looking ahead to 2026, ITRI forecasts that after the initial explosive expansion driven by AI, the buildout of AI infrastructure will gradually transition from rapid scaling to more normalized deployment. At the same time, AI functionality will become increasingly integrated into a wide range of edge devices. As the market enters a more stable and sustainable growth phase, the global IC design industry is projected to reach US$ 315.7 billion in output value in 2026, with a solid annual growth rate of 13.2% (see Figure 16).

Figure 16. Global IC Design Output: 2022-2026



Source: Sayumi Chung, "Market and Technology Trends in AI Semiconductors and IC Design," ITRI, October 28, 2025, p. 11.

Among the world's top ten IC design companies in 2024, NVIDIA continued to dominate the

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

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 7).

Table 7. 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 third quarter of 2025, the global foundry industry continued to post steady growth. According to the latest research by market intelligence firm TrendForce[5], the combined revenue of the world's top ten foundries reached US$ 45.09 billion in the third quarter of 2025, representing a quarter-on-quarter increase of 8.1% and a year-over-year increase of 29.3% compared with the third quarter of 2024. Supported by sustained demand for AI-driven high-performance computing and the rollout of new generations of consumer electronics, overall industry conditions remained on a path of moderate recovery.

Growth momentum during the quarter was driven mainly by two factors. First, continued volume expansion in AI servers and advanced computing platforms kept demand for 7-nanometer and more advanced process nodes at elevated levels. Second, pre-launch inventory build-ups for new smartphone and PC/notebook models boosted demand for chips and peripheral ICs, leading to a simultaneous improvement in capacity utilization for mature process nodes.

TSMC: Global Market Share Exceeds 70%

In the third quarter of 2025, TSMC reported quarterly revenue of US$ 33.06 billion, up 9.3% quarter-on-quarter, outperforming the industry average. Its global market share rose to 71.0%, surpassing the 70% threshold for the first time and setting a new historical high.

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

From the perspective of quarterly contribution, total revenue among the top ten foundries increased by US$ 3.37 billion compared with the previous quarter, of which TSMC accounted for approximately 83.8%, indicating that incremental industry growth during the quarter was largely concentrated in a single firm.

On a year-over-year basis, TSMC's revenue increased by 40.5%. Out of the approximately US$ 10.1 billion in total annual revenue growth generated by the top ten foundries, TSMC contributed 93.3%, reflecting its structural advantages in advanced process technologies, key customer relationships, and high value-added product mix (see Table 8).

Table 8. Top Global Foundries Revenue: 2025Q3

Unit: US$ million

Ranking	Company	2025Q3	2025Q2	Difference	QoQ	Contribution	2024Q3	YoY	Contribution
1	TSMC	33,063	30,239	2,824	9.3%	83.8%	23,527	40.5%	93.3%
2	Samsung	3,184	3,159	25	0.8%	0.7%	3,357	-5.2%	-1.7%
3	SMIC	2,382	2,209	173	7.8%	5.1%	2,171	9.7%	2.1%
4	UMC	1,975	1,903	72	3.8%	2.1%	1,873	5.4%	1.0%
5	GlobalFoundries	1,688	1,688	0	0.0%	0.0%	1,739	-2.9%	-0.5%
6	Huahong Group	1,213	1,061	152	14.3%	4.5%	799	51.8%	4.1%
8	VIS	412	379	33	8.7%	1.0%	366	12.6%	0.5%
9	Nexchip	409	363	46	12.7%	1.4%	332	23.2%	0.8%
7	Tower	396	372	24	6.5%	0.7%	371	6.7%	0.2%
10	PSMC	363	345	18	5.2%	0.5%	336	8.0%	0.3%
Total of Top 10		45,086	41,718	3,368	8.1%	100.0%	34,869	29.3%	100.0%

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

The Second Tier: Limited Contribution to Overall Growth

Samsung Foundry recorded revenue of US$ 3.18 billion in the third quarter of 2025, representing quarter-on-quarter growth of 0.8%, with a market share of 6.8%. While its capacity utilization improved slightly, its contribution to overall industry growth remained limited at both the quarterly and annual levels.

SMIC posted revenue of US$ 2.38 billion in the third quarter of 2025, up 7.8% quarter-on-quarter, with market share holding at 5.1%. Growth was mainly driven by higher utilization rates and improved average selling prices, but remained heavily concentrated in mature process nodes. Its contribution to overall industry growth was approximately 5% on a quarterly basis and around 2% on an annual basis.

UMC and GlobalFoundries reported third-quarter revenues of US$ 1.98 billion and US$ 1.69 billion, respectively, with quarter-on-quarter growth rates of 3.8% and 0%. Although both benefited from inventory build-ups linked to new consumer electronics launches, they continued to lack strong upward momentum in terms of market share and ASP structure (see Table 9).

Table 9. Ranking and Market Share of Global Top 10 Foundries by Revenue: 2022Q3-2025Q3

Ranking	Company	Market share												
		2025 Q3	2025 Q2	2025 Q1	2024 Q4	2024 Q3	2024 Q2	2024 Q1	2023 Q4	2023 Q3	2023 Q2	2023 Q1	2022 Q4	2022 Q3
1	TSMC (TW)	71.0%	70.2%	67.6%	67.1%	64.7%	62.3%	61.7%	61.2%	57.9%	56.4%	60.1%	58.5%	56.1%
2	Samsung (KR)	6.8%	7.3%	7.7%	8.1%	9.1%	11.5%	11.0%	11.3%	12.4%	11.7%	12.4%	15.8%	15.5%
3	SMIC (CN)	5.1%	5.1%	6.0%	5.5%	6.0%	5.7%	5.7%	5.2%	5.4%	5.6%	5.3%	4.7%	5.3%
4	UMC (TW)	4.2%	4.4%	4.7%	4.7%	5.1%	5.3%	5.7%	5.4%	6.0%	6.6%	6.4%	6.3%	6.9%
5	GlobalFoundries (U.S.)	3.6%	3.9%	4.2%	4.6%	4.8%	4.9%	5.1%	5.8%	6.2%	6.7%	6.6%	6.2%	5.8%
6	Huahong Group (CN)	2.6%	2.5%	2.7%	2.6%	2.7%	2.1%	2.2%	2.0%	2.6%	3.0%	3.0%	2.6%	3.3%
7	VIS (TW)	0.9%	0.9%	1.0%	0.9%	1.0%	1.0%	1.0%	1.0%	1.1%	1.2%	1.0%	0.9%	1.2%
8	Nexchip (CN)	0.9%	0.8%	0.9%	0.9%	0.9%	0.9%	1.0%	1.0%	1.0%	n.a.	n.a.	n.a.	1.0%
9	Tower (IL)	0.9%	0.9%	0.9%	1.0%	1.0%	1.1%	1.1%	1.1%	1.2%	1.3%	1.3%	1.2%	1.2%
10 PSMC (TW)		0.8%	0.8%	0.9%	0.8%	0.9%	1.0%	1.0%	1.0%	1.0%	1.2%	1.2%	1.2%	1.6%
Total of Top 10		96.8%	96.80%	97.0%	96.2%	96.2%	96.0%	96.0%	95.0%	95.0%	94.0%	98.0%	98.0%	97.0%

Source: Trendforce, Press Releases.

Long-Term Market Share Trends: Rising Concentration

From the third quarter of 2022 to the third quarter of 2025, TSMC's market share rose from 56.1% to 71.0%, an increase of nearly 15 percentage points over three years. Over the same period, Samsung's market share declined by 8-9 percentages from above 15% to the 6%–7% range.

The combined market share of the top ten foundries has consistently remained in the 96%–97% range, indicating that the industry was already highly concentrated. However, structural changes over the past three years have been characterized by a continued expansion of the market leader's share, further consolidating the industry around TSMC as a single dominant core.

Overall, the global foundry industry in the third quarter of 2025 exhibited a structural profile of moderate growth and high concentration. TSMC's advantages in advanced process technology, customer structure, and capital investment discipline translated into growth contributions—both quarterly and annual—that significantly exceeded those of its peers.

On an annual comparison, TSMC's share rose from 55.4% in 2022 to 69.2% in the first half of 2025, an increase of 13.8 percentage points. Samsung's share fell from 16.0% to 7.5% during the same period, a drop of 8.5 points. These figures indicate that TSMC is steadily driving the market toward a "winner-takes-all" scenario (see Table 10).

Table 10. Ranking and Market Share of Global Top 10 Foundries by Revenue: 2022-2025H1

Ranking	Company	Market Share			
		2025H1	2024	2023	2022
1	TSMC (TW)	69.2%	64.0%	58.9%	55.4%
2	Samsung (KR)	7.5%	9.9%	12.0%	16.0%
3	SMIC (CN)	5.5%	5.7%	5.4%	5.3%
4	UMC (TW)	4.5%	5.2%	6.1%	6.8%
5	GlobalFoundries (US)	4.1%	4.9%	6.3%	6.0%
6	Huahong Group (CN)	2.6%	2.4%	2.7%	3.1%
7	Tower (IL)	0.9%	1.1%	1.2%	1.3%
8	VIS (TW)	0.9%	1.0%	1.1%	1.3%
9	Nexchip (CN)	0.9%	0.9%	1.0%	1.3%
10	PSMC (TW)	0.8%	0.9%	1.1%	1.7%

Source: Raw data are from TrendForce press releases; yearly market share 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.

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

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.

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.

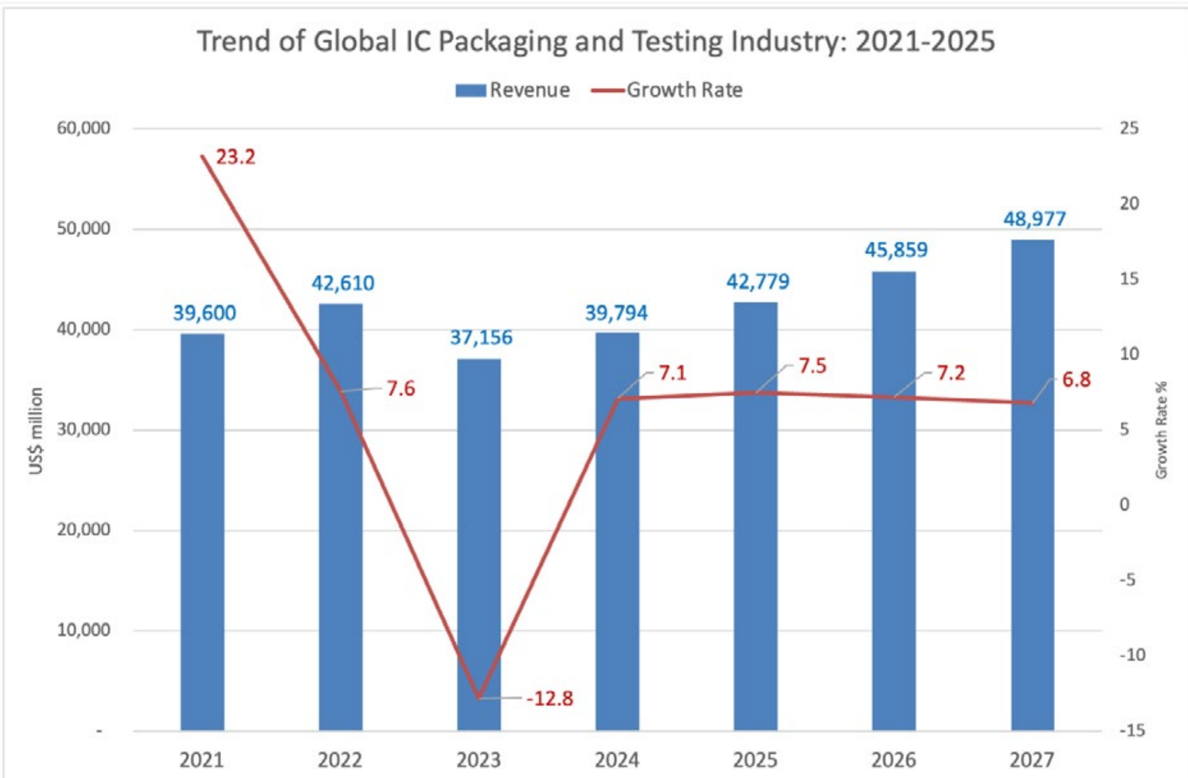
However, at the beginning in the second half of 2022, the global economy began to cool significantly. Central banks in major economies raised interest rates to curb inflation, leading to a contraction in both corporate capital expenditure and consumer electronics demand. The sharp slowdown in end-market 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 11).

Table 11. Global Top 10 OSAT Company Revenue Rankings: 2024

Ranking	Company	Revenue			Top 10 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]

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

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

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.[8]

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 12).

Table 12. Top 10 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%
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%

8 Yole Group, Press Release: "Globalwafers to mass produce advanced SiC wafers by 2025," October 27, 2023.

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.

Global semiconductor equipment market revenue grew steadily from US$ 106.25 billion in 2023 to US$ 117.14 billion in 2024, representing a 10% year-over-year increase, confirming a cyclical recovery in capital spending.

China was the largest contributor to growth, with equipment revenue rising sharply by 35% from US$ 36.6 billion to US$ 49.55 billion, making it the single largest regional market in 2024. This surge reflects accelerated fab construction and strong policy-driven investment momentum. Korea recorded modest growth of 3%, reaching US$ 20.47 billion, while North America expanded more robustly by 14% to US$ 13.69 billion, supported by renewed investment in advanced logic and memory.

In contrast, Taiwan experienced a significant contraction, with revenue declining 16% to US$ 16.56 billion, reflecting inventory adjustments and a pause in leading-edge capital expenditure. Europe saw the sharpest decline, down 25% year on year to US$ 4.85 billion, indicating delayed or scaled-back investment plans. Japan's market remained broadly stable, edging down 1% to US$ 7.83 billion, while Rest of the World grew 15% to US$ 4.19 billion from a smaller base.

Overall, the Table 13 highlights an increasingly uneven regional recovery, with global growth driven primarily by China and, to a lesser extent, North America, while several mature semiconductor regions experienced cyclical pullbacks. This divergence underscores the growing influence of policy and strategic considerations in shaping global semiconductor equipment investment patterns.

Table 13. Semiconductor Equipment Market Revenue by Region: 2023-2024

Unit: US$ billion

Region	2024 Revenue	2023 Revenue	YoY %
China	49.55	36.6	35%
Korea	20.47	19.94	3%
Taiwan	16.56	19.62	-16%
North America	13.69	12.05	14%
Japan	7.83	7.93	-1%
Europe	4.85	6.46	-25%
Rest of the World	4.19	3.65	15%

Total	117.14	106.25	10%

Source: Press Release, "Global Semiconductor Equipment Billings Surged to $117 Billion in 2024, SEMI Reports," Semi, April 9, 2025.

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 14).

Table 14. 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 clearly shifted toward IC manufacturing, reflecting the gradual concentration of the global semiconductor supply chain around Taiwan's production capabilities.

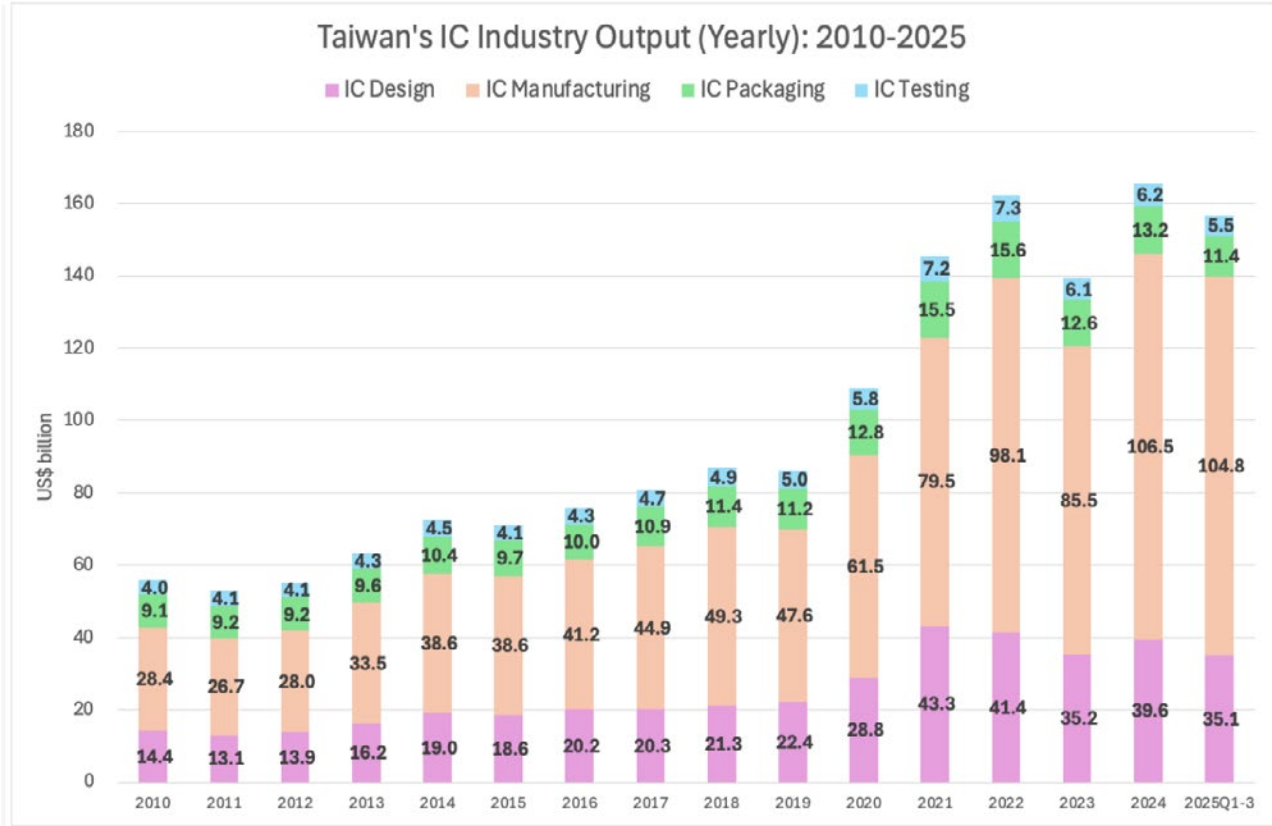
Taiwan's IC design industry, a key component of innovation in the semiconductor supply chain currently anchored by top-performing firms such as MediaTek, Novatek and Realtek, has experienced steady growth since 2010, with output increasing from US$ 14.4 billion to US$ 22.4 billion in 2019. Following 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 the first three quarters of 2025 has already reached US$ 35.1 billion, suggesting that a new record high for the full year is likely and that growth momentum in this segment has 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$ 104.8 billion already achieved in the first three quarters of 2025, another historic high is strongly probable in the near future in the age of AI.

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 over US$ 11 billion already generated in the first three quarters of 2025, the sector appears on track to return 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$ 5.5 billion achieved in the first three quarters of 2025, the full-year number may once again approach the 2021–2022 peak (see Figure 18).

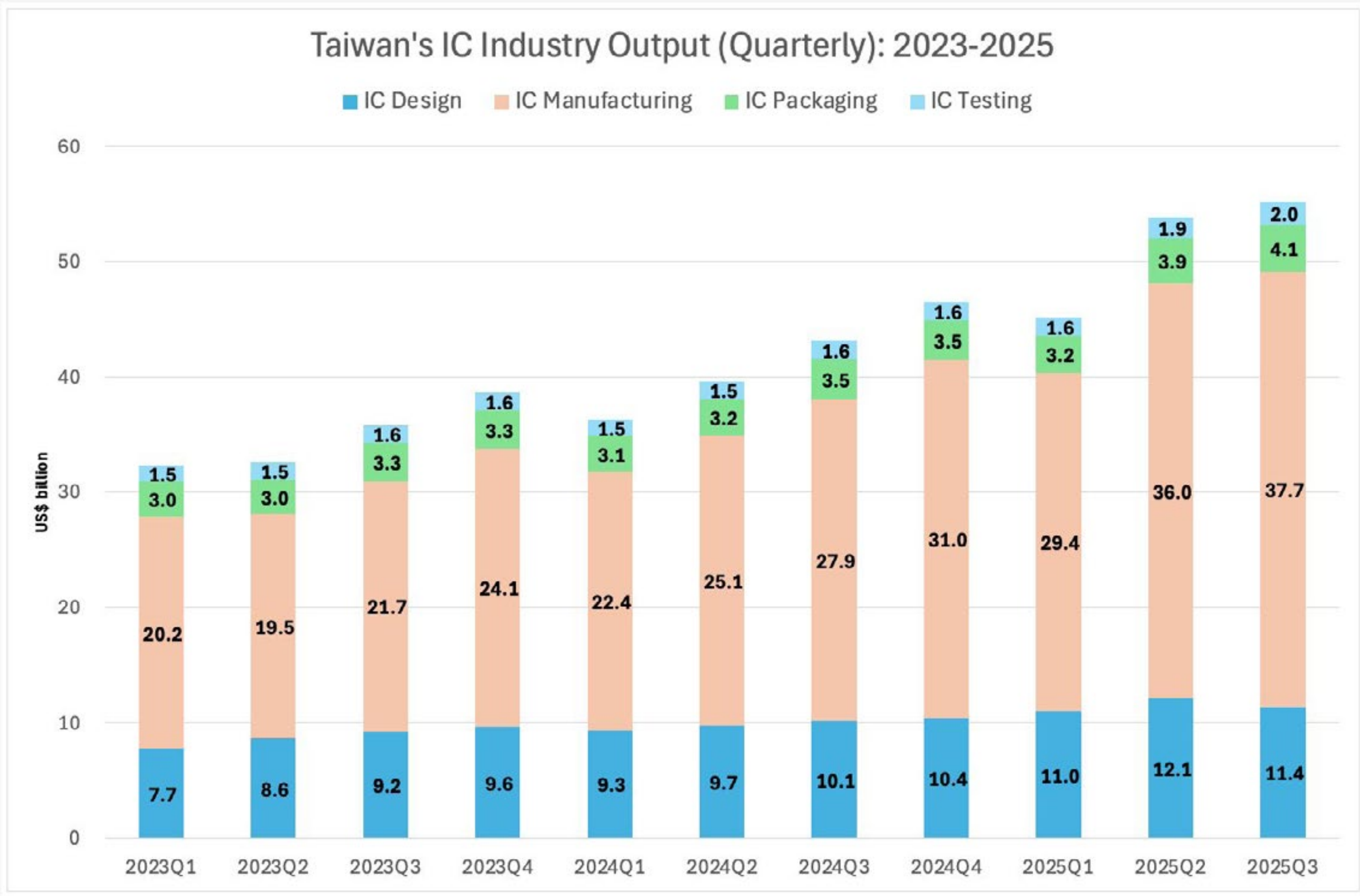
Figure 18. Taiwan's IC Industry Output (Yearly): 2010-2025



Source: IEK, ITRI, November 12, 2025.

Based on available 2025 data, Taiwan's IC industry has experienced rapid expansion in the first three quarters of 2025. In the IC design segment, output increased from US$ 7.7 billion in 2023 Q1 to US$ 9.3 billion in 2024 Q1, rising further to US$ 11.0 billion in the 2025 Q1 and reaching US$ 11.4 billion in the third quarter of 2025 (see Figure 19).

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



Source: IEK, ITRI, November 12, 2025.

In terms of growth rates for the first three quarters of 2025, IC design expanded by 17.8%, IC manufacturing by 36.6%, IC packaging by 15.3%, and IC testing by 17.7%. A closer look reveals that IC design and IC manufacturing both grew rapidly throughout the first three quarters, while growth in IC packaging and IC testing was concentrated mainly in the second and third quarters—highlighting a typical pattern in which back-end processes lag in recovery but display noticeable catch-up momentum once the cycle turns (see Table 15).

Table 15. Growth of Taiwan's IC Industry Output (Quarterly): 2025 Q1-3

	2025 Q1-3 Growth	Q1 Growth	Q2 Growth	Q3 Growth
IC Design	17.8%	17.4%	24.4%	11.9%
IC Manufacturing	36.6%	31.0%	43.2%	35.2%
IC Packaging	15.3%	5.4%	22.2%	17.8%
IC Testing	17.7%	3.6%	24.7%	24.5%

Source: IEK, ITRI, November 12, 2025.

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.

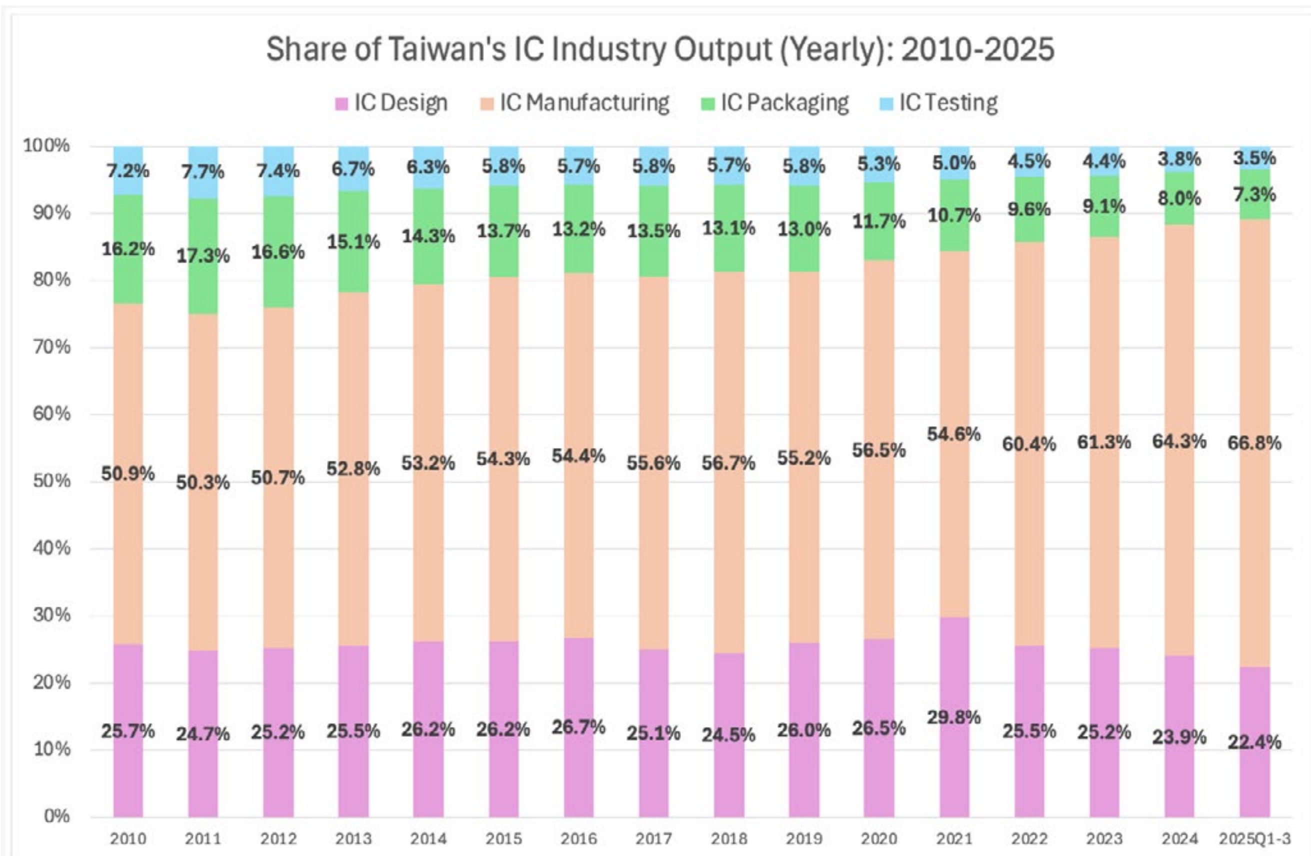
From 2010 to 2020, IC design consistently accounted for roughly 25–27% of total IC industry output. In 2021, surging demand briefly pushed its share to 29.8%, but the proportion has declined steadily since then—falling to 23.9% in 2024 and further to 22.4% in the first three quarters of 2025.

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, reaching 66.8% in the first three quarters 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 7.3% in the first three quarters 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% in the first three quarters of 2025 (see Figure 20).

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



Source: IEK, ITRI, November 12, 2025.

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.

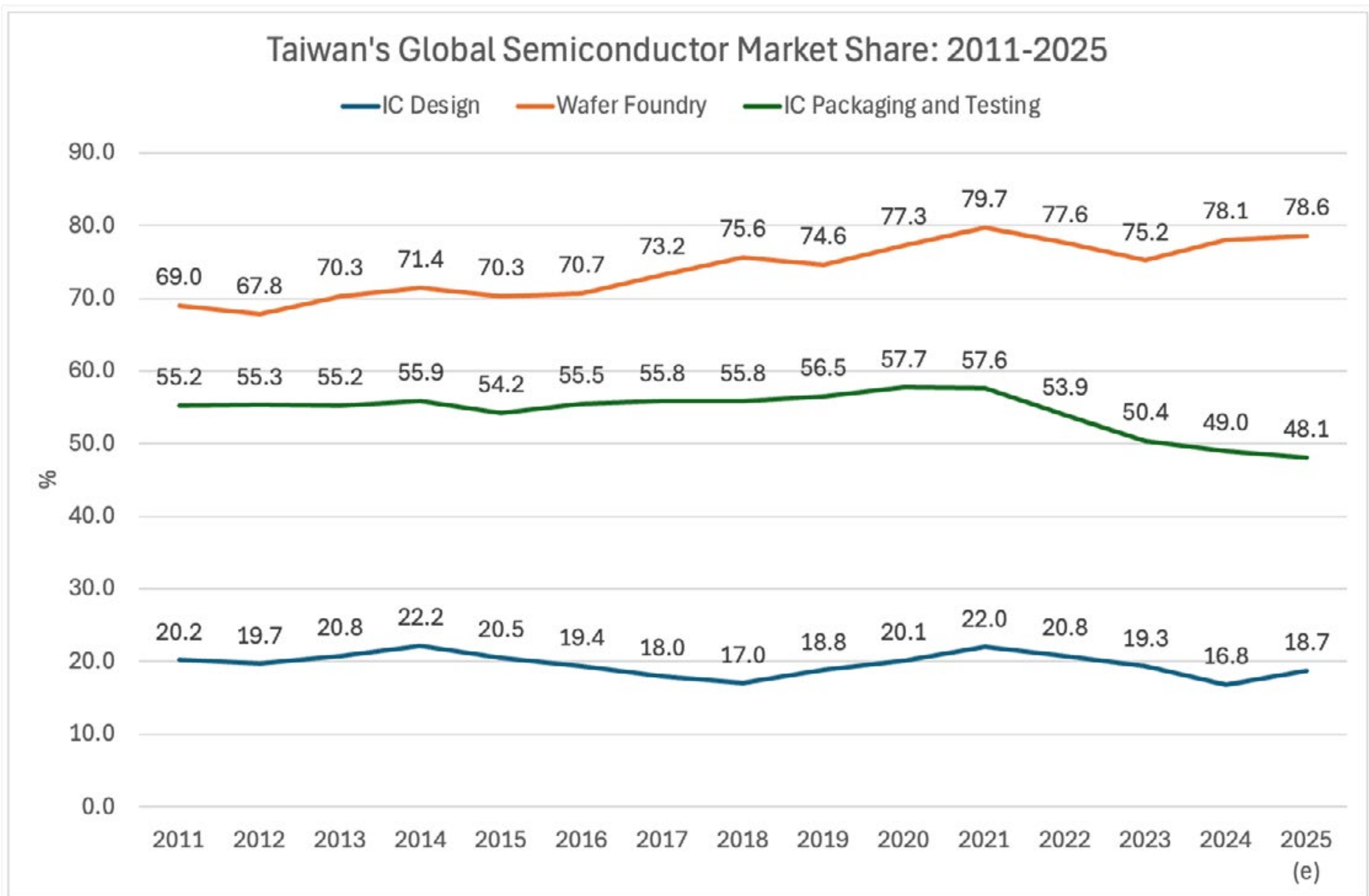
In wafer foundry, Taiwan's share rose steadily from 69.0% in 2011 to a peak of 79.7% in 2021, reflecting the island's continued dominance in advanced manufacturing. The share then dipped to 75.2% in 2023, before rebounding to 78.1% in 2024; ITRI projects a further uptick to 78.6% in 2025.

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).

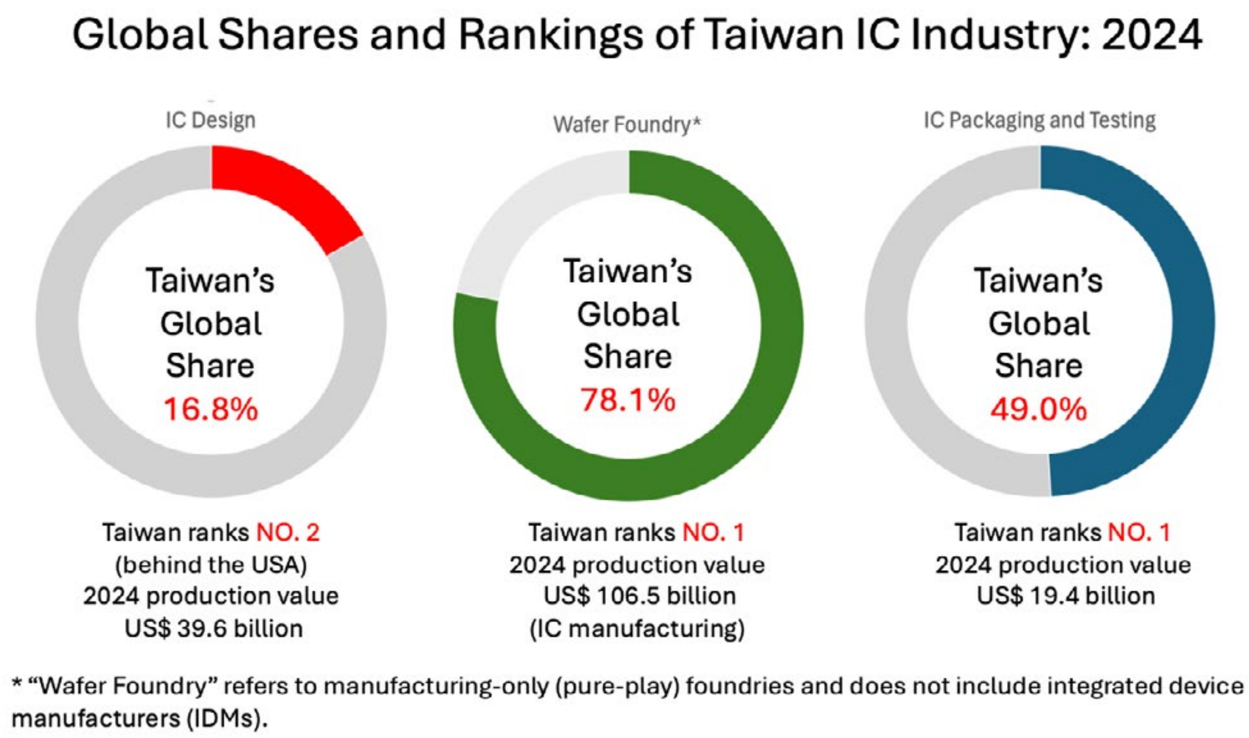
Figure 21. Taiwan's Global Semiconductor Market Share: 2011-2025



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).

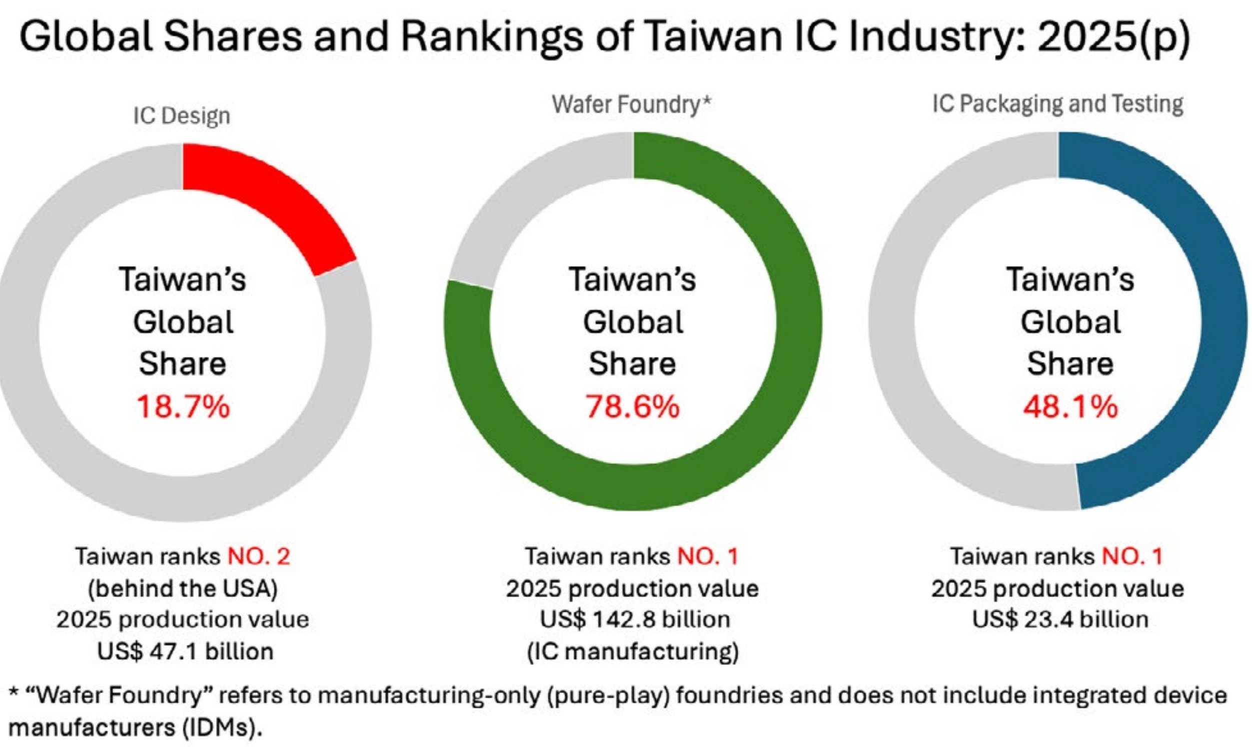
Figure 22. Global Shares and Rankings of Taiwan IC Industry: 2024



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.

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. 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. This dominance underpins the company's historic 71.0% share of the global foundry market in the third quarter of 2025, supported by the rapid ramp-up of 2nm (N2) production in Kaohsiung and preparations for the next-generation 1.4nm (A14) node.

TSMC's 2nm technology has started volume production in 4Q25 as planned. Featuring the first-generation nanosheet transistor structure, N2 represents the most advanced technology in the semiconductor industry in terms of both density and energy efficiency. Additionally, TSMC has developed a low-resistance redistribution layer (RDL) and super high-performance metal-insulator-metal (MiM) capacitors to further boost performance. Furthermore, A14 development is progressing smoothly with yield performance ahead of schedule. 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 16).

Table 16. 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 $165 billion investment aimed at localizing critical supply chains. Originally planned as a $40 billion project, the Arizona campus has expanded to include three fabs, advanced packaging facilities, and an 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 full-scale mass production ramping up in 2025. Meanwhile, the second fab is under construction to produce 3nm chips, significantly boosting U.S. domestic output of advanced logic.

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, 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 the introduction of 7nm-class EUV technology by around 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 Table 17).

Table 17. TSMC Global Fab Matrix: As of Dec 2025

Region	Project Name	Primary Technologies	Operational Status	Est. Volume Production
Taiwan	GigaFabs (Various)	N2 (2nm), A16, N3, Legacy	Operational / Expansion	2025 (N2)
U.S. (AZ)	Fab 21 - Phase 1	N4 (4nm)	Mass Production	Q4 2024 / 2025
U.S. (AZ)	Fab 21 - Phase 2	N3 (3nm)	Structure Complete	2028
U.S. (AZ)	Fab 21 - Phase 3	N2, A16	Ground Broken (Apr 2025)	~2030
Japan	JASM - Phase 1	28/22nm, 16/12nm	Mass Production	Dec 2024
Japan	JASM - Phase 2	N6 (6nm), 7nm	Planned (Delayed)	~2029
Germany	ESMC	28/22nm, 16/12nm	Shell Construction	2027

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 18).

Table 18. Income Statements of Four Major Semiconductor Companies: Q3 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

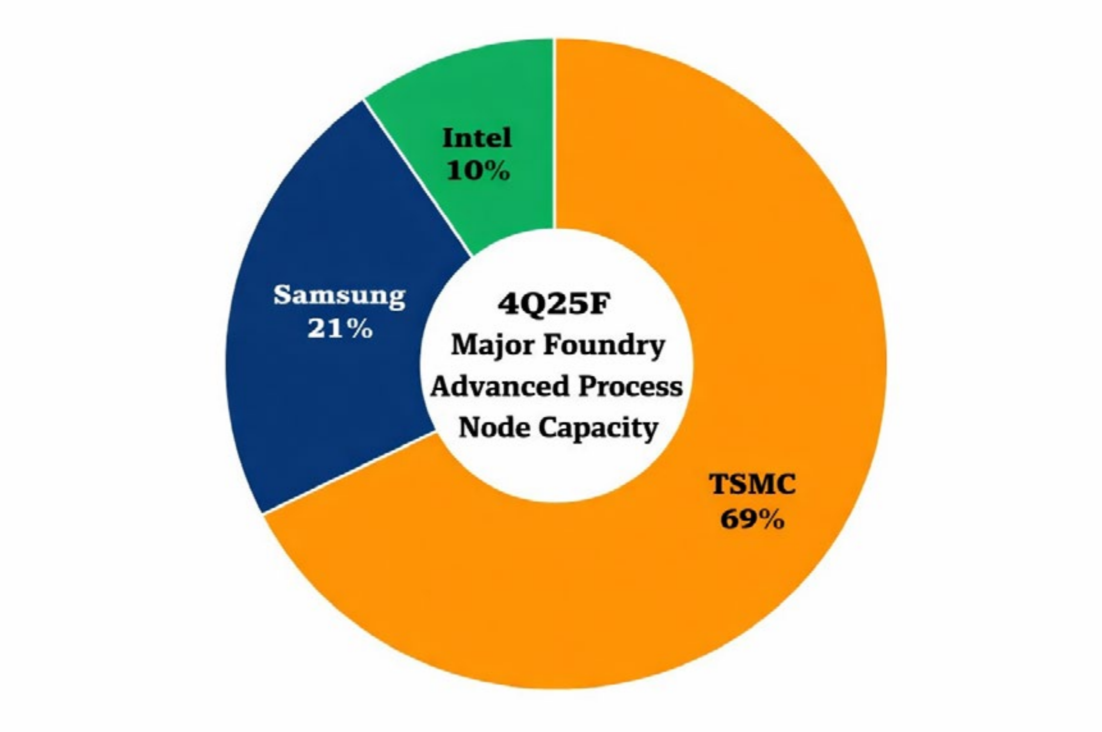
Note:
1 US$ ≈ 1,449 Korean won (KRW) as of November 15, 2025.
Samsung Electronics' figures cover both semiconductors and other electronics products.
Source: TrendForce, https://x.com/trendforce/status/1989206648284664028, November 15, 2025.

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 24).

Figure 24. 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.

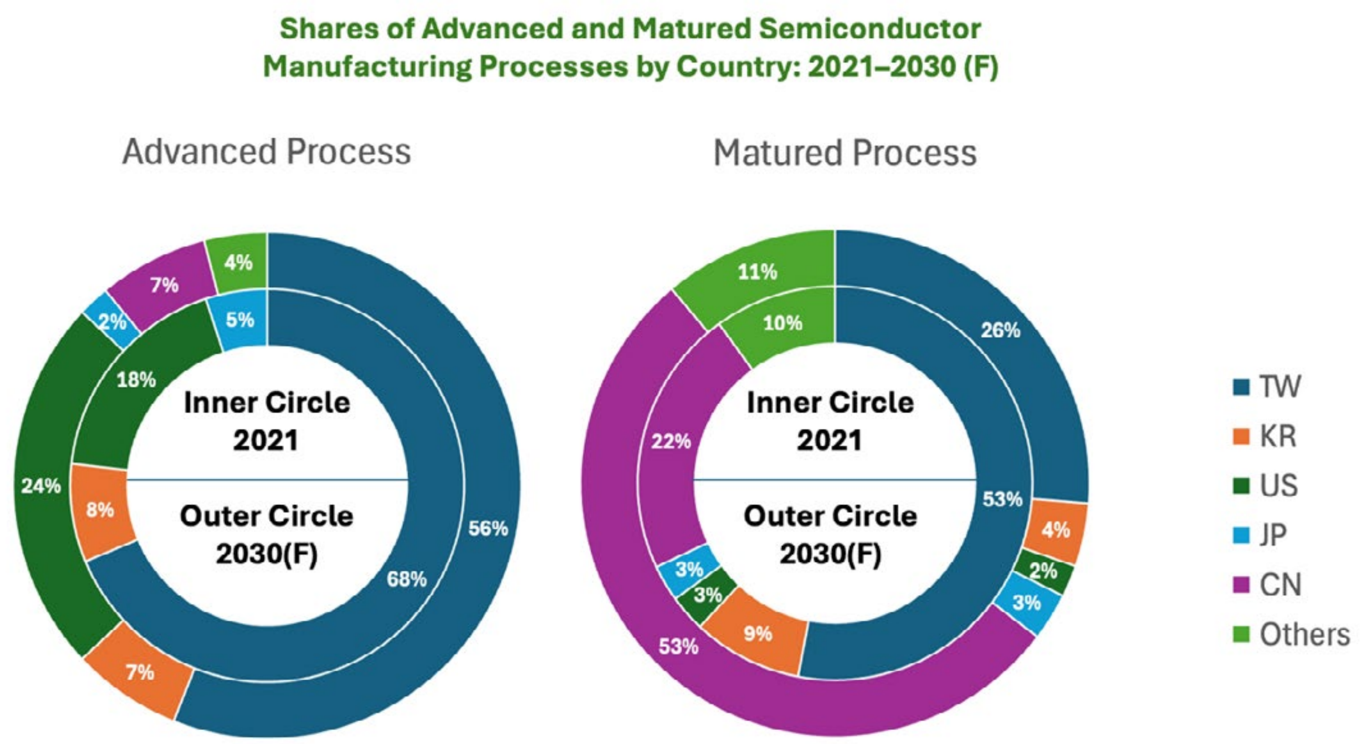
At the company level within the United States, Intel is projected to hold the largest share of US-based advanced manufacturing capacity by 2030 at around 38%, although execution risks remain, including delays at facilities such as the Ohio fab. Samsung follows closely with approximately 34%, reflecting 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 25).

Figure 25. Shares of Advanced and Matured Semiconductor Manufacturing Processes by Country: 2021–2030



Source: TrendForce, January 2026.

ITRI's Estimates for 2029

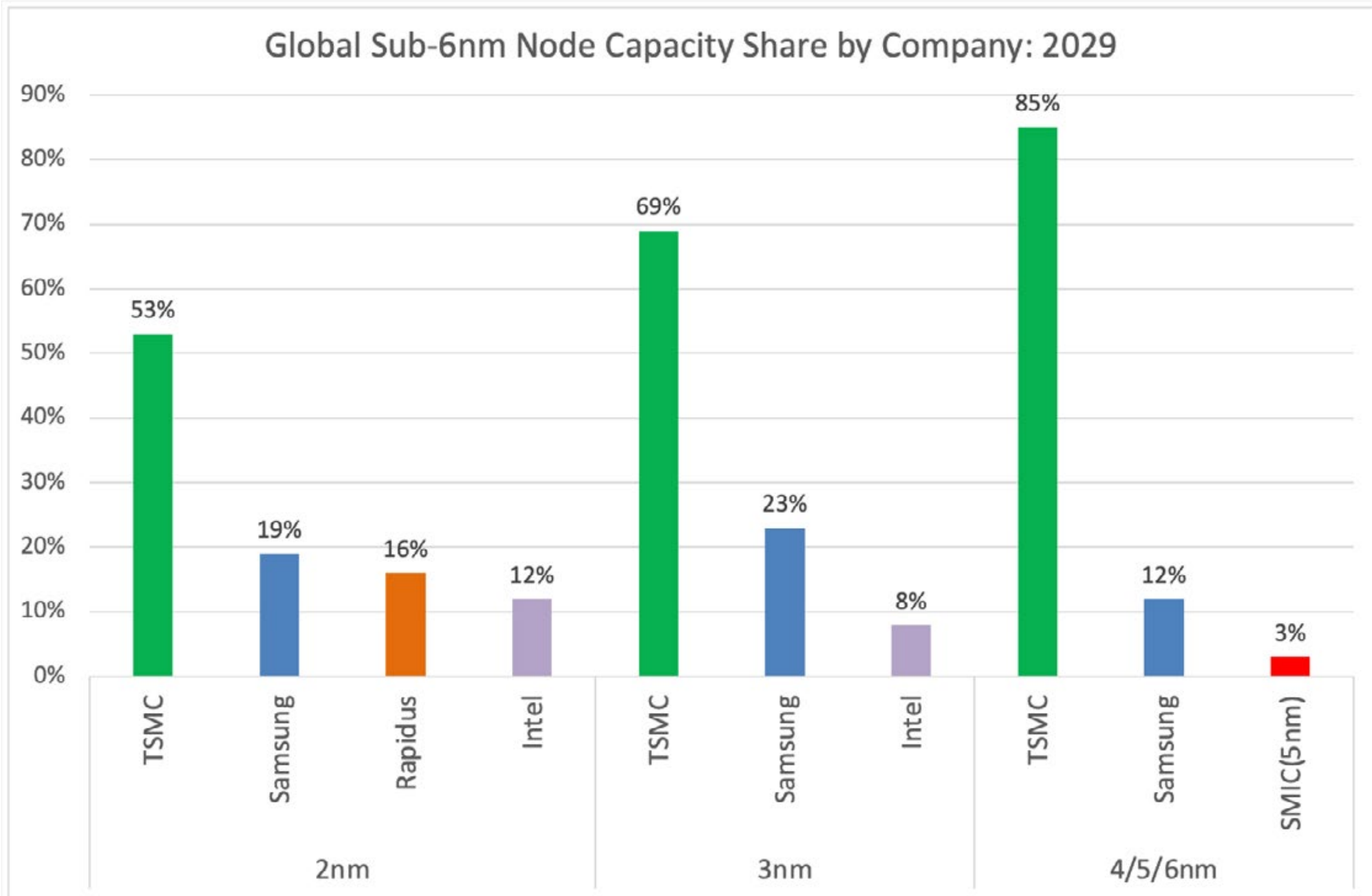
This dominance is even more pronounced in advanced manufacturing below the 7-nanometer threshold. Based on ITRI 's estimates using publicly announced construction schedules and planned production capacities—and projecting effective 2nm–6nm output at the point of full-scale mass production in 2029 (excluding 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 26).

Figure 26. 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.

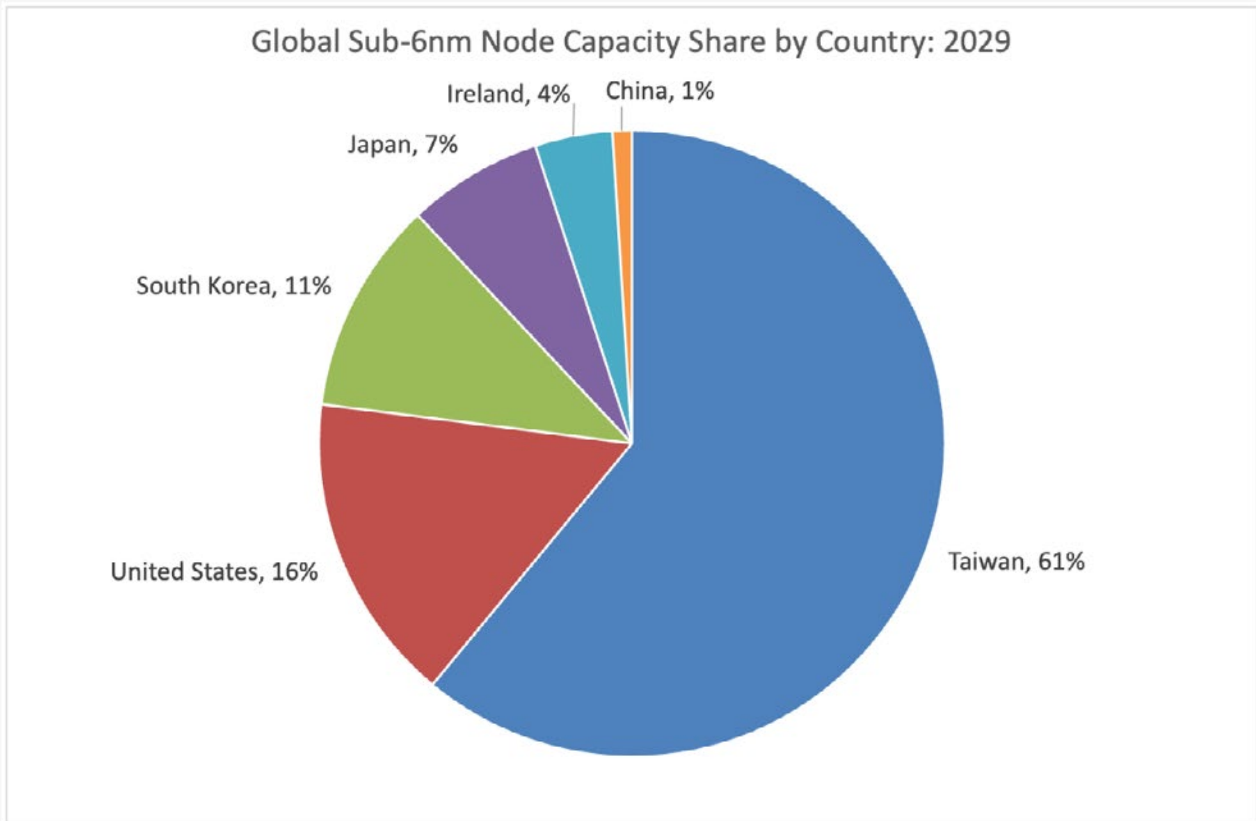
From a policy perspective, the U.S. government has leveraged the CHIPS and Science Act to provide substantial subsidies to companies targeting the 7nm and more advanced technology nodes, aiming to rebuild leading-edge semiconductor manufacturing capabilities on American soil. Among U.S. domestic companies, 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 27).

Figure 27. 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.[9] 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: 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.

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

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.

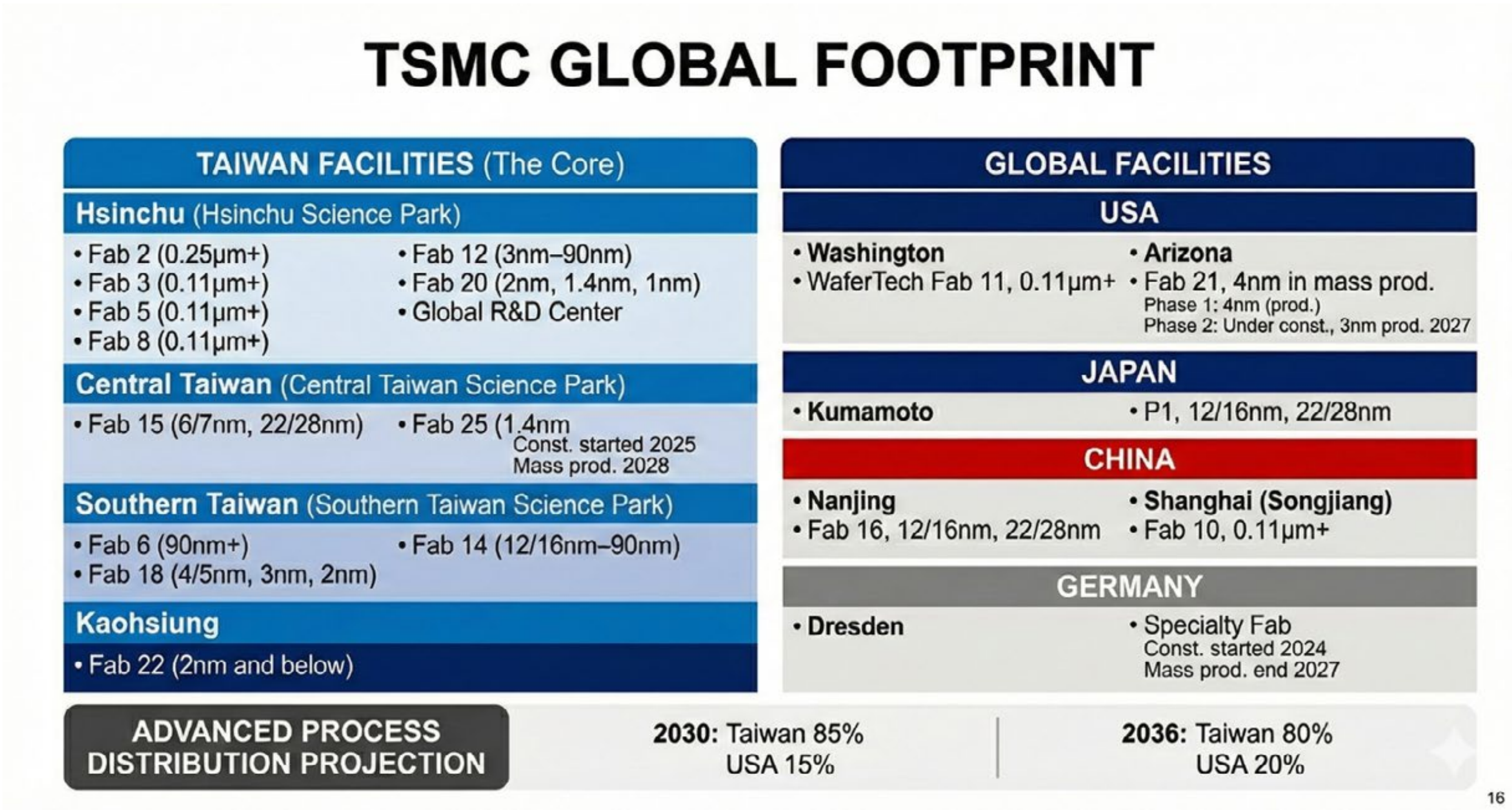
The first involves up to US$ 250 billion in private-sector investment by Taiwanese enterprises across semiconductors, AI-related electronic manufacturing services, energy, and related industries. The second entails government-backed credit guarantees enabling financial institutions to provide up to US$ 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 28).

Figure 28. 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, 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[10] 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 19).

Table 19. 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%.

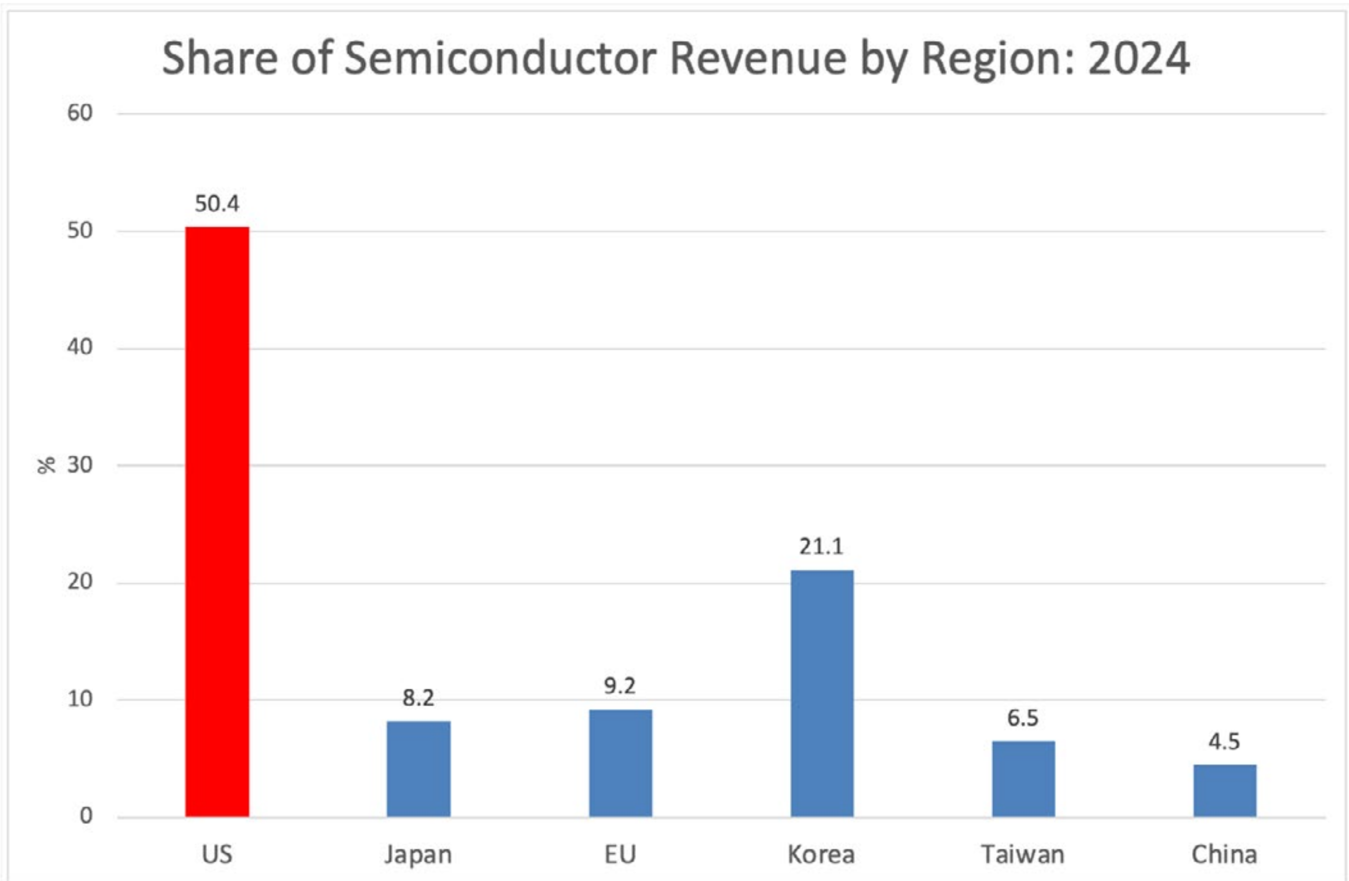
10 The CAGR of the semiconductor industry represents the annualized average rate of revenue growth over a specific period, assuming the growth happens at an exponentially compounded rate.

Moreover, a joint report by BCG and the Semiconductor Industry Association (SIA)[11] warned that, absent policy intervention, the US share of global semiconductor manufacturing capacity could fall further to 8% by 2032.[12]

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.[13]

Nevertheless, the United States has continued to dominate global semiconductor industry since the late 1990s.14 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 29).

Figure 29. Share of Semiconductor Revenue by Region: 2024



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

11 The Semiconductor Industry Association is a U.S.-based trade organization that represents the interests of the semiconductor industry and its global supply chain.

12 Raj Varadarajan, et al., "Emerging Resilience in the Semiconductor Supply Chain," Boston Consulting Group and Semiconductor Industry Association, May 2024.

13 "Semiconductors and the CHIPS Act: The Global Context," Congressional Research Service, May 18, 2023.

14 State of the U.S. Semiconductor Industry Report 2024, Semiconductor Industry Association, September 9, 2024.

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.

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.[15] However, the U.S. has a relatively lower share in the foundry segment (6%) and the OSAT segment (15%) (see Table 20).

Table 20. 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

15 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.

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.

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 21).

Table 21. 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.

****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.[16]

16 Semiconductor Industry Association, SIA 2025 Factbook, May 27, 2025.

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:

- Invest in U.S. production of strategically important semiconductor chips, focusing on leading-edge technologies.
- Assure a sufficient, sustainable, and secure supply of older and current generation chips for national security purposes and for critical manufacturing industries.
- Strengthen U.S. semiconductor R&D leadership to catalyze and capture the next set of critical technologies, applications, and industries.
- Grow a diverse semiconductor workforce and build strong communities that participate in the prosperity of the semiconductor industry.[17]

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

- Make the U.S. home to at least two, new large-scale clusters of leading-edge logic chip fabs,
- Make the U.S. home to multiple, high-volume advanced packaging facilities,
- Produce high-volume leading-edge memory chips, and
- Increase production capacity for current-generation and mature-node chips, especially for critical domestic industries.[18]

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 22).

Table 22. 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.

17 The U.S. Department of Commerce, Press Release: "A Strategy for the Chips for America Fund", September 6, 2022.
18 The U.S. Department of Commerce, Press Release: "Biden-Harris Administration Launches First CHIPS for America Funding Opportunity", February 28, 2023.

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

- **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.[19] 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.[20] 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.[21]

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 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.

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."[22]

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

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

20 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.

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

22 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.

officials, determines poses a threat to U.S. national security or foreign policy.[23] 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 23).

Table 23. 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.**
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.[24]

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

23 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).

24 "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.

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.[25]

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 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.

3. 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

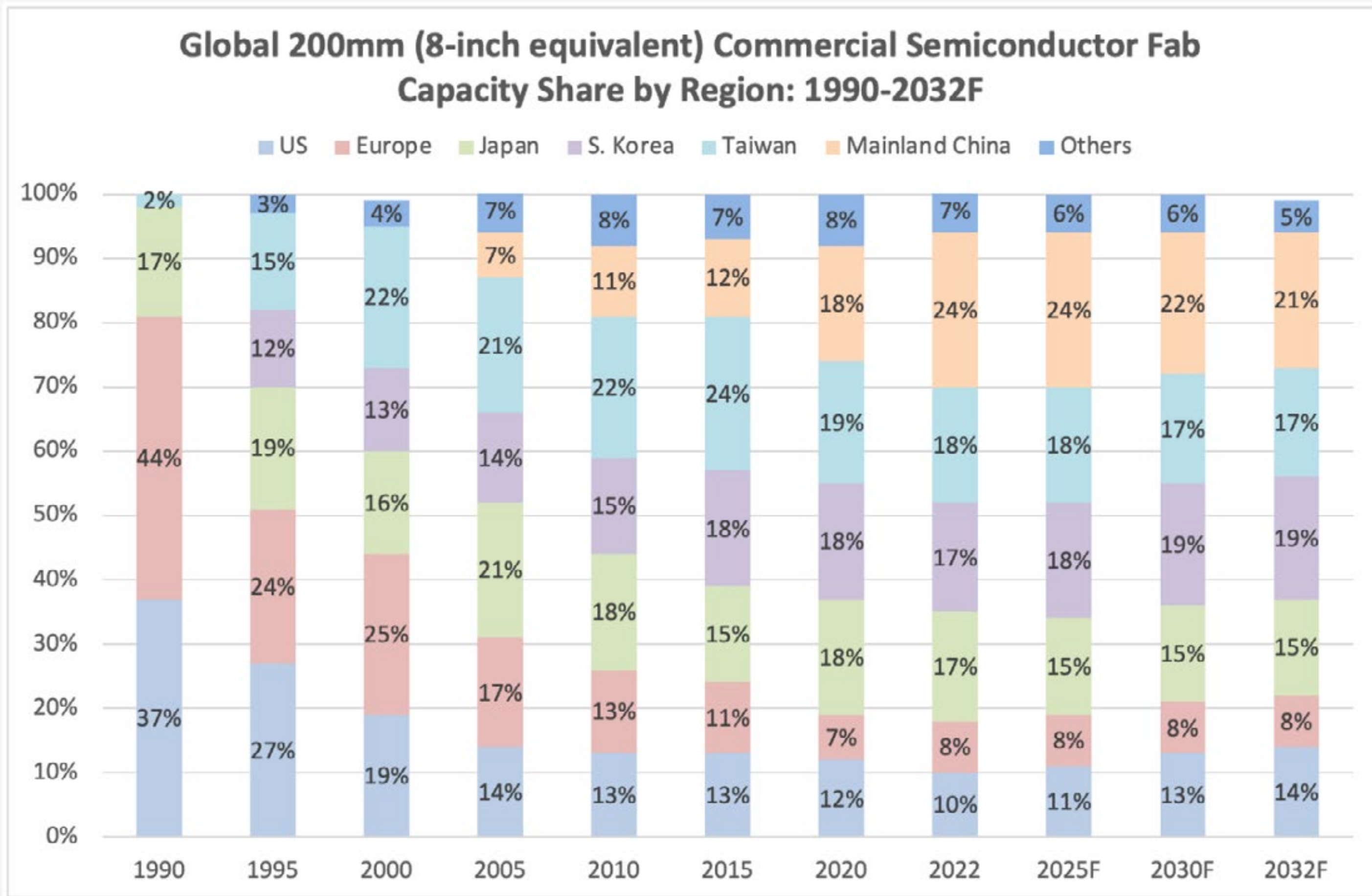
A BCG-SIA report released in May 2024 projected the United States will see a tripling of its domestic semiconductor manufacturing capacity from 2022—when CHIPS was enacted—to 2032. The report also projected the U.S. will capture over one-quarter (28%) of total global capital expenditures from 2024-2032.

25 National Institute of Standards and Technology, "CHIPS for America- Preventing the Improper Use of CHIPS Act Funding- Final Rule", September 22, 2023.

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 30).

Figure 30. 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 24).

Table 24. Finalized CHIPS for America Awards

Company	Award Amount	Locations
Intel Corporation	US$ 7.8 billion	1. Rio Rancho, NM 2. New Albany, OH 3. Chandler, AZ 4. Hillsboro, OR
Micron	US$ 6.165 billion	1. Manassas, VA 2. Boise, ID 3. Clay, NY
BAE Systems, Inc.	US$ 35 million	Nashua, NH
GlobalFoundries	US$ 1.975 billion	1. Burlington, VT 2. Malta, NY 3. Sherman, TX 4. 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	1. San Jose, CA 2. 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	1. Sherman, TX 2. Lehi, UT
Samsung Electronics	US$ 4.745 billion	2. Austin, TX 3. 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."[26] 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

26 NIST, "Due Diligence Process Fact Sheet," July 2024, Accessed November 25, 2024.

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.[27] 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.[28] 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, 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.[29] 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.

4. Updates in 2025 and Prospects

In 2025, the U.S. semiconductor industry reached a crucial turning point, shifting from broad-based policy deployment to a phase focused on performance evaluation and institutional adjustment, and a "transaction-driven" investment strategy. More than three years after the CHIPS Act came into force, Washington's ambition to rebuild domestic supply chains and advanced manufacturing capacity is now entering a stage where concrete outcomes can be observed and strategic paths recalibrated.

The overall contours of 2025 can be sketched along several intertwined themes: diverging results in capacity build-out, a fundamental redesign of subsidy and governance instruments toward maximizing taxpayer returns, and, within the broader framework of technological competition, a relationship between the United States and China that shows tactical easing on one front while tightening export and capital

27 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.

28 National Institute of Standards and Technology, Press Release: "TSMC Arizona Community Impact Report," November 15, 2024.

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

controls on another through new trade investigation tools.

Capacity Building in the U.S. so far

On the manufacturing side, TSMC's progress is undoubtedly the most emblematic. In early 2025, the first fab of Fab 21 in Phoenix, Arizona, officially began volume production using the 4-nanometer process. Reportedly, its yield rate already exceeds that of comparable plants in Taiwan by about four percentage points, sending a powerful signal to U.S. policymakers and the business community: leading-edge manufacturing need not be confined to existing clusters in East Asia; under an appropriate mix of policies, institutions, and talent, the United States is still capable of hosting advanced production.

On this foundation, TSMC confirmed plans in early 2025 to establish a "Gigafab" cluster of six fabs in Arizona, with a total investment of about US$ 165 billion. The second fab is scheduled to begin volume production of 3-nanometer and 2-nanometer chips in 2028, while construction of the third fab starts in 2025 with the goal of producing 2-nanometer and A16-class nodes around 2030. If this blueprint proceeds as planned, the Arizona campus could eventually account for more than 30 percent of TSMC's global production capacity for nodes at 2 nanometers and below.[30]

In stark contrast, Intel lags behind in expanding its front-end manufacturing. Its fab project in New Albany, Ohio—once touted as a symbol of the renaissance of U.S. domestic chipmaking, with an investment of about US$ 28 billion—has faced multiple delays in both completion and ramp-up. The first fab is now expected to reach volume production only around 2030–2031, with the second deferred to 2032.

Yet Intel's layout in back-end packaging looks considerably brighter. Following their launch in 2024, Fab 9 and Fab 11x in Rio Rancho, New Mexico, had by 2025 become the core production base for Intel's Foveros 3D packaging technology and the only facilities in the United States capable of large-scale 3D packaging. This gives them strategic importance for both Intel's own products and future foundry customers.

Intel has also stated that its 18A process node (roughly equivalent to 1.8-nanometer class) completed preparations for mass production in the second half of 2025, with output to be ramped up gradually starting in 2026. Market views on its prospects are generally cautiously optimistic, with attention focused on future yield performance and production stability, as well as its competitive position relative to TSMC's N2 and other advanced nodes.

After facing earnings pressures and organizational restructuring in 2022–2023, Intel showed signs of recovery in 2025. In addition, its ownership structure started to change significantly under the new administration's "transaction-driven" strategy. In August 2025, the U.S. Department of Commerce announced that it would convert US$ 8.9 billion in previously allocated funding (comprising US$ 5.7 billion in manufacturing grants and US$ 3.2 billion for the "Secure Enclave" defense project) into a direct equity investment. Through this conversion, the U.S. federal government acquired approximately a 9.9

30 FinSMEs, "TSMC Arizona Expansion Accelerates as Chairman Wei Commits to U.S. Manufacturing Scale," Dec 5, 2025.

percent stake in Intel.

Additionally, to prevent the stripping of core manufacturing assets, the deal included a five-year warrant agreement, giving the government the right to purchase an additional 5 percent of shares of Intel's stake in its foundry business falls below 51 percent. In the same year, Japan's SoftBank invested around US$ 2 billion, and Nvidia announced plans to invest about US$ 5 billion for a roughly 4 percent stake. This shift transforms the U.S. government from a mere donor into a passive stakeholder. expecting financial returns.

Samsung's and Micron's footprints in the United States, by contrast, reflect differing market pressures and product strategies. Samsung's new fab in Taylor, Texas, with an investment of about US$ 44 billion, has already completed 90 percent of its construction and was originally intended to produce 4-nanometer logic chips. However, there remains considerable uncertainty remains over whether it can quickly win large orders from key customers such as Nvidia and Apple. The production timeline has thus been pushed back from the original 2024–2025 window to 2026 or later.

Micron Technology, on the other hand, is pivoting more explicitly toward AI-related memory markets. In the town of Clay, New York, it has planned a massive DRAM campus with phased investments of up to US$ 100 billion over twenty years, envisioned as the largest DRAM manufacturing base in the United States. Yet the start of construction on the first fab has been postponed to 2026, and the production date pushed back to 2030.

At the same time, Micron is reshaping its product mix, concentrating resources on high-value products such as high-bandwidth memory (HBM) while gradually exiting lower-margin consumer memory segments. In fiscal 2025, revenues from Micron's HBM products grew rapidly, with third-quarter sales of about US$ 2 billion—up nearly 50 percent from the previous quarter—showing that demand for high-end memory driven by AI applications has become its main growth engine.

Beyond the leading-edge nodes, GlobalFoundries has maintained its "differentiated foundry" positioning, focusing on mature and specialty processes. Simultaneously, it is building an advanced packaging and testing center in New York to offer U.S. customers more comprehensive local manufacturing and packaging services. For applications that rely heavily on mature nodes—such as automotive electronics, communications, and power management—GlobalFoundries' role helps stabilize domestic supply capacity.

At the same time, localization of packaging is making new progress. As demand for AI chips such as Nvidia's Blackwell architecture continues to surge, TSMC's CoWoS capacity in Taiwan has become a global bottleneck. In response, Amkor, the world's second-largest OSAT provider, launched an investment of about US$ 7 billion in Peoria, Arizona, in 2025, targeting advanced 2.5D packaging technologies. By siting the new plant next to TSMC's fab, Amkor aims to build a localized supply chain that covers the full flow from wafer fabrication to packaging and testing. The first phase is scheduled for completion in 2027, with production starting in 2028 (see Table 25).

Table 25. 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 2028; 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 2030–2032; 18A ramp-up from 2026; NM packaging fabs operational
Samsung	Taylor, Texas	Approx. US$ 44 billion	4nm logic (planned)	Construction ~90% complete; 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; advanced packaging and testing	Ongoing expansion
Amkor	Peoria, Arizona	Approx. US$ 7 billion	Advanced 2.5D packaging	Construction started in 2025; production begins in 2028

More Policies to Incentivize Semiconductor Industry

By early 2025, the Commerce Department had pledged US$ 32.59 billion in subsidies and US$ 5.85 billion in loans, covering 39 firms and 49 projects. As this capacity comes online, Washington is shifting strategies: moving from "big-ticket spending" to precise oversight and accelerated investment.

In March 2025, the Trump administration established the United States Investment Accelerator (USIA) within the Department of Commerce. The USIA is tasked with streamlining bureaucratic processes for investments exceeding US$ 1 billion and, crucially, supervising the CHIPS Program Office to negotiate better deal terms for taxpayers. Faced with more than US$ 70 billion in applications, the CHIPS Program Office under USIA oversight has adopted more stringent project review standards.

This new approach was exemplified in November 2025 with the Vulcan Elements deal. The Department of Commerce signed a letter of intent to provide US$ 50 million in incentives to Vulcan Elements for a rare-earth magnet facility. Unlike traditional grants, this funding was structured as an exchange for US$ 50 million in equivalent equity, complemented by a US$ 700 million loan commitment from the Department of Defense. This move aligns with Executive Order 14241, issued in March 2025, which expands the Defense Production Act to prioritize critical mineral supply chains alongside semiconductor manufacturing, treating them as an integrated national security imperative.

Compared with direct grants, the Advanced Manufacturing Investment Tax Credit (ITC) has demonstrated even greater leverage. Companies can claim a 25 percent tax credit on eligible semiconductor plant and equipment expenditures, with no aggregate cap. The ITC is estimated to reduce tax revenue by about US$ 2.68 billion in 2025, and the fiscal cost for 2025–2034 is projected at roughly US$ 14.73 billion.31 Judging from the concrete investment plans of TSMC, Samsung, Micron, and others, the ITC has already become a major structural incentive for firms to commit long-term capital to U.S. projects.

In terms of R&D and governance architecture, the institutional design of the National Semiconductor Technology Center (NSTC) has undergone a significant shift. Natcast, an independent nonprofit set up in 2023 to prepare for NSTC's launch, had initially been entrusted with managing a budget of US$ 11 billion and charged with building a "next-generation Bell Labs."

However, changes in administration and governing style brought Natcast's legal authority and operating model under scrutiny in both political and legal arenas. In August 2025, acting on a legal opinion from the Department of Justice, the Secretary of Commerce decided to withdraw the previously approved US$ 7.4 billion in funding and terminate the operating agreement. Natcast consequently reduced its staff and halted preparatory work.[32]

Thereafter, the National Institute of Standards and Technology (NIST) was assigned a new role and took over NSTC-related functions. NIST proposed a more "venture-style" approach to research funding, no longer prioritizing the establishment of a large, permanent research institution, but instead drawing on the experience of Defense Advanced Research Projects Agency and venture capital. Under this model, government support is channeled through project-based, phased, and adjustable allocations targeted at specific technology roadmaps and application domains, shifting the state's role from "direct operator of an institution" to "early-stage catalyst and resource integrator in key areas."[33]

A Delicate Balance with China?

U.S.–China rivalry remains a constant backdrop. In December 2024, Beijing restricted exports of gallium, germanium, and antimony to the United States. Given China's market dominance, U.S. defense and optoelectronics sectors suffered price spikes and uncertainty in early 2025, forcing many to rely on third-country transshipments.

However, a November summit in South Korea between Presidents Trump and Xi yielded a tactical truce. China agreed to a temporary "general license" system for exports to U.S. users until late 2026 and halted its antitrust investigation of Micron.

31 Ellen D. Harpel, "Tracking CHIPS Act incentives," Smart Incentives, Oct 24, 2025
32 Clare Zhang, "Trump Administration Overhauls CHIPS R&D Plans," American Institute of Physics, Nov 26, 2025.
33 Clare Zhang, "Trump Administration Overhauls CHIPS R&D Plans," American Institute of Physics, Nov 26, 2025.

In return, the United States adjusted certain tariffs on fentanyl precursor chemicals, maintained its suspension of heightened reciprocal tariffs on Chinese imports, and recalibrated its Section 301 investigation into China's maritime logistics sector. While this arrangement does little to resolve structural divergences over technology and security, it has provided a temporary buffer for an otherwise highly strained supply chain environment.[34]

Nevertheless, export and investment controls continue to tighten. Since October 2022, the United States has repeatedly imposed restrictions on exports of high-end GPUs, advanced logic process technologies, and critical equipment to China, adding multiple Chinese high-performance computing and AI firms to the Entity List and extending controls to EDA software and advanced packaging technologies.

In 2024–2025, the U.S. government went further, requiring prior approval for exports of next-generation AI chips such as Nvidia's H20 and AMD's MI300 to China, repeatedly revising the "military end-user" list, and, through an executive order in August 2024, restricting U.S. capital from flowing into China's advanced semiconductor and AI sectors.

The policy focus has gradually shifted from sanctions on specific firms to comprehensive rules that set performance thresholds and define permissible manufacturing pathways—for example, imposing performance caps on HBM products and expanding the scope of the Foreign Direct Product Rule, thereby bringing under U.S. jurisdiction any advanced chips and equipment produced globally that use U.S. technology. These measures have also affected third-country companies with fabs in China.

In 2025, the United States revoked the validated end-user status previously granted to Samsung, Siemens, and others for their Chinese facilities, requiring that, starting in 2026, imports of semiconductor technologies and equipment for those plants be subject to new license applications. Through this rule-making, Washington is seeking to reshape the flows of technology and the configuration of global supply chains.

Furthermore, the U.S. government has opened a new front in trade defense. On April 1, 2025, the Department of Commerce self-initiated a Section 232 investigation into semiconductors and their supply chains, covering not only chips but also manufacturing equipment and downstream products. While the investigation results are expected between late 2025 and early 2026, President Trump signaled in August 2025 the potential for tariffs as high as 100 percent on semiconductor imports, with possible exemptions for companies manufacturing within the United States. This creates a high degree of policy uncertainty that could further compel global chipmakers to reshuffle their manufacturing footprints.

In this policy and geopolitical environment, domestic investment momentum in the U.S. semiconductor sector remains strong. According to the Semiconductor Industry Association, from 2020 through the end of 2025, more than 140 chip-related projects were announced across 28 states, involving over US$ 600 billion in private investment and projected to create more than 500,000 direct and indirect jobs.[35] In scale, this wave of investment has already surpassed the semiconductor growth cycles

34 White House, "Fact Sheet: President Donald J. Trump Strikes Deal on Economic and Trade Relations with China," Nov 1, 2025.

35 Semiconductor Industry Association, "America's Chip Resurgence: Over $630 Billion in Semiconductor Supply Chain

of the 1980s and 1990s, and it suggests that “supply chain resilience” and “technological sovereignty” are increasingly becoming bipartisan pillars of U.S. industrial policy.

Investments,” December 4, 2025.

V.The Chinese Semiconductor Industry

1. China in the Global Semiconductor Supply Chain

China plays a significant role in the global semiconductor industry. 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 14).

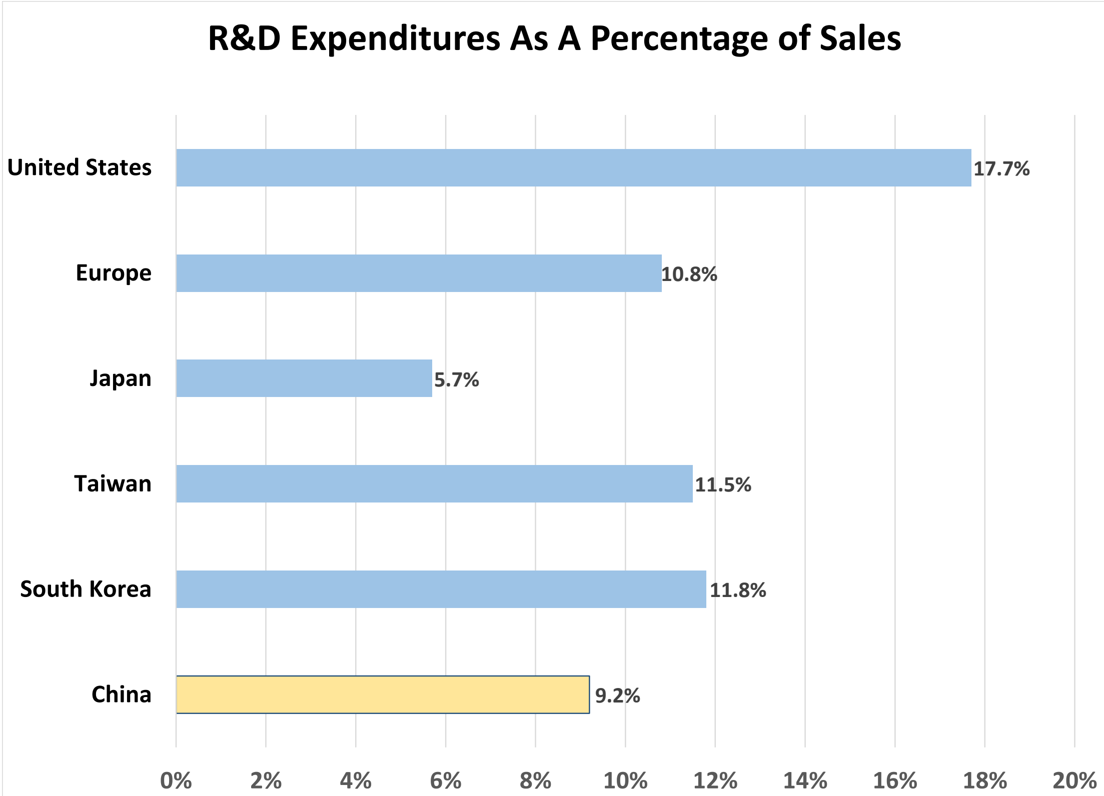
Research and Development

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.[36]

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 31).

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

Figure 31. 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.[37] 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.

37 "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.

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% 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 14).

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 26).

Table 26. 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%**

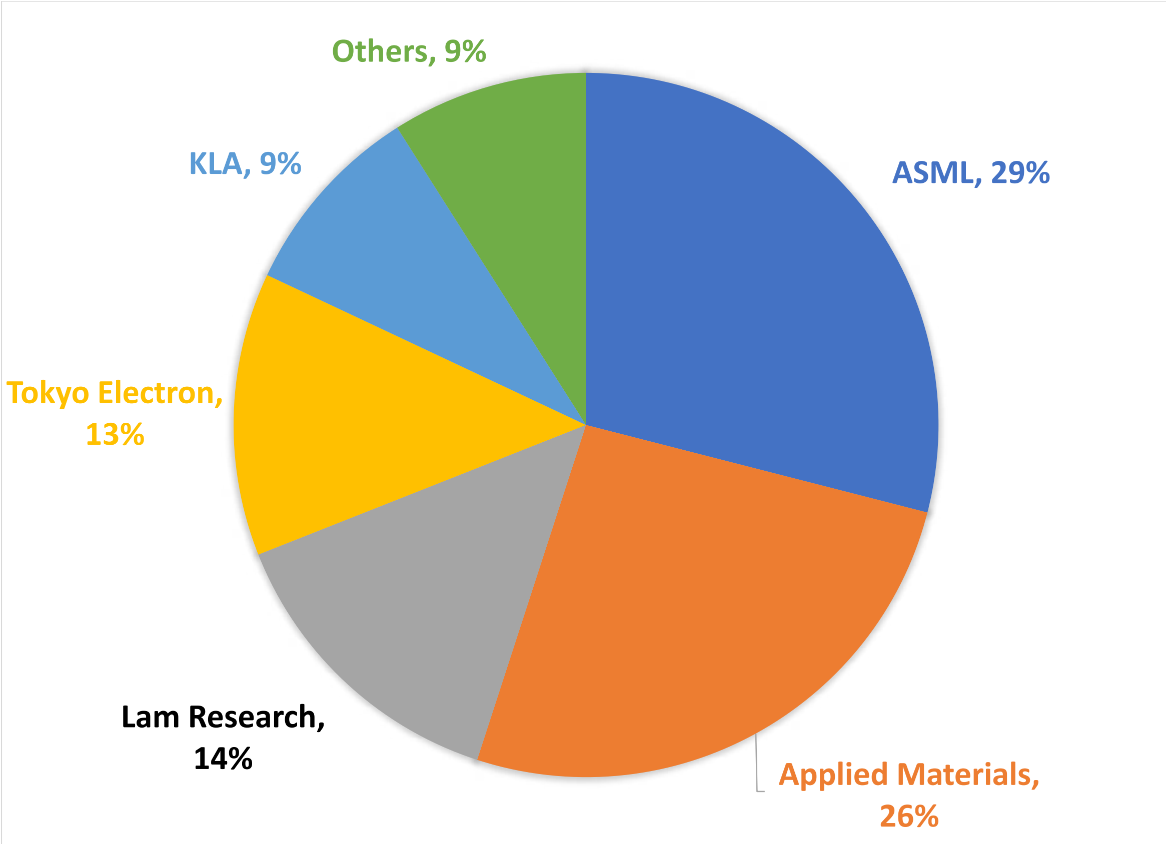
Source: Omdia, "New Omdia Research Reveals 2023 Semiconductor Market Revenue down 9% from 2022," March 27, 2024; TSMC Annual Report 2023.

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 14).

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 32).

Figure 32. Semiconductor Manufacturing Equipment Vendor Market Share by Revenue Worldwide: 2023



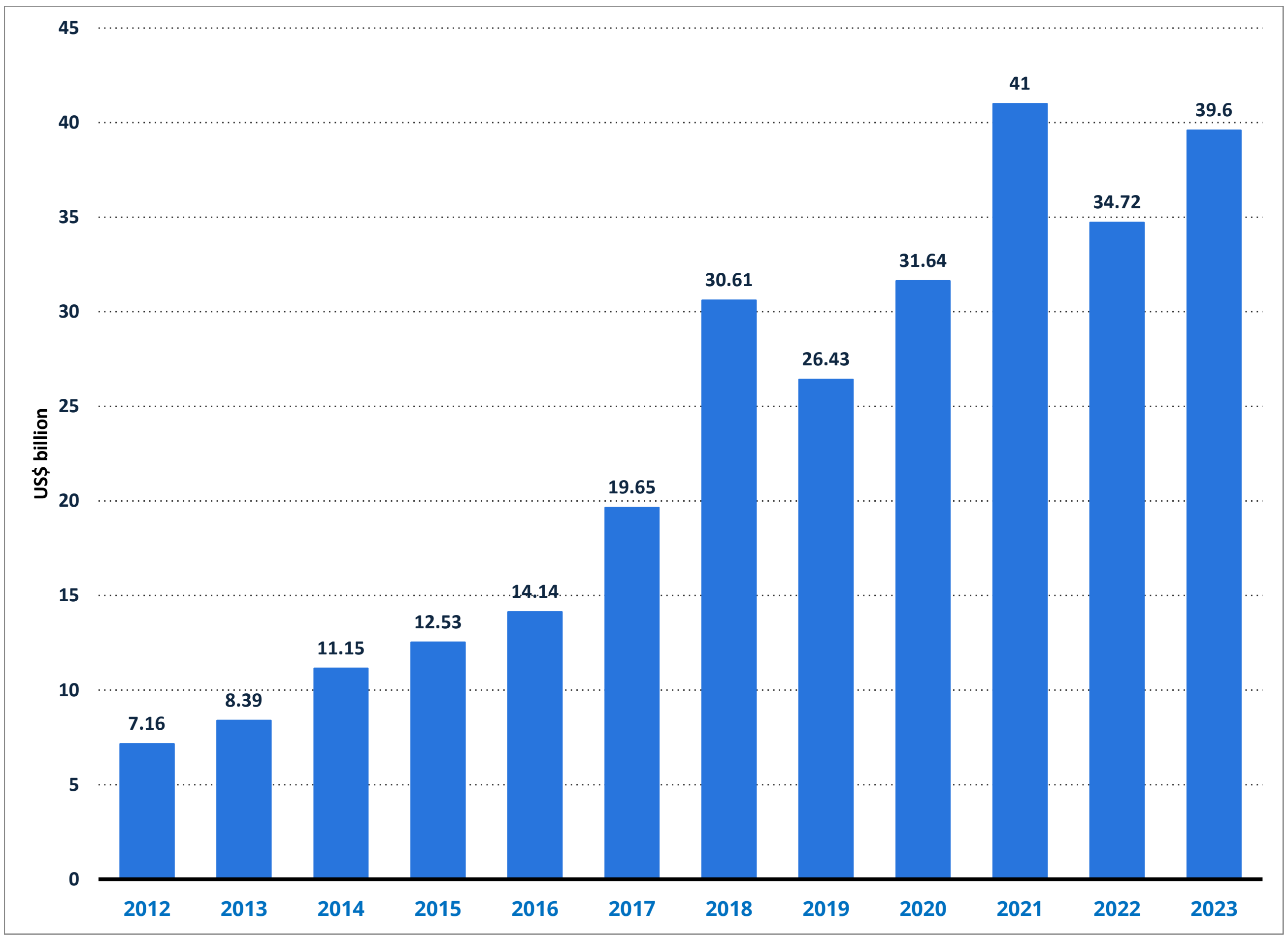
Source: Market share derived from revenue figures from CompaniesMarketCap.com, accessed on February 3, 2025; "Semiconductor Manufacturing Equipment Market Report," Grand View Research, accessed on February 3, 2025.

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 33).

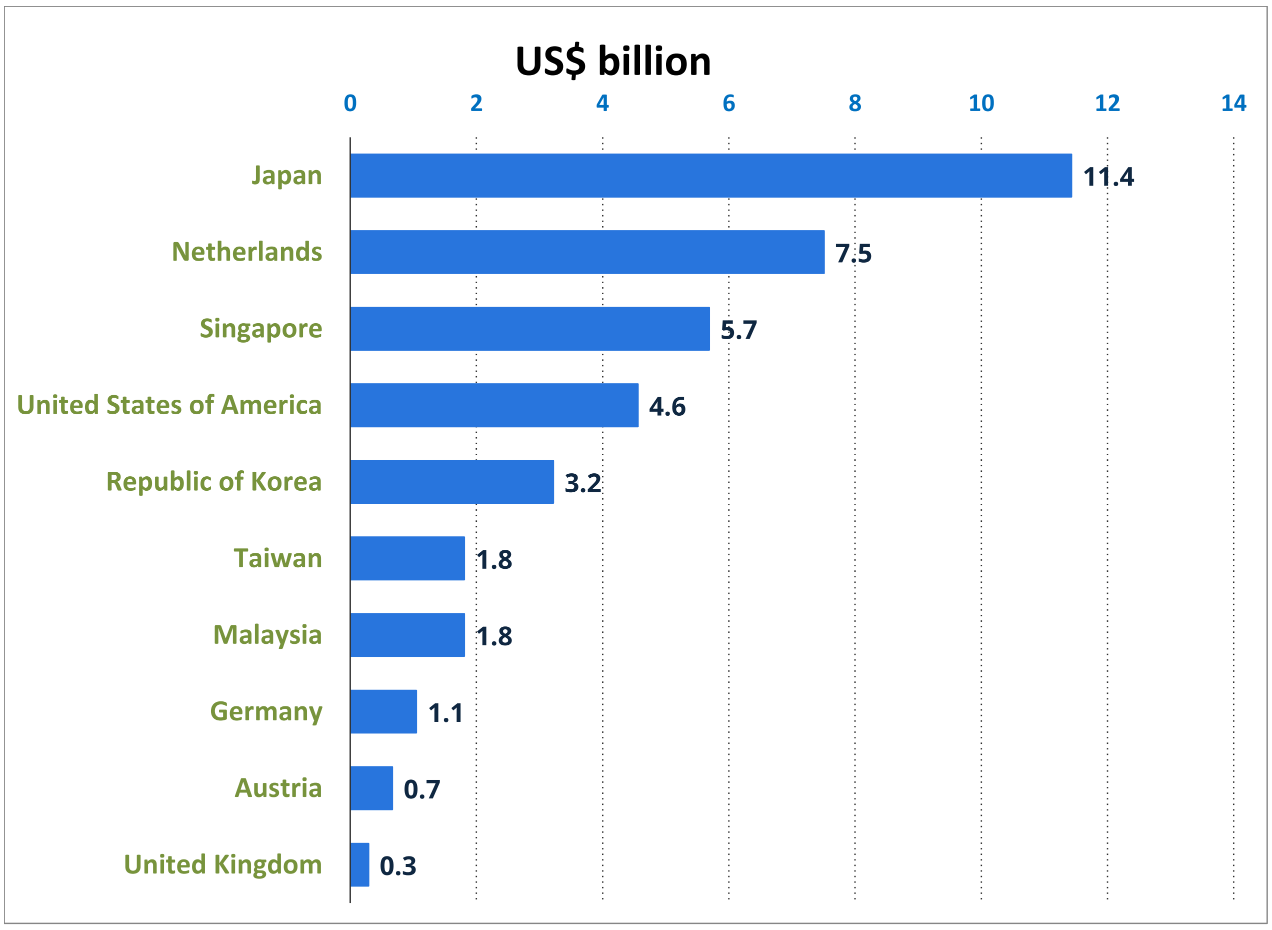
Figure 33. Import Value of Machines for Manufacturing Semiconductors in China: 2012 to 2023



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 34).

Figure 34. 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.

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 14).

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.[38] Rare earths are critical for producing components used in

38 Gracelin Baskaran, "Could Africa replace China as the world's source of rare earth elements?" Brookings, December 2022.

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, 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 14).

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 14).

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.

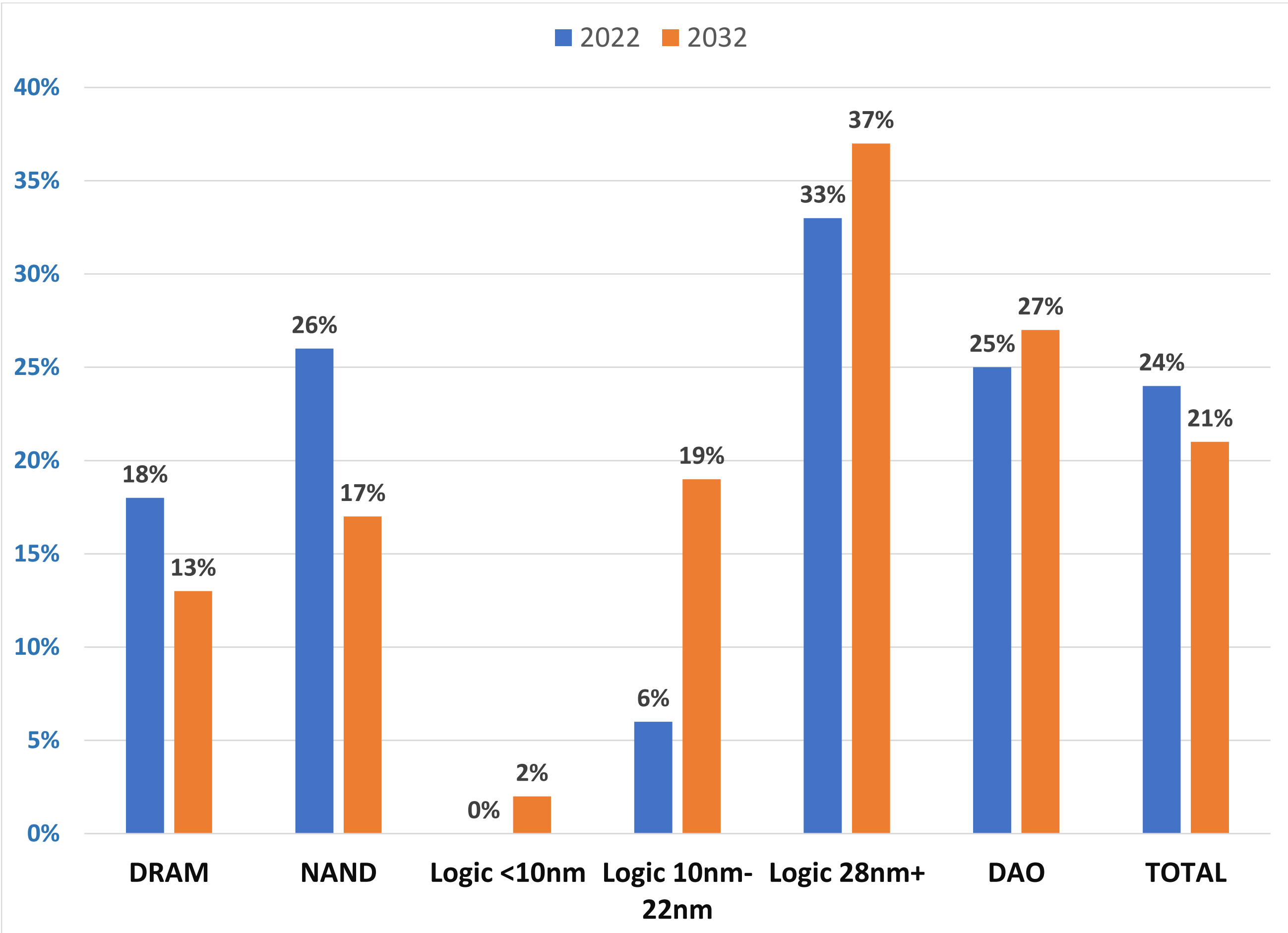
According to BCG's May 2024 report, Chinese firms accounted for approximately 24% of global wafer fabrication capacity in 2022, underscoring China's substantial footprint in semiconductor manufacturing by volume. This strength is particularly evident in memory chips. In 2022, China held around 18% of 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 35).

Figure 35. 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.[39]

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.[40]

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

39 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.

40 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.

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 27).

Table 27. 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.[41]

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

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

foundries and equipment manufacturers and fabless companies, creating a comprehensive and self-sufficient semiconductor ecosystem (see Table 28).

Table 28. 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 29).

Table 29. Made in China 2025 (MIC 2025) Initiative

MIC 2025 focuses on intelligent manufacturing in 10 strategic sectors: 1) advanced information technology; 2) automated machine tools and robotics; 3) aerospace and aeronautical equipment; 4) ocean engineering equipment and high-tech shipping; 5) modern rail transport equipment; 6) energy saving and new energy vehicles; 7) power equipment; 8) new materials; 9) medicine and medical devices; and 10) 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.[42] The new focus shifted to reaching US$ 305 billion in semiconductor output by 2030 and meeting 80% of domestic demand for semiconductors (see Table 30).

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

Table 30. 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%.
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.

MEASURE	DETAILS
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.
"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.

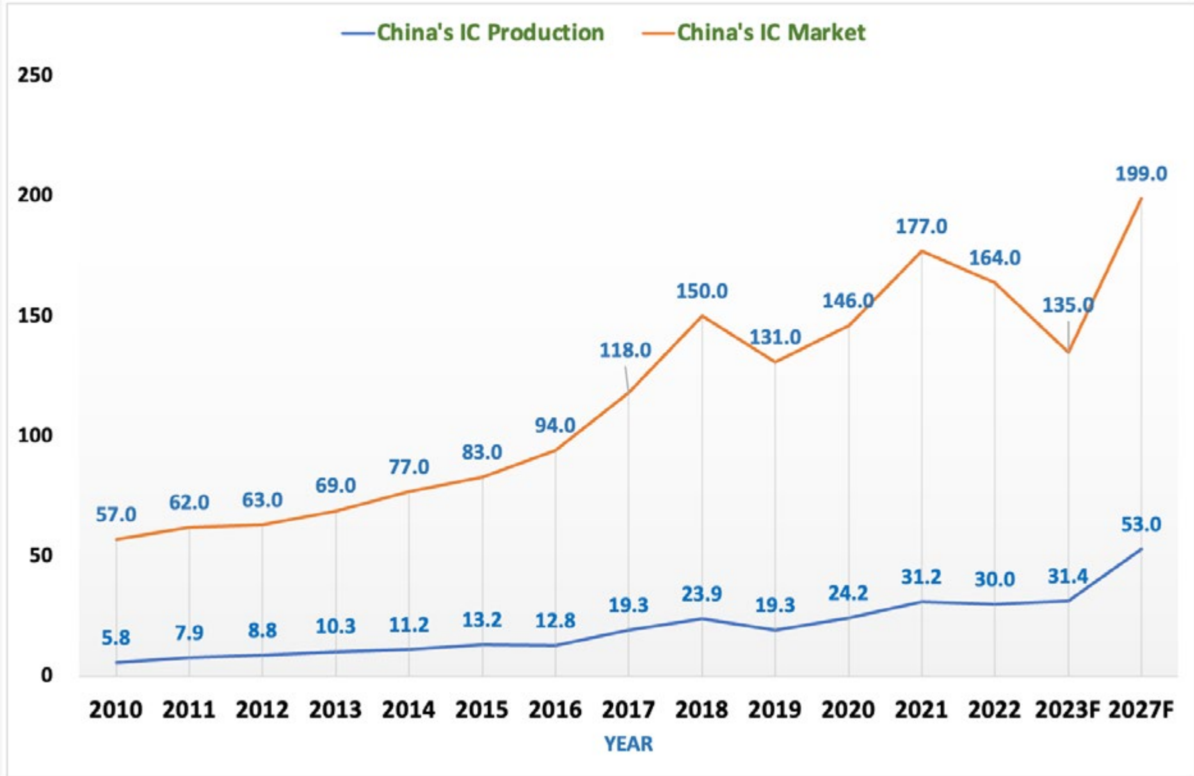
The rapid growth of China's electronics industry coupled with the restrictions imposed by Western countries have widened the gap between the country's IC market and its production. As demand for consumer electronics, smartphones, electronic vehicles and other technology products continues to rise, the 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 36 and 37).[43]

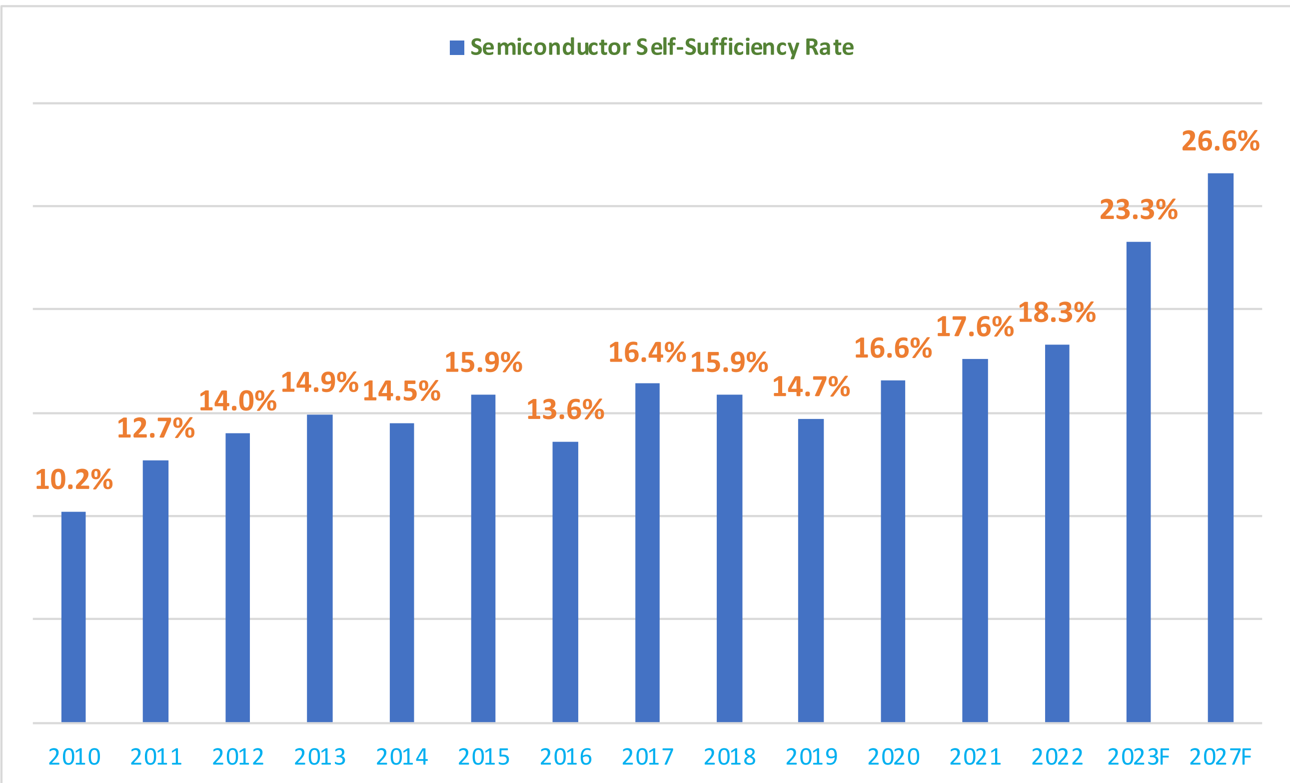
43 "China's Semiconductor Industry Self-Sufficiency Rate Continues to Rise, Expected to Reach 26.6% by 2027," MIRU News and Reports, October 2, 2024.

Figure 36. 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.

Figure 37. 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.[44] 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%.

Expanding Scale, but Slight Decline in Market Share

Global market share data reveals the specific drivers of the growth of Chinese foundries. According to TrendForce data in terms of revenue, the combined global market share of SMIC, HuaHong Group, and Nexchip declined from 9.6% in 2022 to 8.6% in the third quarter of 2025. This suggests that, despite policy support and strong domestic demand, their overall global influence has remained stagnant and has even edged down. However, in terms of production capacity, China's importance in mature-node manufacturing continues to increase.

Individually, SMIC's market share increased from 5.3% in 2022 to a peak of 5.7% in 2024, before retreating to 5.1% in the third quarter of 2025. HuaHong Group's share declined from 3.1% to 2.6%, while Nexchip's fell from 1.3% to 0.9%, where it has since stabilized. A common feature among these firms is their heavy reliance on mature process nodes, with constrained average selling prices limiting the ability of market share to rise in tandem with capacity expansion.

Overall, growth in China's foundry sector has primarily reflected global demand expansion and internal substitution, rather than a meaningful displacement of existing international market share (see Table 31).

Table 31. Global Market Share of Top 3 Chinese Foundries by Revenue: 2022-2025

	2022	2023	2024	2025Q3
SMIC (CN)	5.3%	5.4%	5.7%	5.1%

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

Huahong Group (CN)	3.1%	2.7%	2.4%	2.6%
Nexchip (CN)	1.3%	1.0%	0.9%	0.9%
Sum	9.6%	9.0%	9.1%	8.6%

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.[45] 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.

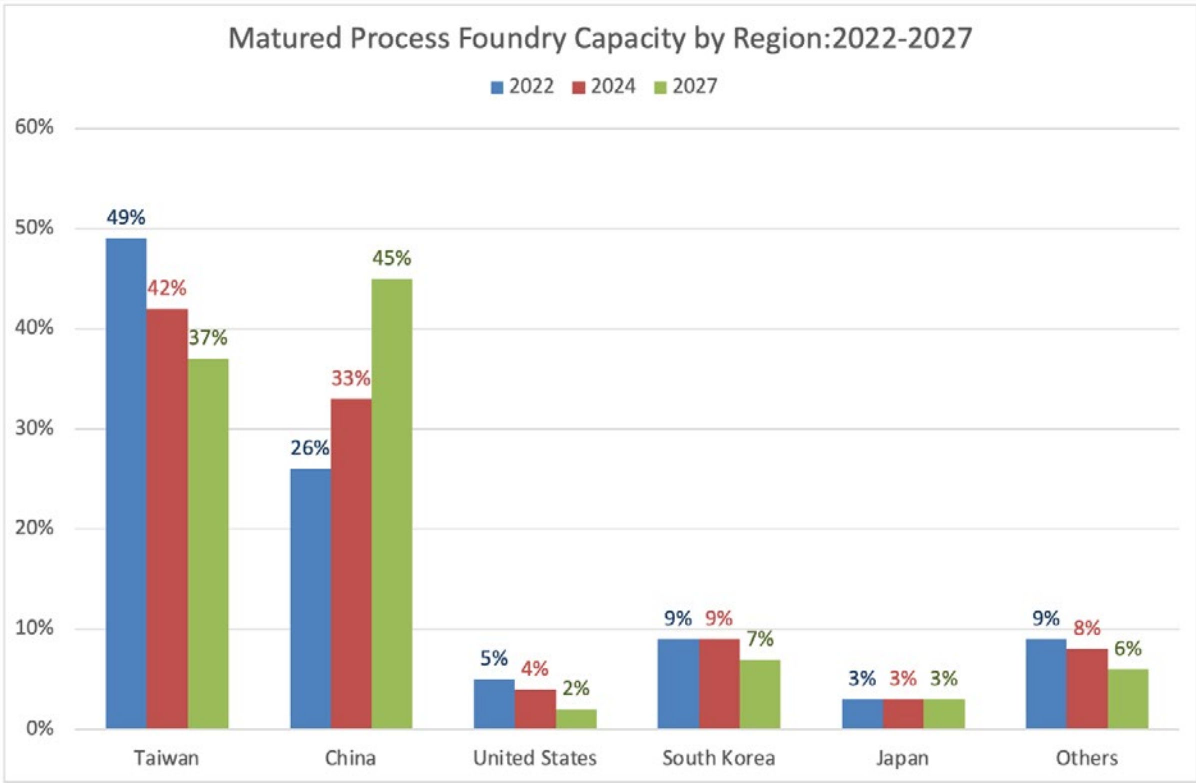
In 2022, Taiwan was the undisputed leader, commanding 49%of the world's mature node capacity. However, this dominance is projected to steadily erode, falling to 42% in 2024 and to 37% by 2027. This downward trend reflects a strategic pivot by Taiwanese firms toward high-margin advanced nodes rather than 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 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 38).

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

Figure 38. 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 32).

Table 32. 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.

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

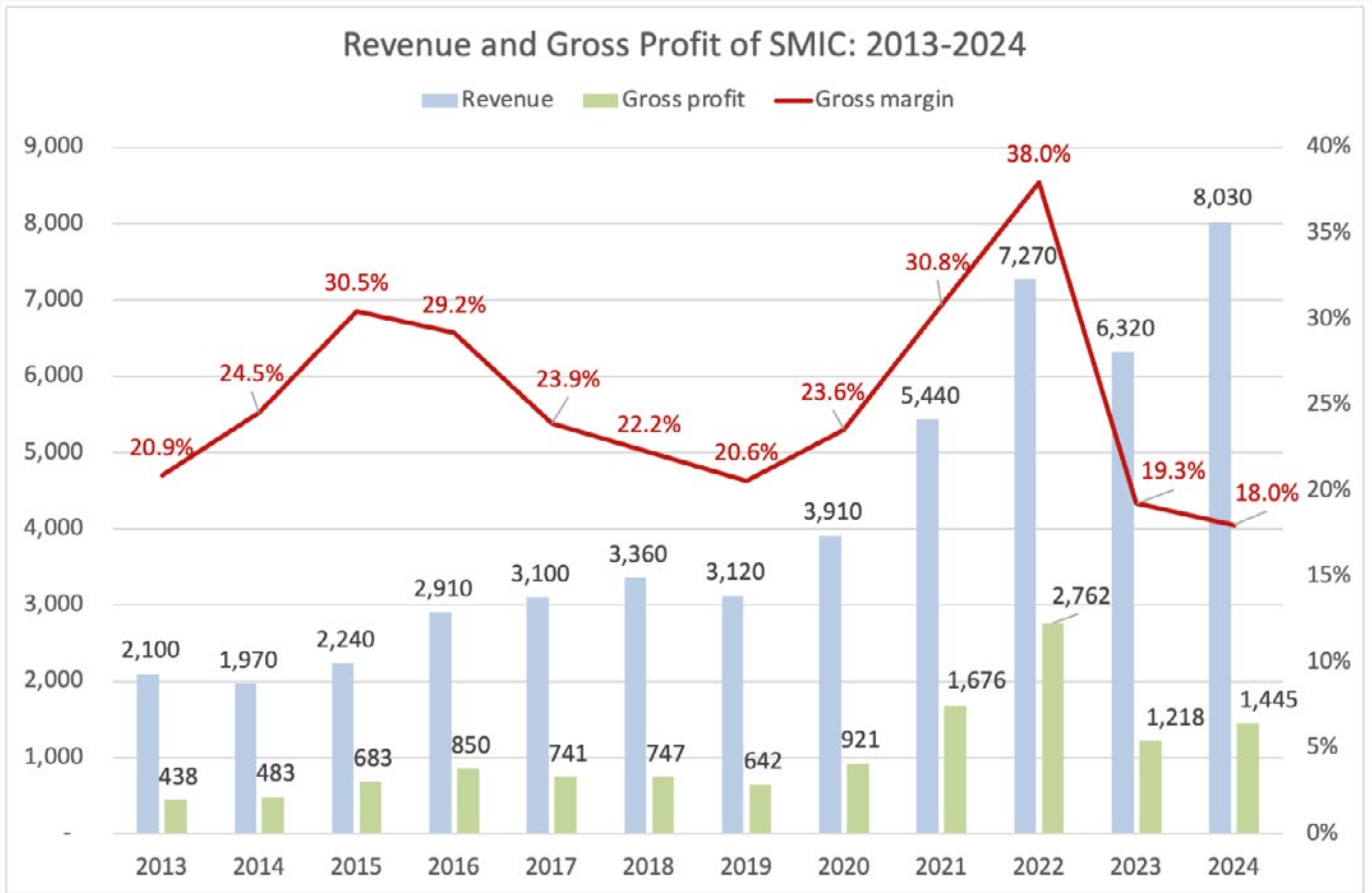
SMIC has posted strong revenue growth since 2013, reaching a record US$ 8.03 billion in 2024 after a downturn in 2023. However, aggressive expansion in mature-node capacity has led to persistent oversupply, depressing prices and constraining profitability.

While gross profit rebounded modestly in 2024, margins continued to erode. Gross margin fell from 38.0% in 2022 to 18.0% in 2024, and net margin declined even more sharply—from 25.0% to 6.1% over the same period—despite record revenues.[46]

46 SMIC Q4 2024 Financial Presentation, February 2025.

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 39).

Figure 39. Revenue and Gross Profit of SMIC: 2013 to 2024



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

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.[47] 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.[48] 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.[49]

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. The divergence persisted in the first half of 2025: TSMC maintained gross margins near 59% and net margins above 42%, while SMIC's gross margins fluctuated around 20–23% and net margins slipped to below 9%, underscoring sustained cost pressures. Multiple media reports attribute this sharp deterioration largely to the exceptionally high costs of producing 7nm chips for Huawei, where low yields and complex manufacturing processes severely eroded profitability.[50]

47 Mavis Tsai and Levi Li, "Huawei Ascend 910C reportedly hits 40% yield, turns profitable; aims for 60% industry standard," DIGITIMES Asia, February 25, 2025.
48 News, "Overview of China's Semiconductor Equipment Industry," TrendForce, February 17, 2024.
49 Yuan Gao and Debby Wu, "China's Chip Advances Stall as US Curbs Hit Huawei AI Product," Bloomberg, November 19, 2024
50 News, "SMIC 2024 Sales Hit Record, But Profit Drops Reportedly Due to High Huawei Chip Costs," TrendForce, February 12, 2025.

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 33).

Table 33. 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	88.27	56.1%	40.5%	8.03	18.1%	6.1%
2025Q1	25.53	58.8%	43.1%	2.25	22.5%	8.3%
2025Q2	30.24	58.6%	42.7%	2.21	20.4%	5.9%

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

4. Updates in 2025 and Prospects

A Dual-Track Semiconductor Strategy under Intensifying Technology Controls

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 result is a striking contrast between constrained progress in the front-end and rapid growth in the back-end of the industry.

The recent breakthroughs from the collaboration between SMIC and Huawei symbolize this landscape. Even without access to advanced tools, China has managed to mass-produce 7 nm chips using DUV multi-patterning and is even attempting to move toward 5 nm—an indication of its technological resilience in reverse-engineering pathways. Yet these advances come with heavy costs.

Compared with TSMC, SMIC's 7 nm process is estimated to be 40–50% more expensive with only about one-third the yield, severely limiting commercial competitiveness.[51] Production is sustained primarily through the price premiums of Huawei's flagship devices and potential policy support. As for whether DUV can push below 5 nm, the market largely believes China is approaching physical and economic limits, while the timeline for a domestically built EUV tool remains highly uncertain.[52]

Capacity Expansion, Price Competition, and Structural Imbalances

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—far more than any other region. By the end of 2024, China was projected to hold 33% of global mature-node capacity, potentially rising to 45% by 2027. This wave of new capacity is already reshaping the global landscape. Chinese foundries are undercutting UMC and GlobalFoundries by 20–30%, quickly gaining share in PMICs, MCUs, display driver ICs, and other segments, and triggering a new round of price competition in mature nodes (see Table 34).[53]

Table 34. Progress of Semiconductor Investment and Production in China: 2025

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.

Against this backdrop of aggressive expansion, progress in domestic semiconductor equipment has been comparatively slower. The 28 nm-class immersion DUV lithography tool under testing by Shanghai Micro Electronics marks a meaningful step, yet it still lags behind ASML's mainstream systems by several generations, and its real-world yield and stability remain unproven.

China's strategic effort to strengthen weak links in the supply chain is becoming clearer with the third phase of the "Big Fund." Investments prioritize the most vulnerable parts of China's semiconductor ecosystem and future strategic choke points. High-bandwidth memory (HBM) and AI chips have become

51 News, "Decoding China's Lithography Push to Challenge ASML: From SiCarrier to Alternative EUV Paths," TrendForce, November 10, 2025 .
52 Rajesh Krishnamurthy "Process Node Analysis: Kirin 9020 SoC ," TechInsights, December 20, 2024.
53 News, "China's Low-Cost SiC and Mature Chips Ignite Global Semiconductor Price War," TrendForce, February 27, 2025.

top priorities, reflecting China's intent to challenge the dominance of SK Hynix, Samsung, and Micron. At the same time, the Big Fund is increasing support for advanced packaging and key process equipment, hoping improvements in back-end processes and core tools can partially offset the front-end bottlenecks created by lithography constraints.

Resilience with Limits

However, rapid expansion has also resulted in intense industry shakeouts. In 2024, China's semiconductor sector underwent a "bubble-cleansing" correction: more than 14,600 chip-related firms were deregistered or dissolved, far exceeding the 10,900 recorded in 2023. This wave of failures reflects a bloated structure inflated by past subsidies and capital. As funding tightens and competition intensifies, firms lacking core technologies and relying purely on subsidies are being quickly eliminated.

Externally, China's semiconductor environment remains under heavy pressure. Since the U.S. tightened chip and equipment export controls in October 2022, the U.S., Japan, and Europe have continued to introduce more targeted restrictions from 2023 through 2025. In October 2023, the U.S. blocked Chinese firms from acquiring high-end GPUs through third-party channels and expanded controls to include HBM and advanced chiplet components. The Netherlands and Japan simultaneously imposed stricter export rules on advanced DUV tools, etchers, and coating/developing equipment.

Restrictions have also increasingly extended to the application layer. The U.S.'s "Know Your Customer" (KYC) rule issued in late 2024 targeted China's use of overseas cloud services to access compute resources. The AI model-safeguard rule in January 2025 explicitly prohibited the re-export of high-performance AI chips containing U.S. technology to China and required tighter oversight of cloud-based AI training. By May 2025, the U.S. even classified "training AI models globally using Huawei Ascend chips" as a violation, severely constraining China's ability to deploy high-end compute hardware.[54]

54 Congress.gov. "U.S. Export Controls and China: Advanced Semiconductors." September 19, 2025, https://www.congress.gov/crs-product/R48642.

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 14).

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 14).

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 14).

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 14). 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.[55]

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 35).

Table 35. 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, 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

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

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.[56]

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.[57] 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 U.S. firms and one European company.[58]

56 Canon, Press Release, "Nanoimprint lithography semiconductor manufacturing system that covers diverse applications with simple patterning mechanism," October 13, 2023.
57 Naoko Tochibayashi and Naoko Kutty, "How Japan's semiconductor industry is leaping into the future," World Economic Forum, November 20, 2023.
58 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.

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 36).

Table 36. 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.[59]

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.

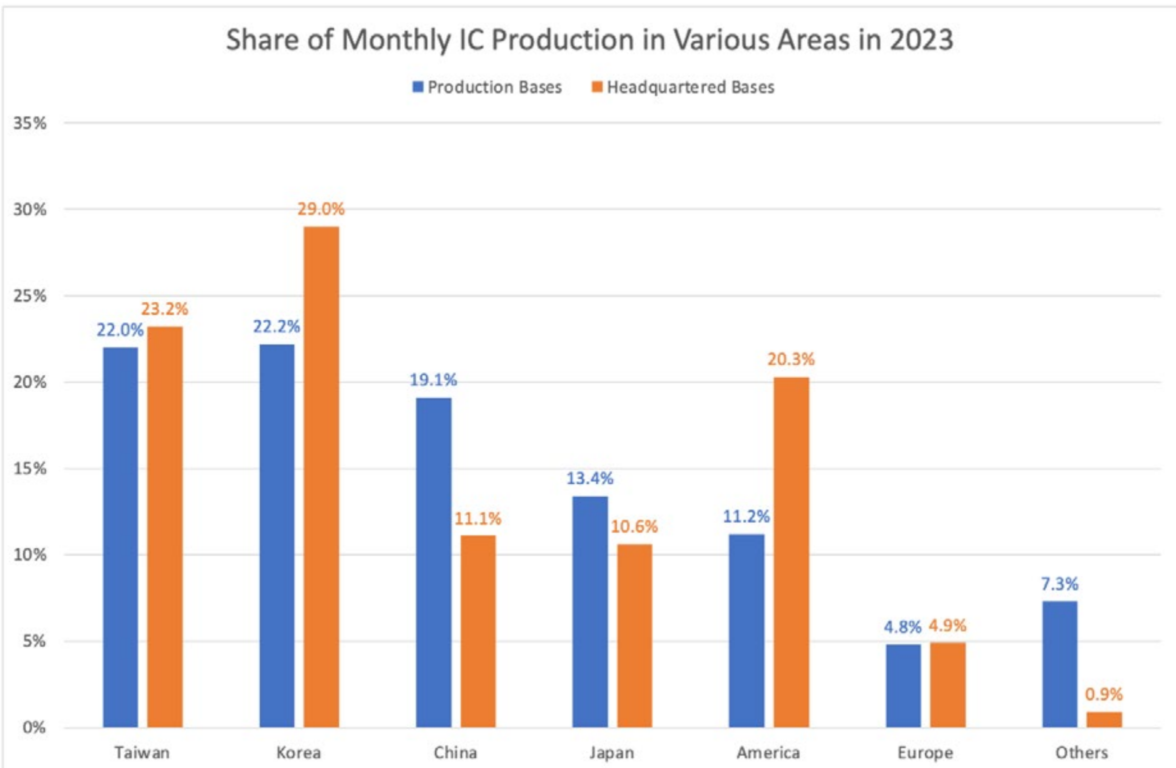
59 Semiconductor Industry News (Sangyo Times Co., Ltd.), "Episode 20 Rise and Fall of Japanese Semiconductors," Makimoto Library, January 9, 2008, p. 3.

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 40).

Figure 40. 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 37).

Table 37. 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.

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.[60]

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 38).

60 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 38. 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.

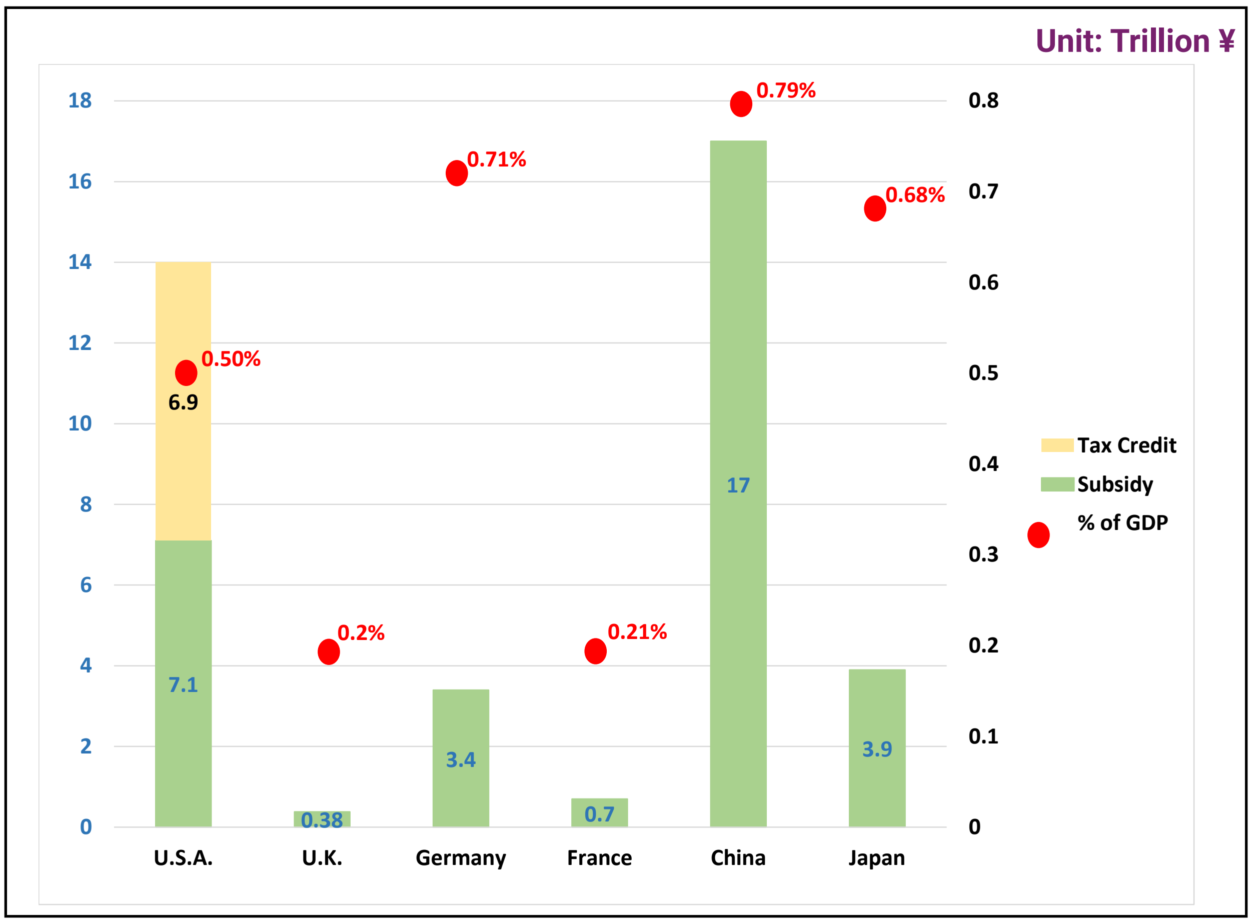
A notable illustration of this policy direction is the acquisition of JSR Corporation by the state-backed Japan Investment Corporation (JIC). Between March 19 and April 16, 2024, JIC acquired more than 84% of JSR's outstanding shares through a tender offer valued at approximately ¥ 900 billion (US$ 6.5 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 41).

Figure 41. 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.[61]

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. These subsidies are conditional upon a minimum of 10 years of domestic production and include requirements to prioritize domestic supply during periods of global shortage, underscoring Japan's emphasis on long-term industrial anchoring and supply security.

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

61 Kumamoto Prefecture Government, "Kumamoto Semiconductor Industry Promotion Vision," March 6, 2023, p. 39.

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.[62]

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

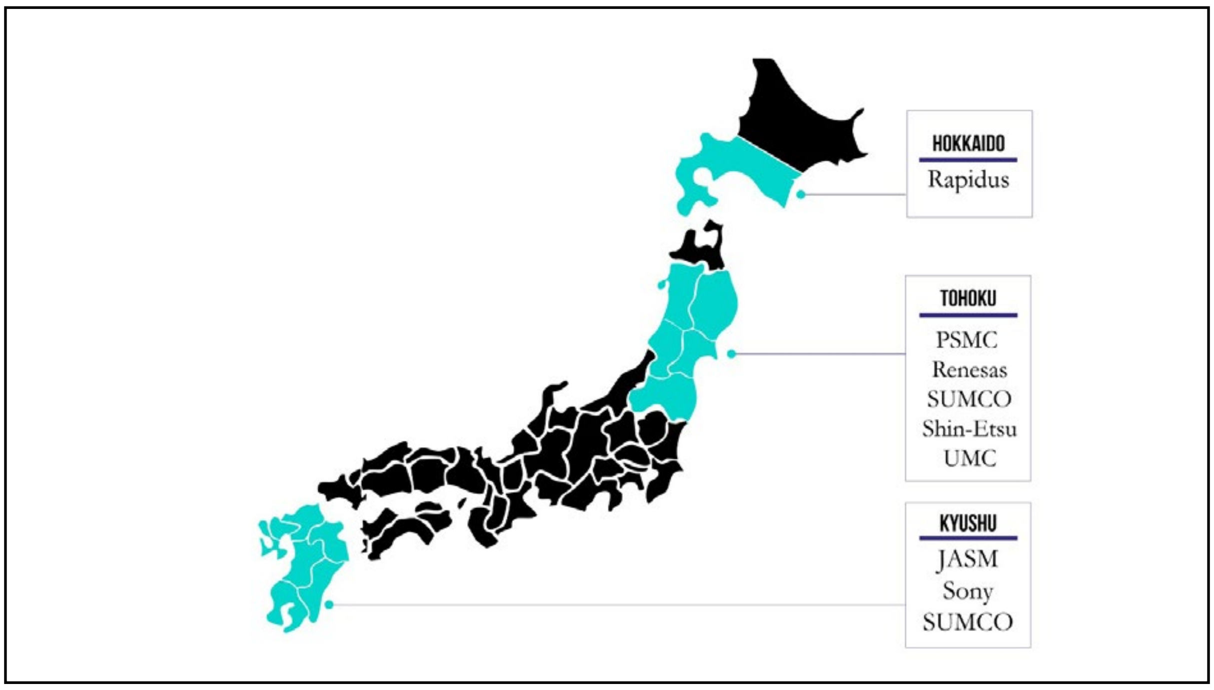
62 Ryohtaroh Satoh, "Japan's Rapidus and universities aim for 'beyond 2nm' chip tech," Nikkei Asia, February 9, 2024.

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 42).

Figure 42. 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 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 39).

Table 39. Progress of Semiconductor Investment and Production in Japan: 2025

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)	6 nm, 7 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.

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.

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 14).

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 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 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.

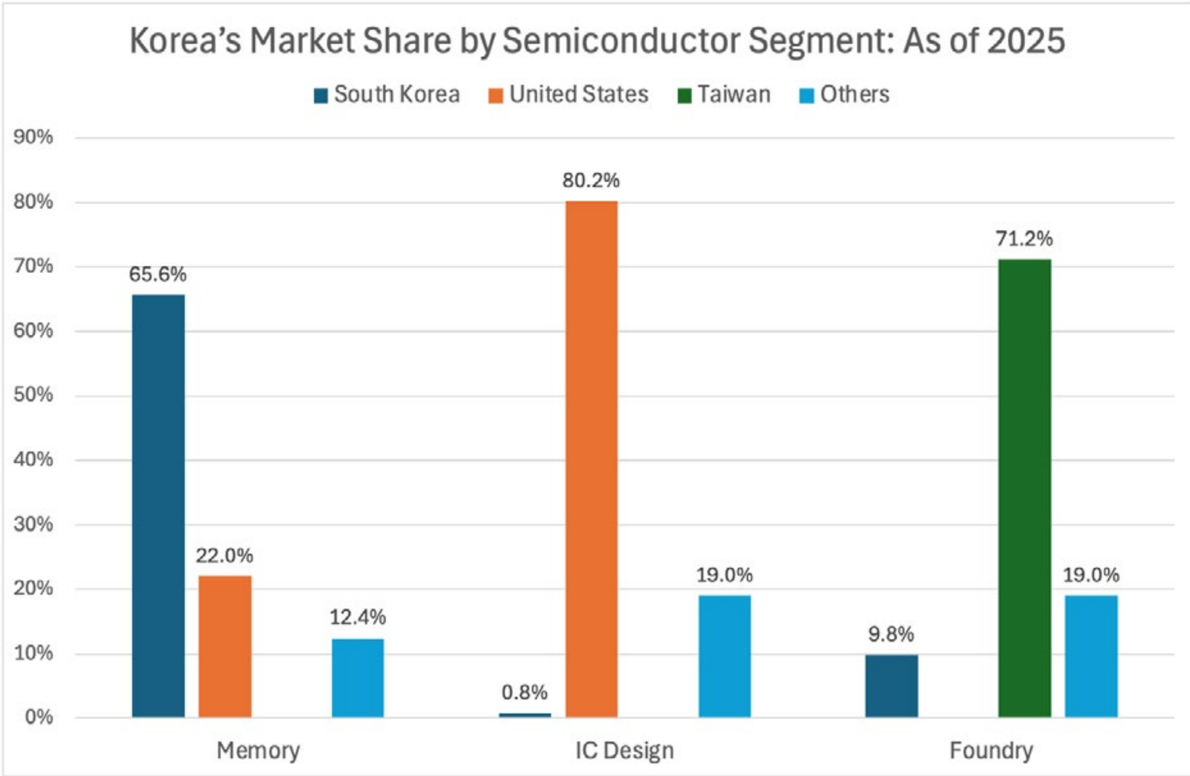
Samsung Electronics has similarly developed advanced packaging platforms such as I-Cube (2.5D) and X-Cube (3D), which enable the integration of logic, memory, and interposer chips within a single package. In selected segments, Samsung's packaging technologies compete directly with TSMC's Chip-on-Wafer-on-Substrate (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 43).

Figure 43. 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 reflects 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 40).

Table 40. 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 9.9% in 2024, and dropped sharply to 7.5% by the first half of 2025.

This trajectory represents a loss of more than half of Samsung's foundry market share within just three and a half 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 41).

Table 41. Ranking and Market Share of Global Top 5 Foundries by Revenue: 2022-2025H1

Ranking	Company	Market Share			
		2025H1	2024	2023	2022
1	TSMC (TW)	69.2%	64.0%	58.9%	55.4%
2	Samsung (KR)	7.5%	9.9%	12.0%	16.0%
3	SMIC (CN)	5.5%	5.7%	5.4%	5.3%
4	UMC (TW)	4.5%	5.2%	6.1%	6.8%
5	GlobalFoundries (U.S.)	4.1%	4.9%	6.3%	6.0%

Source: Raw data are from TrendForce press releases; yearly market share 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 3nm 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 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 rises from about US$ 77 billion in 2016 to 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.

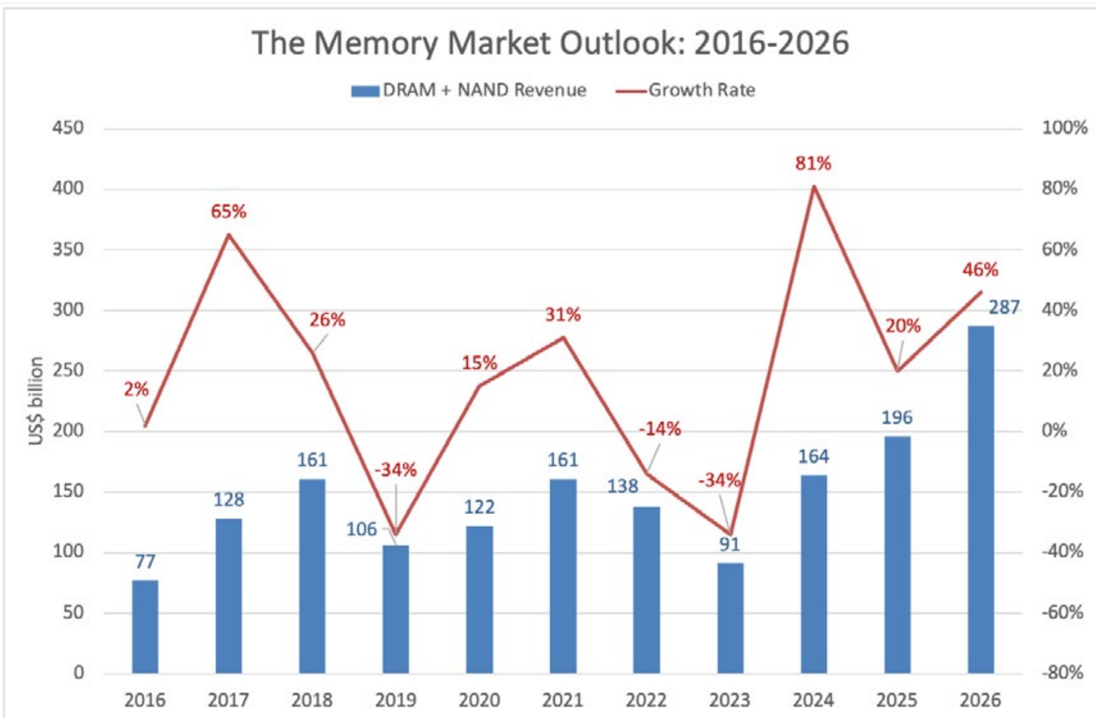
The upswing in 2017 and 2018, when revenues climbed from US$ 128 billion to US$ 161 billion, reflected tight supply conditions and strong demand from smartphones and data centers, allowing Korean memory producers to enjoy exceptional pricing power. This momentum reversed abruptly in 2019, when revenues 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 forecasted US$ 196 billion in 2025 and forecasted US$ 287 billion in 2026, corresponding to growth rates of 20% and 46%. Cyclicality has not disappeared, but the overall scale of the market has clearly expanded. Volatility may remain the industry's constant companion, yet the longer-term trajectory suggests that memory—especially advanced memory—has become too central to the global digital economy for Korea's leadership to be anything but enduring (see Figure 44).

Figure 44. The Memory Market Outlook: 2016-2026



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

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.

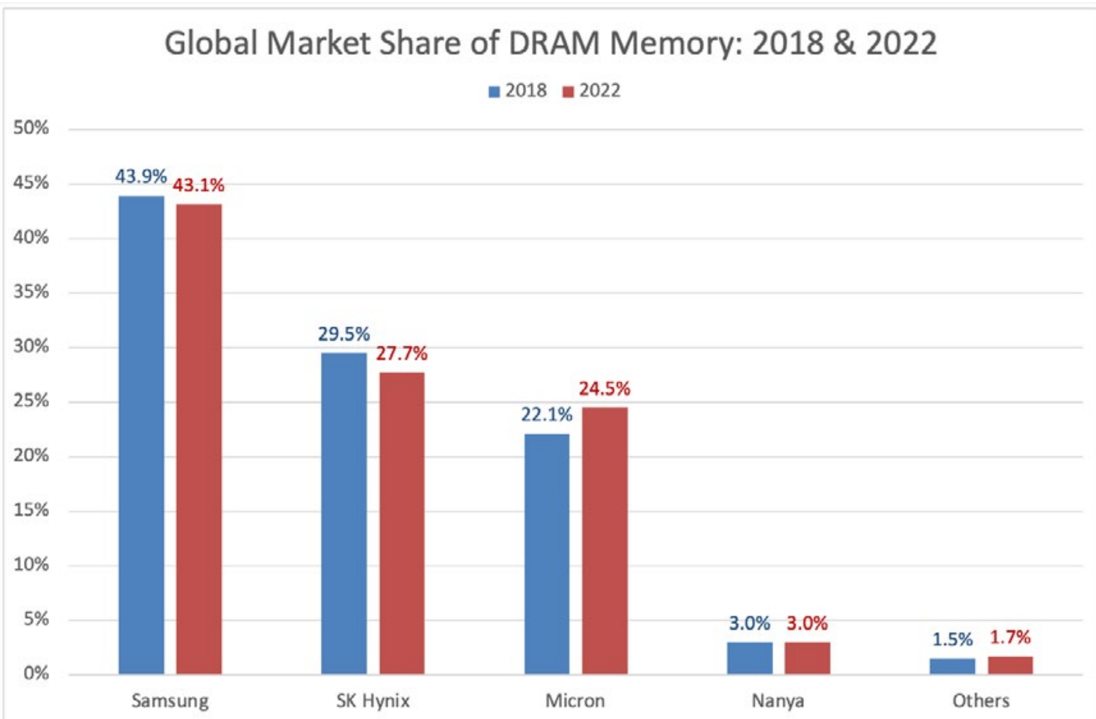
In the late 2010s, Korea's dominance in DRAM was already firmly established. In 2018, Samsung and

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 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 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 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 45 ; Table 42).

Figure 45. Global Market Share of DRAM Memory: 2018 & 2022



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

Table 42. 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 Q3–Q4 2024 to about 67% by Q3 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 Q3 2024 to around 33% by Q3 2025, while SK hynix rose from 33% to 36% over the same period, briefly becoming the world's largest DRAM supplier by revenue in several quarters. This transition highlights SK hynix's growing strength, particularly in advanced DRAM and high-bandwidth memory tied to AI workloads.

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 43).

Table 43. Global DRAM Market Share by Revenue (Quarterly): Q3 2024-Q3 2025

Market Share	Q3 2024	Q4 2024	Q1 2025	Q2 2025	Q3 2025
Samsung	40%	38%	34%	32%	33%
SK hynix	33%	35%	36%	38%	34%
Micron	21%	22%	25%	23%	26%
CXMT	3%	4%	5%	5%	5%
Nanya	1%	1%	1%	1%	2%
Others	1%	1%	0%	1%	1%
Korean Share	73%	73%	70%	70%	67%
Total	100%	100%	100%	100%	100%

Source: Counterpoint, "Global DRAM and HBM Market Share: Quarterly," December 19, 2025.

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 high speed.

From Q3 2024 to Q3 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.

SK hynix emerged as the dominant market leader, with its share peaking at 69% in Q1 2025 before easing to 57% by Q3 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.

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 44).

Table 44. Global HBM Market Share by Revenue (Quarterly): Q3 2024-Q3 2025

Market Share	Q3 2024	Q4 2024	Q1 2025	Q2 2025	Q3 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%

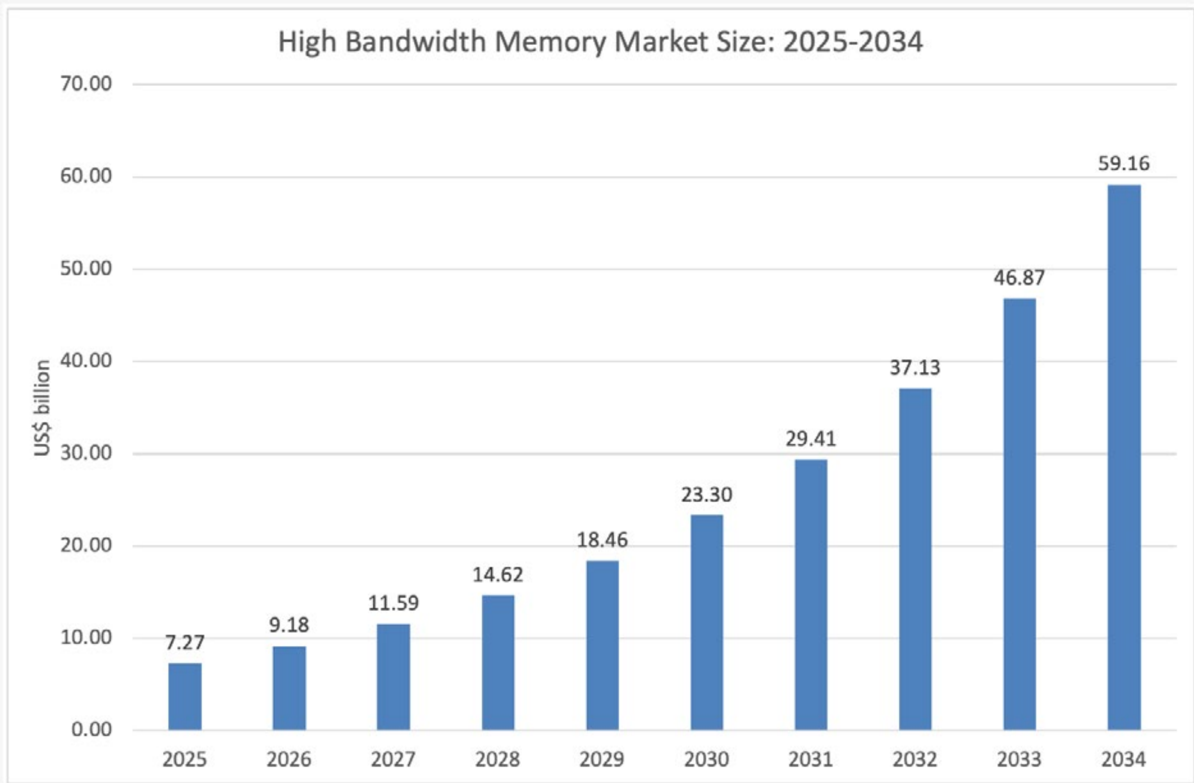
Source: Counterpoint, "Global DRAM and HBM Market Share: Quarterly," December 19, 2025.

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 46).

Figure 46. High Bandwidth Memory Market Size: 2025-2034



Source: "High-Bandwidth Memory Market Size, Share and Trends 2025 to 2034," Precedence Research, October 14, 2025.

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 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 45).

Table 45. 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.

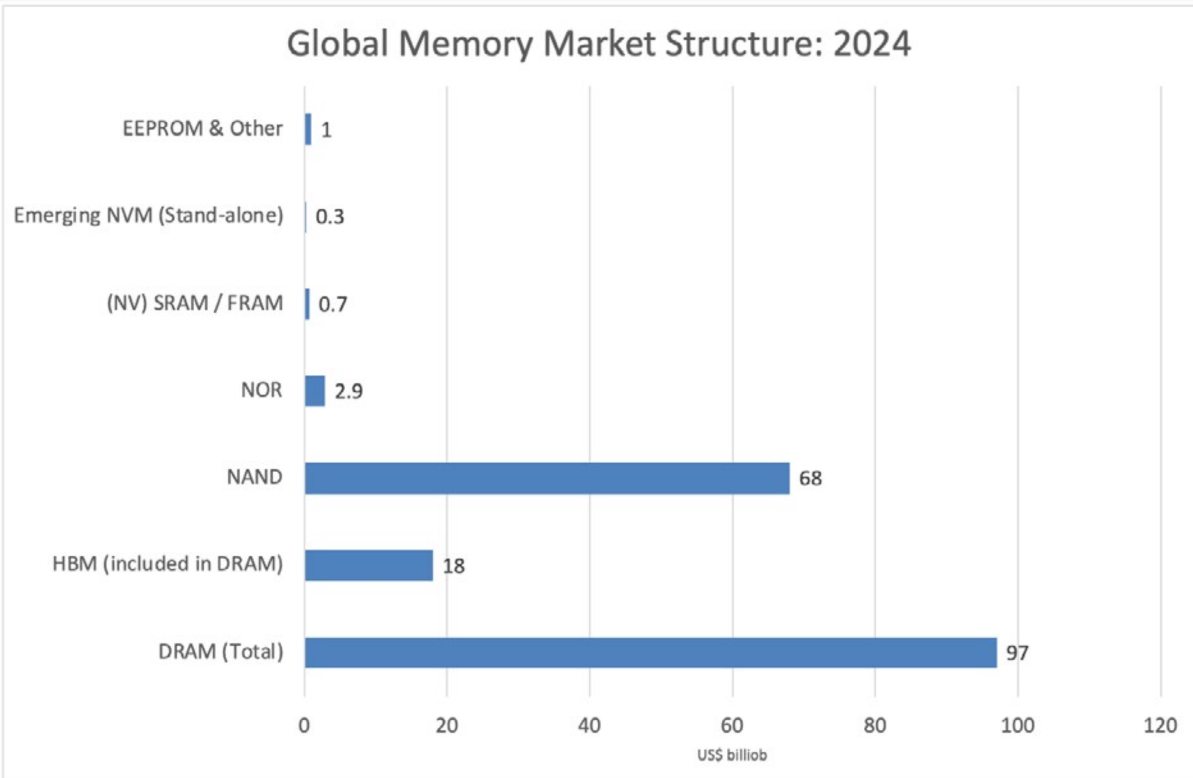
Looking ahead, the market's evolution is increasingly defined by changes in value distribution rather than volume alone. By 2030, global memory revenue is projected to reach roughly US$ 302 billion, implying a CAGR of around 10% from 2024 to 2030. DRAM revenue is expected to double to approximately US$ 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.

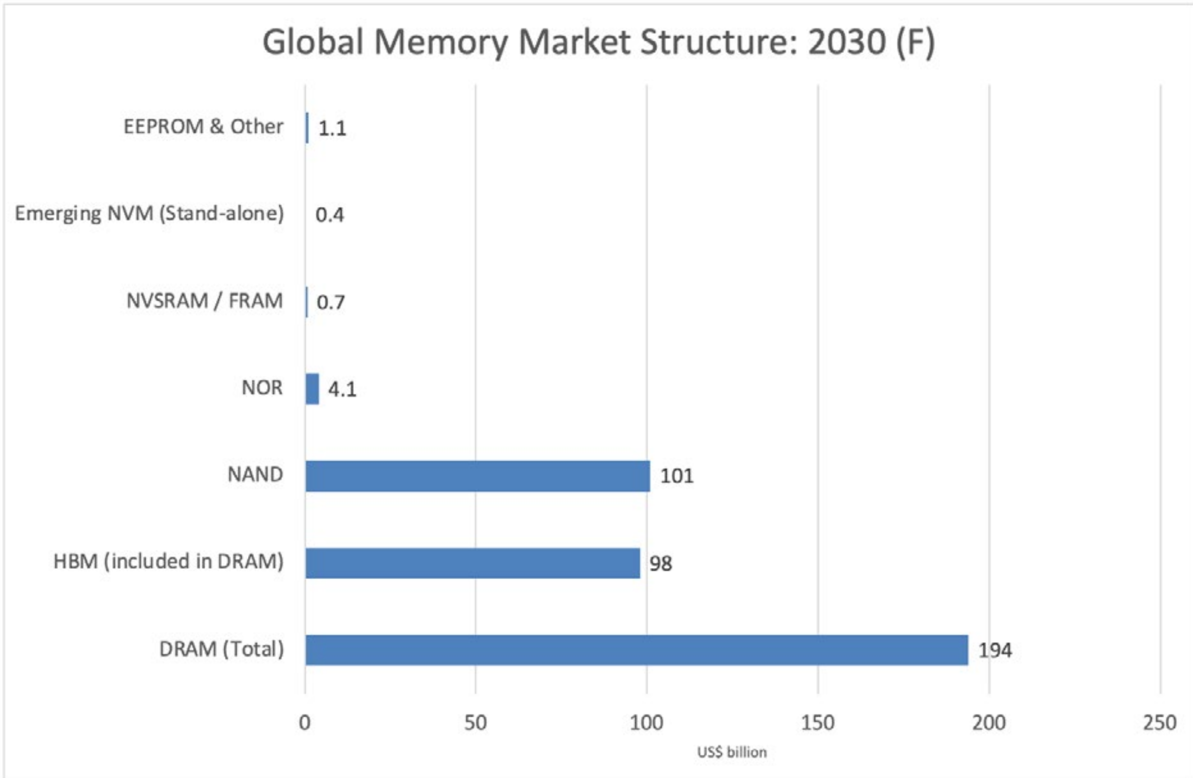
Overall, the global memory market is no longer driven solely by traditional cyclical forces. While DRAM and NAND remain its backbone, HBM is steadily redefining the industry's center of gravity, shifting value creation toward AI-driven infrastructure, technological bottlenecks, and geopolitical resilience (Figure 47 and 48).

Figure 47. 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 48. 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.

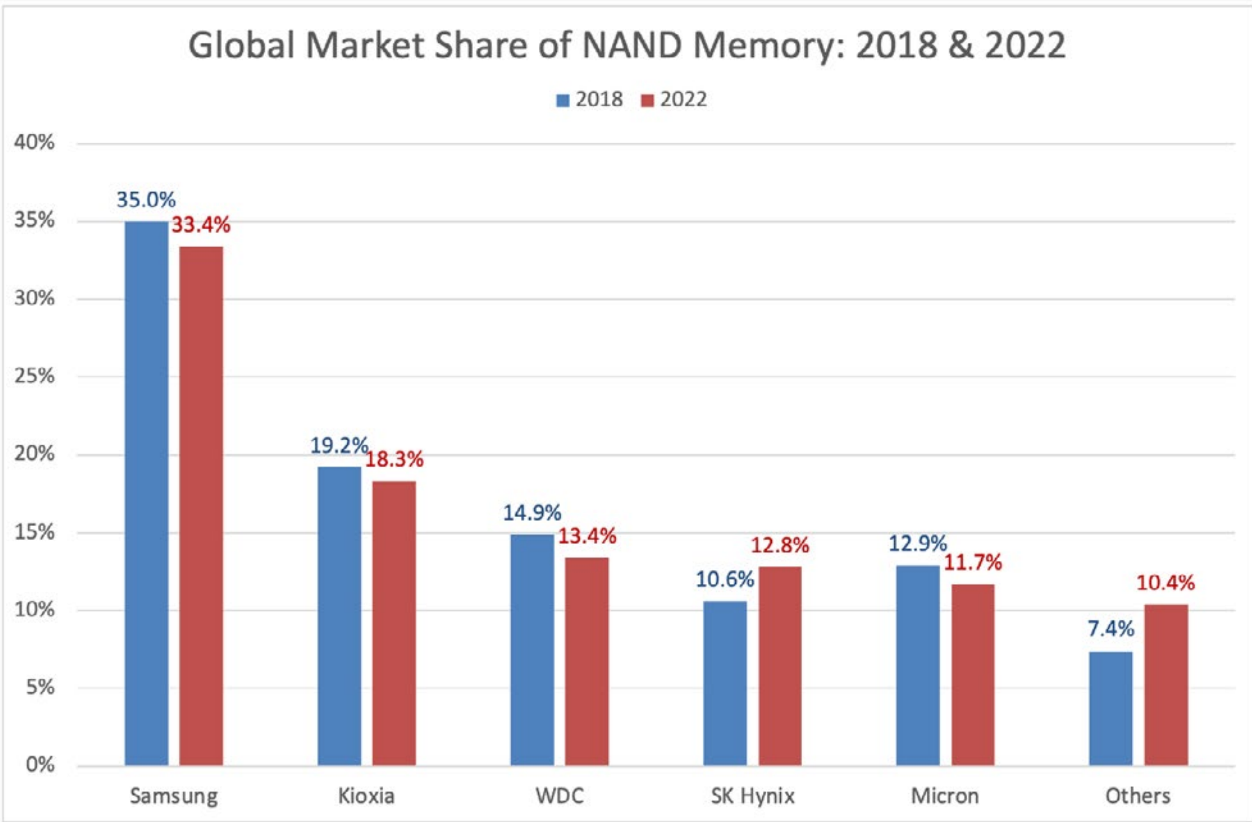
NAND Market Share

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. but not quite a majority position. At that stage, In this time, Korea's dominance rested primarily on Samsung's scale and technology leadership, with SK hynix still 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 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 49; Table 46).

Figure 49. Global Market Share of NAND Memory: 2018 & 2022



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

Table 46. 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, but not a loss of strategic position. 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. Samsung's share stabilized at around 31–32%, while SK hynix fluctuated between 17% and 20%. Even with this easing, Korean firms continue to control about half of the global NAND market, a level that still confers substantial influence over supply dynamics.

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 47).

Table 47. Global NAND Market Share by Revenue: Q2 2024 – Q3 2025

Market Share	Q2 2024	Q3 2024	Q4 2024	Q1 2025	Q2 2025	Q3 2025
Samsung	35%	32%	31%	31%	32%	32%
SK hynix	22%	20%	20%	17%	20%	19%
Kioxia	16%	17%	17%	17%	14%	15%
Micron	12%	13%	13%	15%	13%	13%
SanDisk	10%	10%	11%	13%	12%	12%
YMTC	6%	7%	8%	8%	9%	n.a.
Korean Share	57%	52%	51%	48%	52%	51%
Total	100%	100%	100%	100%	100%	n.a.

Source: Counterpoint, "Global NAND Memory Market Share: Quarterly," October 17, 2025. Press Release, "AI Infrastructure Continues to Strengthen NAND Flash Demand; Kioxia Posts Highest QoQ Growth of 33.1% in 3Q25, Says TrendForce," TrendForce, December 3, 2025.

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 strategically critical 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.[63]

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

63 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

within the semiconductor ecosystem.[64]

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. 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).[65]

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.

64 Chosun Biz at https://biz.chosun.com/en/en-inance/2025/03/05/ZA5JSW7R3RGZ5ID5LO3LCSFH4Q
65 Yonhap, "Korea to expand investment in chip industry to secure global competitiveness," *Korean Times*, April 15.

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 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 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.[66]

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.

66 Yoon Da-bin, "Korea plans $520 billion semiconductor industry expansion," The Donga Ilbo, December 11, 2025.

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 48).[67]

Table 48. 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

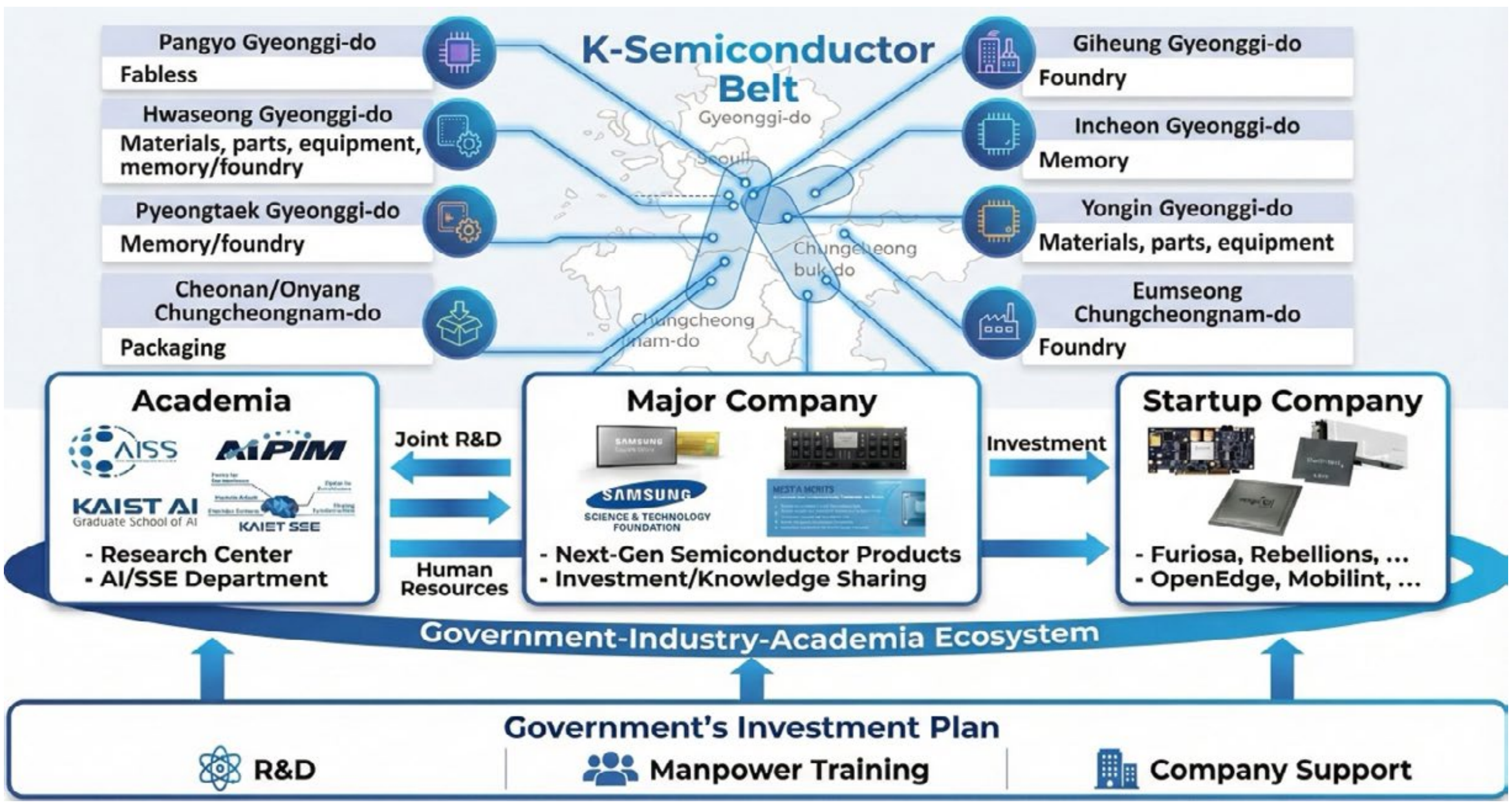
67 Ji-Hoon Kim, Sungyeob Yoo, and Joo-Young Kim, "South Korea's Nationwide Effort for AI Semiconductor Industry," Communications of ACM, July 1, 2023.

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.[68]

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 50).

Figure 50. 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.

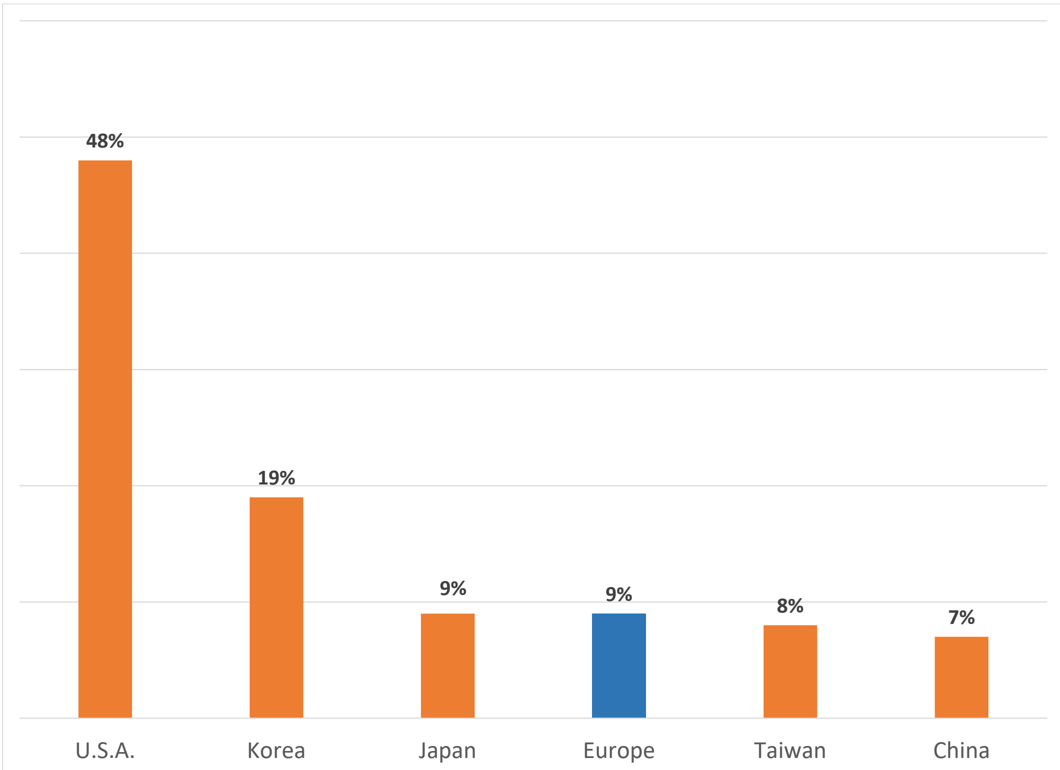
68 Ji-Hoon Kim, Sungyeob Yoo, and Joo-Young Kim, "South Korea's Nationwide Effort for AI Semiconductor Industry," Communications of ACM, July 1, 2023.

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 51).

Figure 51. Global Market Share: 2022



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$ 54.1 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$ 60.4 billion, 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 49).

Table 49. 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.

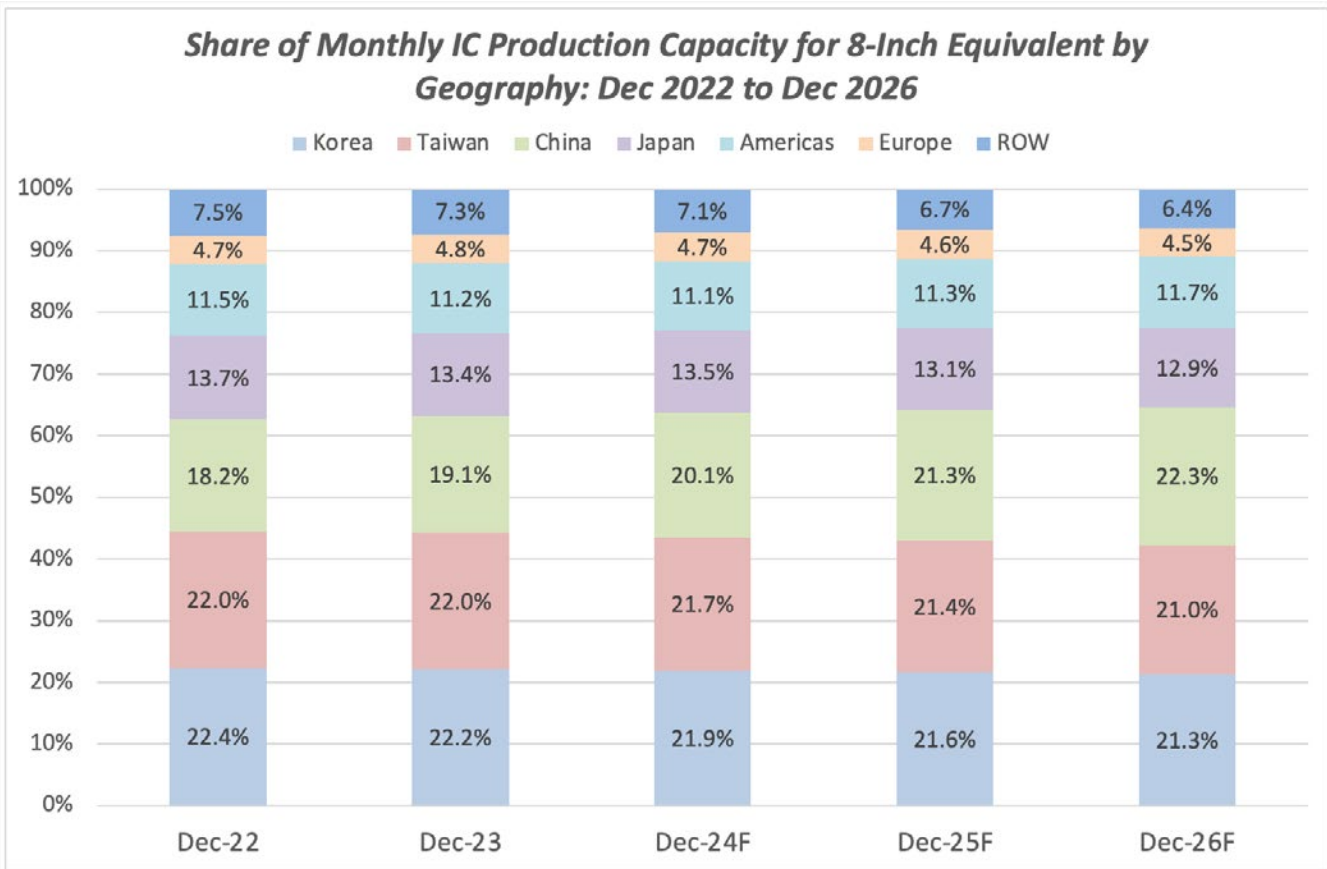
A rebound in IC demand emerged in the latter part of 2023 and is expected to extend through 2024–2026, supported by a renewed global investment cycle. According to Knometa Research, worldwide wafer capacity for IC production is projected to grow by 4.5% year-over-year by December 2024, followed by faster 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 52).

Figure 52. 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 50).

Table 50. 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: 1. Strengthen research and technological leadership; 2. Build and reinforce Europe's capacity to innovate in the design, manufacturing and packaging of advanced chips; 3. Put in place an adequate framework to increase production by 2030; 4. Address skills shortage and attract new talent; 5. 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: 1. Capacity Building: Increasing Europe's semiconductor production of cutting-edge and sustainable semiconductors, including processors. 2. Innovation: Fostering technological advancements and innovation in semiconductor technologies. 3. 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 and Prospects

Strategic Awakening amid Structural Decline

Europe's semiconductor sector in 2025 stands at a subtle but significant turning point—one shaped by measured progress, strategic urgency, and a growing understanding of how central chips have become to economic resilience. Across the continent, leaders increasingly place semiconductors alongside aerospace and defence in terms of strategic importance, recognizing that chips support everything from electric mobility and industrial automation to cloud infrastructure and national security.

WSTS estimates for 2025 indicate that Europe's share of the global semiconductor market is expected to decline further, to around 7.0%. Looking ahead, WSTS forecasts for 2026 point to a continued erosion, with Europe's global share projected to fall to approximately 6.2%. Against this trajectory, the ambition articulated in 2021–22—to double Europe's market share to 20% by 2030—now appears increasingly difficult to realize. The European Court of Auditors' 2025 report explicitly pointed out that this quantitative target is "unrealistic" and overly broad, lacking clear strategic direction and regulatory mechanisms. This assessment underscores the widening gap between political ambition and the realities of industrial scale in the global semiconductor race.

Even so, Europe retains several areas of real strength. ASML continues to hold a dominant position in advanced lithography equipment, giving the region a unique role in the global supply chain. European firms also lead in automotive, analog, and power semiconductors—sectors central to Europe's digital transition and climate-policy objectives. These advantages help explain why semiconductor capacity has become closely linked to the idea of economic sovereignty.

Chips Act Review and New Strategic Directions

The European Chips Act, adopted in 2023, set out a comprehensive roadmap to reinforce the semiconductor ecosystem through R&D support, incentives for new fabrication plants, and tools to mitigate future supply disruptions. It established the goal of achieving a 20-percent global market share by 2030 and mobilized roughly € 43 billion in public-private investment.

Government strategy became the defining feature of the 2025 landscape. By the second half of 2025, the European Commission and member states recognized a significant gap between the execution of the Chips Act and its original goals. Consequently, the policy focus shifted from "crisis management" and "capacity expansion" toward a long-term strategy centered on "indispensability" and "supply chain resilience."

In September 2025, the Semicon Coalition, comprising 27 member states, issued a manifesto proposing a "Phase 2" for the EU Chips Act. The manifesto argued that the original goal of 20% market share did not reflect actual market needs. Instead, it proposed three core objectives: "Prosperity" (creating value across industries), "Indispensability" (ensuring Europe holds a key position in global supply chains), and "Resilience" (guaranteeing supply security).

To operationalize this shift, the European Commission launched a three-month public consultation in September 2025, concluding in late November with 209 stakeholder submissions. The feedback converged on four priorities for revising the strategy: reorienting from a narrow self-sufficiency approach toward positioning Europe as a critical partner in global value chains—especially in automotive, industrial automation, and sensors; extending policy support upstream to encompass chip design, intellectual property, RISC-V architectures[69], and photonics to bridge the "lab-to-fab" gap; broadening the definition of supply-chain security to cover critical materials and industrial gases; and strengthening execution by streamlining administrative procedures, creating a dedicated semiconductor budget under the European Competitiveness Fund, and expanding "First-of-a-Kind" (FOAK) status to include equipment and materials suppliers to catalyze wider investment.

The European Commission is expected to publish a formal evaluation report in the first quarter of 2026, which will serve as the technical and policy basis for the "Chips Act 2.0".

Industrial Outcomes

On the industrial front, the picture is mixed. One of Europe's most promising developments is the European Semiconductor Manufacturing Company (ESMC), a € 10 billion joint venture in Dresden led by TSMC alongside Bosch, Infineon, and NXP. Following groundbreaking in August 2024, the project advanced steadily through structural construction in 2025. Equipment installation is scheduled for 2026,

69 RISC-V is an open, royalty-free instruction set architecture that allows unrestricted implementation and customization, offering an alternative to proprietary CPU architectures such as x86 and ARM.

with production slated to begin in 2027. The facility will manufacture 28/22nm and 16/12nm chips—nodes that may not power generative-AI systems but are essential to Europe's automotive and industrial base. The project has already encouraged complementary investments, including GlobalFoundries' € 1.1 billion capacity expansion and Infineon's € 5 billion power-semiconductor fab, set to open in 2026.

Other initiatives encountered challenges. Intel's planned € 30 billion "megafab" in Magdeburg—once expected to be a pivotal step toward hosting more advanced manufacturing—was suspended and ultimately canceled in mid-2025 due to financial pressures, softer demand, and concerns about global overcapacity. This cancellation further fueled the debate on whether Europe should continue to subsidize ultra-advanced manufacturing or refocus on its existing industrial strengths. France's expansion in Crolles also slowed after adjustments by GlobalFoundries in response to market conditions.

At the same time, Italy has emerged as a notable success story in backend manufacturing, a segment gaining strategic importance as advanced packaging becomes increasingly critical for high-performance computing and AI applications. The € 3.2 billion Silicon Box investment in Novara is establishing a leading-edge packaging hub, while STMicroelectronics' integrated silicon-carbide campus in Catania—combining substrate production with device fabrication—strengthens Europe's capabilities in power electronics and supports the continent's electric-vehicle supply chain (see Table 51).

Table 51. 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	Suspended and canceled (mid-2025) due to financial and market pressures.
GlobalFoundries	Crolles, France	Capacity expansion	n.a.	Progress slowed due to market condition adjustments.

Regulatory Alignment and a Narrowing Path to Scale

Regulatory developments also shaped the environment in 2025. The Netherlands refined and tightened its export-control regime, extending licensing requirements to additional Deep Ultraviolet (DUV) systems as well as deposition and inspection equipment. The measure aligns closely with U.S. objectives to limit high-end technology transfers to China. The introduction of the "NL900" general authorization for trusted partners such as the United States, the United Kingdom, and Japan established a tiered export-control structure that further defines Europe's position within global technology flows.

In conclusion, Europe's semiconductor strategy in 2025 is transitioning from a pursuit of sheer volume to a quest for strategic relevance. By acknowledging that the 20% market share target is unlikely to be met, European policymakers are pivoting toward a "Chips Act 2.0" that prioritizes technological indispensability, upstream innovation, and supply chain security.

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 14). 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.[70] This highlights Singapore's outsized functional importance relative to its geographic and demographic scale.

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 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

70 "What makes Singapore a prime location for semiconductor companies driving innovation?" Economic Development Board, August 20, 2024.

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).

According to Statista, Singapore's semiconductor market is projected to reach approximately US$ 43.4 billion in 2024 and is expected to expand at an annual growth rate of 10.3% between 2024 and 2029, reaching about US$ 70.9 billion by 2029. This growth trajectory reflects Singapore's deep integration into global semiconductor value chains and its ability to capture demand across multiple segments of the industry.[71]

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 52).

Table 52. 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

71 "Semiconductors – Singapore," Statista, Aug 2024.

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 53).

Table 53. 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. 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 54).

Table 54. 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
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. 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.

3. 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.[72]

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 55).

72 Singapore Economic Development Board, 'Singapore Seeking Frontier Firms for 'Manufacturing 2030'', Economic Development Board, Singapore, 2 February 2021.

Table 55. Singapore's Semiconductor Policy

<table>
<tr><td rowspan="2">Guidance</td><td>Target</td><td>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).</td></tr>
<tr><td>Policy</td><td>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.</td></tr>
<tr><td>Measures</td><td>Key Initiatives</td><td>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.</td></tr>
</table>

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.[73]

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

73 "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.

industry where capital intensity is exceptionally high.[74]

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 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. Key developments—including Micron Technology's move into High Bandwidth Memory (HBM), GlobalFoundries' acquisition of Advanced Micro Foundry (AMF), and the accelerated construction of the VIS–NXP joint-venture fab—are unfolding amid intensifying US–China rivalry. These shifts have pushed Singapore to reinforce export-control governance to protect its standing as a trusted and indispensable node in global supply chains.

This strategic importance was underscored in November 2025 when MTI raised Singapore's GDP growth forecast to around 4.0 percent, up from the earlier 1.5–2.5 percent range. The revision was driven by surging demand for AI-related semiconductors and server-class products that began accelerating in the third quarter of 2024 and continued through 2025.[75]

Market estimates value the semiconductor industry at US$ 10.16 billion in 2025, with projected growth to US$ 14.15 billion by 2030.76 Integrated circuits remain dominant, sensors and MEMS continue to expand quickly, and AI applications have emerged as the most dynamic segment shaping global capital allocation.

At the same time, geopolitical uncertainties have hastened "China-Plus-One" diversification among Western multinationals, positioning Singapore as a principal beneficiary. VIS's decision to speed up construction of its NXP joint-venture fab reflected rising customer demand for capacity outside China.[77] Singapore's dual advantage—politically trusted for Western intellectual property yet geographically integrated into Asian supply chains—has proven hard for competitors to replicate. This strategic posture, however, requires unwavering regulatory discipline, particularly as global technology controls expand.

74 The White House, "Building Resilient Supply Chains, Revitalizing American Manufacturing, and Fostering Broad-Based: 100-Day Reviews under Executive Order 14017," June 2021.
75 Ministry of Trade and Industry (Singapore), "MTI Upgrades GDP Growth Forecast for 2025 to "Around 4.0 Per Cent" and Forecasts GDP Growth of "1.0 to 3.0 Per Cent" for 2026," Press Release, Nov 21, 2025.
76 Mordor Intelligence Research & Advisory, "Singapore Semiconductor Market Size & Share Analysis - Growth Trends And Forecast (2025 - 2030)," Mordor Intelligence, August 2025.
77 "Taiwan's Vanguard to hasten construction of Singapore factory," Business Times, Apr 11, 2025.

Accordingly, Singapore Customs and MTI issued new circulars in April 2025 governing advanced semiconductor and AI technologies. These directives clarified that while Singapore does not enforce foreign laws wholesale, it will not tolerate diversion of dual-use goods or sanctions evasion. Enforcement actions earlier in the year against illicit server diversions reinforced this position, assuring partners in Washington and Brussels that Singapore's neutrality is principled and rules-based. Through such measures, Singapore signaled that trust is a strategic asset requiring constant maintenance.

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. 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.[78]

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.[79]

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 56).

78 Low Youjin, "Singapore invests S$37 billion in RIE2030 research plan; semiconductors, ageing among focus areas," Business Times, Dec 5, 2025.
79 Mordor Intelligence Research & Advisory, "Singapore Semiconductor Market Size & Share Analysis - Growth Trends And Forecast (2025 - 2030)," Mordor Intelligence, August 2025.

Table 56. 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.

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.[80]

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.

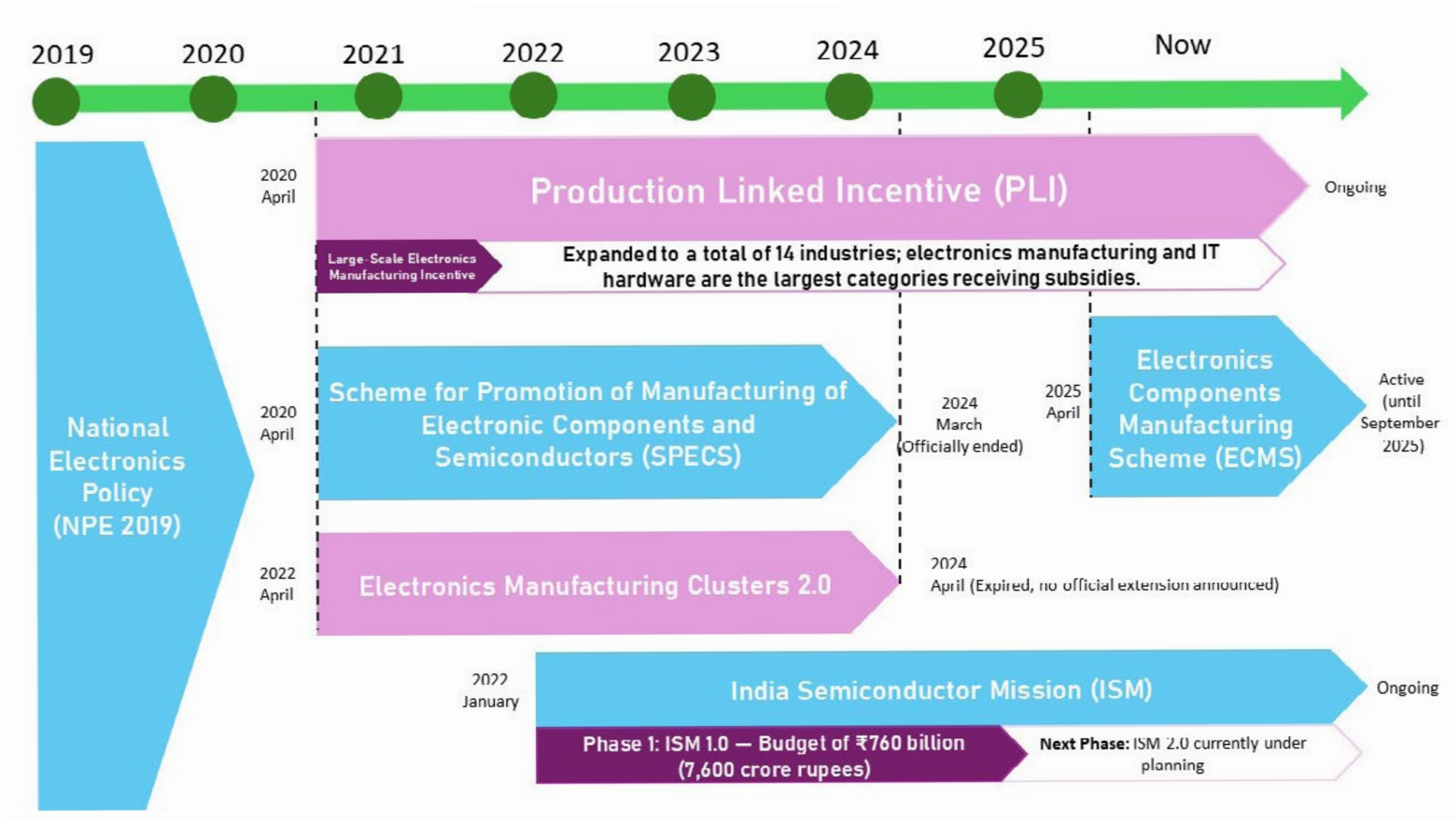
80 Mordor Intelligence Research & Advisory, "Singapore Semiconductor Market Size & Share Analysis - Growth Trends And Forecast (2025 - 2030)," Mordor Intelligence, August 2025.

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 53).

Figure 53. 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. 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 57). The key details are as follows:

Table 57. 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 Q4 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 Q1 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.

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.

4. Challenges and Responses

Despite the Modi administration's strong push to advance semiconductor development and the active efforts of various state governments to attract investment through incentives and subsidies, India still faces multiple challenges in building a complete semiconductor ecosystem. In recent years, several proposed investment projects have been put on hold due to concerns over market conditions and policy risks—reflecting the need for further institutional improvements as India moves along its semiconductor growth trajectory.

At the same time, in an effort to narrow the gap with leading global semiconductor technologies, Indian companies have begun adopting more proactive strategies, including overseas acquisitions and technology-driven mergers. These cases show that India's industry stakeholders increasingly recognize that relying solely on domestic fab construction and government support is insufficient to reach international standards. Instead, external technology integration and global expansion are essential for accelerating the development of competitive capabilities.

(1) Major Semiconductor Investment Projects Put on Hold in India

Kaynes Semicon (India) and Aptos Technology (Taiwan)

Aptos Technology, a subsidiary of Taiwan Mask Corp., announced in February 2024 that it had signed a cooperation agreement with India's Kaynes Semicon, originally aimed at providing training and know-how licensing in assembly and test technologies. However, Aptos Technology formally declared bankruptcy in June 2025, leading to the termination of the partnership. The company stated that issues had already surfaced during the collaboration process, and both parties had mutually decided to end the cooperation before bankruptcy proceedings began.

Zoho (India)

In May 2024, India's IT and SaaS giant Zoho submitted a proposal to invest US$ 700 million in a semiconductor fab in Tamil Nadu, aimed at producing compound semiconductors for EV and power-electronics applications, and sought government subsidies for the project. After a year of assessment, Zoho announced in May 2025 that it would suspend the investment plan, citing the lack of a suitable technology partner, limited government fiscal support, and excessively high capital expenditure risks. As a result, the board resolved to halt the project.

Adani Group (India) and Tower Semiconductor (Israel)

Adani Group, one of India's major conglomerates, announced in 2024 that it would partner with Israel's Tower Semiconductor to enter mature-node semiconductor manufacturing, including 28-nm chip R&D and production. The companies submitted a joint venture proposal worth about US$ 10 billion to ISM. In September 2024, the Maharashtra state cabinet approved their plan to build a wafer fab in the Panvel area near Mumbai. However, after further due diligence, Adani Group announced in April 2025 that it would suspend the collaboration, citing significant uncertainty in India's semiconductor market demand and major challenges in supply chains, financing, and technology. The company concluded that the investment lacked strategic and commercial viability, leading both sides to terminate the partnership.

Vedanta (India) and Foxconn (Taiwan)

In September 2022, India's industrial and energy conglomerate Vedanta and Taiwan's Foxconn announced a plan to jointly invest about US$ 19.5 billion to establish India's first 12-inch wafer fab and associated assembly and test facilities in Gujarat. However, in July 2023, Foxconn officially withdrew from the joint venture and stated that it would no longer participate in the operation of the proposed company. Vedanta subsequently shifted to seeking either sole investment or new partners to continue the project (see Table 58).

Table 58. 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.

(2) Indian Firms Build Semiconductor Capabilities via Acquisitions

In recent years, Indian semiconductor companies have actively pursued overseas mergers and acquisitions to rapidly acquire experienced engineering teams, process equipment, and key intellectual property. This strategy not only shortens India's learning curve in semiconductor talent development but also strengthens its autonomy in advanced technology R&D.

In effect, India is adopting a dual-track approach of "talent acquisition" and "technology upgrading" to accelerate its catch-up with global semiconductor competitors. Below are representative cross-border acquisition cases undertaken by Indian firms over the past two years:

June 2025 – L&T Semiconductor Technologies and Kaynes Semicon acquire Fujitsu General Electronics' power module business

In June 2025, India's IC design firm L&T Semiconductor Technologies and Kaynes Semicon jointly acquired the power module business of Japan's Fujitsu General Electronics for INR 1.18 billion (approximately US$ 13.8 million). According to the plan, Fujitsu's related production lines in Japan will be gradually relocated to Kaynes Semicon's facilities over the next 12 to 18 months.

August 2024 – Polymatech Electronics acquires U.S.-based Nisene Technology Group

In August 2024, India's Polymatech Electronics, via its Singapore subsidiary, completed the acquisition of California-based semiconductor packaging and test equipment maker Nisene Technology Group. Founded in the 1970s, Nisene is one of the industry's long-standing equipment manufacturers, best known for its IC design and testing expertise for silicon carbide (SiC) wafers, and holds more than 50 core patents.

2025 – Tata Electronics in talks with Malaysian semiconductor and OSAT firms

Media reports indicate that since April 2025, Tata Electronics has been in discussions with multiple Malaysian semiconductor and assembly-test companies, including wafer foundry X-Fab, semiconductor manufacturer SilTerra Malaysia, and OSAT and sensor producer Globetronics Technology. No further developments have been disclosed to date. Tata's objective is to directly acquire mature-node fabrication and packaging capacity in Malaysia to accelerate the expansion of its global semiconductor footprint.

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.

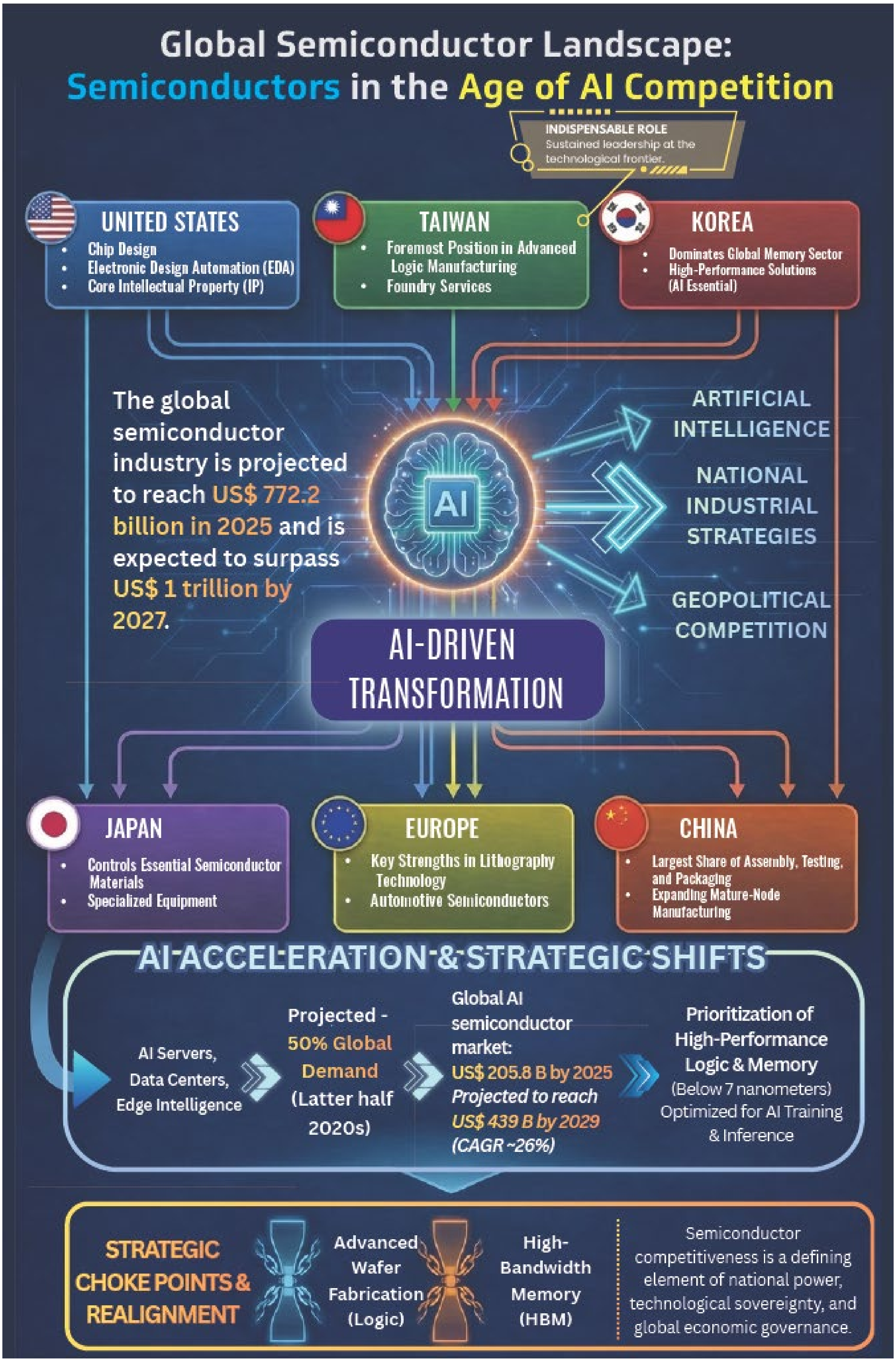
This transformation is closely intertwined with a reconfiguration of the global division of labor across the semiconductor value chain. Major economies occupy distinct yet interdependent positions: the United States leads in chip design, electronic design automation, and core intellectual property; Taiwan 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 54).

Figure 54. 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. 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.

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. Preliminary data from 2025 confirm that this divergence is structural rather than cyclical: TSMC sustained net margins above 42 percent, while SMIC's margins declined from 8.3 percent in Q1 to 5.9 percent in Q2. 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 together 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

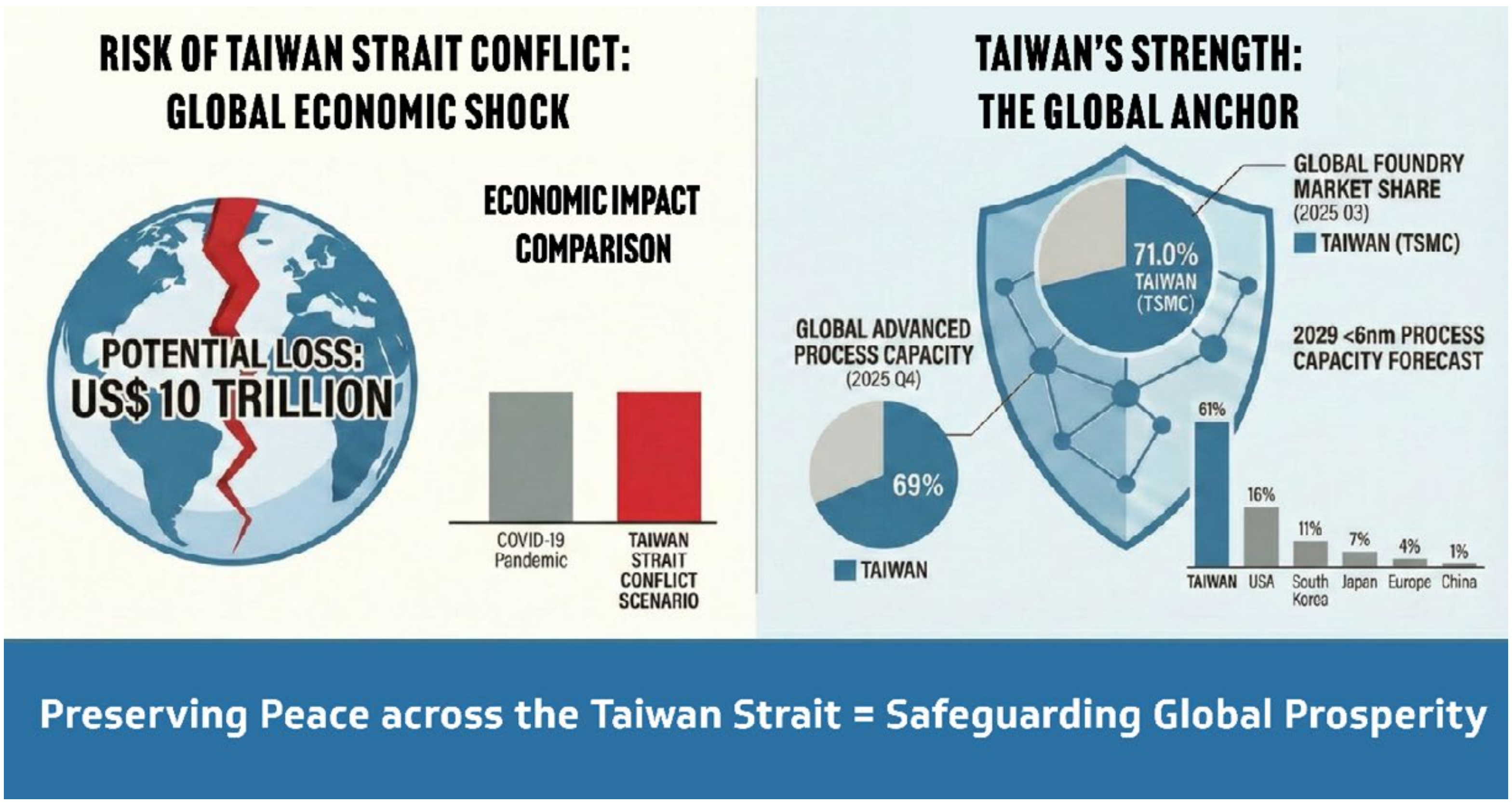
90 percent of electronic devices across almost every category worldwide. A sudden halt in TSMC's production, she estimated, could inflict an ANNUAL global economic loss of between US$ 600 billion and US$ 1 trillion during the initial years—underscoring the degree to which Taiwan's semiconductor output 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 estimates, the economic cost of a major conflict in the Taiwan Strait could reach approximately US$ 10 trillion, equivalent to nearly 10 percent of global GDP—a magnitude that would eclipse the impact of most modern global crises, including the war in Ukraine, the COVID-19 pandemic, and the Global Financial Crisis.

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 55).

Figure 55. 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 56).

Figure 56. Forging Strategic Partnership with Taiwan