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Taiwan and the Global Semiconductor Supply Chain: Global Semiconductor Policy and Development

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Executive Summary

This report examines global semiconductor policy initiatives across the United States, Southeast Asia and Japan, as various governments around the world attempt to raise the local bar on the semiconductor industry. The second half covers manufacturing deployment, IC design market performance, and trends in 2024, with projections into 2025. The collective analysis covers international policies enacted and compares the results against the goals, the IC design industry and AI-related applications on the industry at large.

Firstly, in the U.S., the CHIPS and Science Act's US$ 52.7 billion funding accelerated manufacturing, R&D, and advanced packaging, with 19 companies—such as TSMC, Intel, Samsung, and Micron—securing subsidies for new fabs and technology facilities. However, the change in administration in D.C. affects the execution of the agreements as the Trump administration seeks to impose tariffs on semiconductors and renegades on Biden-era deals.

Secondly, in Europe, the Chips Act advanced R&D pilot lines and secured investments in mature- and advanced-node manufacturing, with notable projects by STMicroelectronics, TSMC's ESMC joint venture, and Silicon Box's first panel-level packaging plant in Italy. However, its ambitious 3 Pillar plan may be delayed due to a lack of clear execution timeline and a slow investment pace.

Thirdly, Japan deepened its advanced-node manufacturing through Rapidus' 2nm fab and broadened into IC design and packaging R&D, backed by a US$ 69 billion framework for semiconductors and AI through 2030.

Fourthly, more companies consider Southeast Asia a key strategic growth market, increasing investing in the region. While Singapore does not have a dedicated semiconductor industry policy, the government has actively invested in infrastructure and offers a highly stable environment. Malaysia's position as a key OSAT(Outsourced Semiconductor Assemble and Test) attracts international investment from various firms such as Texas instruments, Micron and Siliconware Precision Industries Co.. India leverages its large domestic market and revised ISM (Indian Semiconductor Mission), to offer subsidies for fab factories, the Indian government also actively backs joint ventures between local indian firms and Taiwanese firms to develop a domestic supply chain ecosystem.

Fifthly, the IC design industry experienced significant rebound due to demand for generative AI and other AI-related applications. As the industry gears up to accomodate AI changes, NVIDIA leads the charge with double the revenue alongside Taiwan's IC design firms, which stands to benefit from the surge in demand for AI applications, with a 85% market share in 2025.

Lastly, the IDM market reached US$ 395.16 billion (+14.5%), foundry revenue climbed to US$ 122.6 billion (+22.3%) with TSMC holding 73.4% share, with projections of a 25% annual growth in 2025. TSMC announces the A14 node to start production in 2028. Projections for 2025 remain bullish, with AI-related compute semiconductors and advanced-node capacity as primary growth drivers, but geopolitical uncertainties and policy execution gaps, especially in Europe, could influence the industry's trajectory.

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1. Semiconductor Policy Developments and Industry Deployment in Major Economies

1.1 Progress of the U.S. CHIPS Act

In 2022, the United States passed the CHIPS and Science Act, allocating a total of US$ 52.7 billion in funding. Among this, US$ 39 billion is dedicated to promoting domestic semiconductor manufacturing and packaging facilities, with a primary focus on investing in strategically important semiconductor chip production to ensure the stability of national supply and safeguard national security interests.

On the R&D side, US$ 11 billion is allocated to establish a domestic semiconductor research ecosystem, advancing areas such as forward-looking design and cutting-edge packaging technologies. The remaining US$ 2.7 billion is mainly directed toward national defense and semiconductor workforce training.

The R&D investment initiatives under the CHIPS and Science Act consist of **four** major programs: the CHIPS National Semiconductor Technology Center (NSTC), the CHIPS National Advanced Packaging Manufacturing Program (NAPMP), the CHIPS Manufacturing USA Institute, and the CHIPS Metrology Program. These programs collectively target the most critical areas of concern for the U.S. semiconductor industry, aiming to build a new ecosystem that strengthens the nation's leadership in semiconductor R&D, shortens the time and cost for commercializing new technologies, and enhances U.S. national security (see Table 1).

Table 1. U.S. CHIPS R&D Investment Plan

CHIPS for Manufacturing USA Institute	CHIPS Metrology Program
Aim: To create a collaborative environment through digital twin technology, reducing the costs of chip R&D and manufacturing in the United States.	**Aim: To develop new metrology instruments, measurement methods, and measurement information models.**
In 2025, a grant of US$ 285 million was awarded to the Semiconductor Research Corporation Manufacturing Consortium Corporation (SRC) to establish and operate the CHIPS Manufacturing USA Institute—SMART USA—headquartered in Durham, North Carolina. The future focus will be on the development, validation, and use of digital twin technology to improve U.S. semiconductor design, advanced packaging manufacturing, and testing processes.	Executed by the National Institute of Standards and Technology (NIST), this program continuously conducts research in measurement science and metrology related to the development of new semiconductor materials, packaging, and production methods.
National Advanced Packaging Manufacturing Program (NAPMP)	**National Semiconductor Technology Center (NSTC)**
Aim: R&D in advanced packaging and the validation of new technologies.	**Aim: To serve as a platform for semiconductor technology R&D, conducting advanced technology research and integrating semiconductor ecosystem resources.**
In 2025, a total of US$ 1.4 billion in incentives was confirmed to strengthen U.S. advanced packaging technology, enabling the validation and large-scale domestic transfer of new technologies within the U.S. manufacturing industry. Advanced substrate and materials research: Absolics Inc.; Applied Materials Inc; Arizona State University. Establishment of an advanced packaging pilot line: Natcast's advanced packaging facility located in Tempe, Arizona.	In 2025, a long-term agreement was announced with Natcast, granting it US$ 6.3 billion in funding to operate the National Semiconductor Technology Center. This funding is intended to advance semiconductor technology R&D plans, shorten prototype design time and costs, operate advanced R&D facilities, and establish and maintain the semiconductor labor ecosystem, among other goals.

Source: Chia-Chen Lee, "Semiconductor Policy Developments and Industry Deployment in Major Economies," ITRI (Industrial Technology Research Institute), IEK (Industrial Economics and Knowledge Center), July 2, 2025, p. 1.

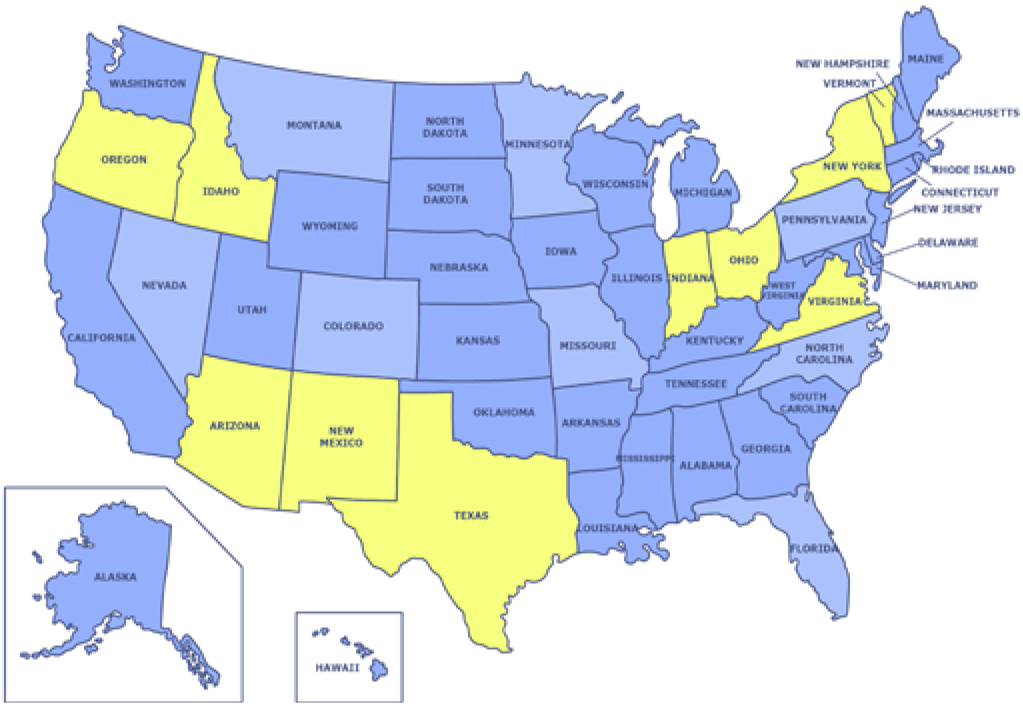
At the beginning of 2024, the Biden administration signed *preliminary term memorandums* with relevant semiconductor companies, covering areas such as mature process technologies, advanced process nodes, as well as equipment, materials, and specialized manufacturing processes. These agreements were intended to undergo individual reviews before finalizing contracts and disbursing subsidies.

Before the end of the Biden administration, these subsidy agreements with 19 companies were formalized before the change in U.S. administration to avoid political uncertainty. This included major advanced process manufacturers—such as Taiwan Semiconductor Manufacturing Company (TSMC), Samsung, and Intel.

Since the beginning of the Trump administration in early 2025, the progress of implementing manufacturing subsidies under the CHIPS Act has slowed as President Trump has repeatedly indicated plans to renegotiate agreements with manufacturers that have already received subsidies. A change in U.S. politics has led to a change in investments and agreements as the current U.S. government may continue to demand that these companies further increase their investment commitments in the United States.

For example, in June 2025, Micron announced an additional investment in the U.S., raising its total U.S. investment to US$ 200 billion—of which US$ 150 billion is allocated to manufacturing and US$ 50 billion to R&D.

Table 2: Major Semiconductor Manufacturers and Their Projects Receiving Subsidies Under the U.S. CHIPS Act



Micron

Approval date: 2024/11/15 & 2025/06/12

- New York: Build the first two fabs of a "megafab complex" focusing on advanced DRAM chip production.
- Idaho: Build two new high-volume manufacturing fabs for advanced DRAM.
- Virginia: Expand and modernize a fab to strengthen the supply of 1α (1-alpha) DRAM.

Intel

Approval date: 2024/11/26

- Arizona: Build 2 new advanced fabs and modernize 1 existing fab.
- Ohio: Build 2 new advanced fabs.
- New Mexico: Convert existing facilities into 2 new advanced packaging facilities.
- Oregon: Modernize existing facilities and introduce High-NA EUV.

Samsung

Approval date: 2024/12/20

- Taylor, Texas: Build two new 2nm advanced process fabs and one R&D facility.
- Austin, Texas: Expand existing facilities to support FD-SOI process technology production.

TSMC

Approval date: 2024/11/15

- Arizona: Build 3 new advanced fabs: Fab 1 (2025 mass production): 4/5nm; Fab 2 (2028 mass production): 3nm; Fab 3 (2030 mass production): 2nm/A16.

GlobalFoundries

Approval date: 2024/11/20

- Malta, New York: Build a new 12-inch advanced fab, expand existing fab's production capacity for automotive chips, and increase advanced packaging capacity.
- Burlington, Vermont: Expand existing fab to produce GaN-on-Silicon (Gallium Nitride on Silicon).

Amkor

Approval date: 2024/12/20

- Arizona: Build a new advanced packaging and test facility utilizing 2.5D technology to meet future demand for artificial intelligence (AI) chips.

SK hynix

Approval date: 2024/12/19

- Indiana: Build a new HBM (High Bandwidth Memory) backend and advanced packaging manufacturing and R&D facility.

Source: Chia-Chen Lee, "Semiconductor Policy Developments and Industry Deployment in Major Economies," IEK, ITRI, July 2, 2025, pp. 2-3.

1.2 Progress of the European Chips

In 2022, the European Commission introduced the European Chips Act with the aim of promoting research in advanced chip design, manufacturing, and packaging technologies, as well as attracting companies to invest in building semiconductor fabs within Europe. The goal is to enhance local chip production and ensure supply chain stability.

The European Chips Act seeks to drive the development of the semiconductor industry through three main pillars of action.

Pillar One focuses on fostering technological innovation, transforming scientific research results into industrial applications, and narrowing the gap between research and mass production. The overall R&D ecosystem plan consists of five key components working in coordination: pilot production lines for R&D, virtual design platforms, competence centers, a semiconductor investment fund, and quantum-related technologies.

At the core of this ecosystem are the design platforms and pilot production lines, supported by funding, supply chain integration, platform development, and enhanced manufacturing capabilities to enable comprehensive collaboration across industries. Starting in 2024, tenders have been progressively issued for these pilot lines, with five R&D pilot production lines already planned and gradually entering operation.

Table 3: Pillar 1 of the European Chips Act - R&D Pilot Line Projects

Pilot Line Name	Leading Organization	Partners	Main Project
FAMES	CEA-Leti	imec, Fraunhofer, Tyndall, VTT, UCLouvain, SAL, SiNANO, etc.	FD-SOI technology, RF components, embedded non-volatile memory, 3D integration, PMIC, etc.
NanoIC	imec	CEA-Leti, CSSNT, VTT, Fraunhofer, Tyndall, ASML, etc.	Development and validation of sub-2nm process SoCs (System-on-Chip).
APECS	Fraunhofer	FBH, IHP, TU Graz, VTT, imec, CEA-Leti, FORTH, etc.	Development of heterogeneous integration and chiplet technology.
WBG	CNR	FBK, CEA-Leti, Fraunhofer, CHIPS-IT, etc.	Developing wide-bandgap (WBG) semiconductors for power and radio frequency (RF) electronic devices.
PIXEurope	ICFO	UPV, CSIC, UC3M, UVigo, etc.	Development of an advanced Photonic Integrated Circuit (PIC) ecosystem.

Source: Chia-Chen Lee, "Semiconductor Policy Developments and Industry Deployment in Major Economies," IEK, ITRI, July 2, 2025, pp. 4-5.

The most closely watched Pillar Two – "Supply Security and Resilience" focuses on strengthening Europe's local chip production capabilities and enhancing the stability and resilience of its supply chain. To achieve this, the European Union has been actively attracting companies to invest in expanding capacity across key semiconductor manufacturing stages, including fabrication, packaging, testing, and assembly. EU member states have been authorized to provide subsidies to encourage companies to build fabs within Europe.

From the perspective of approved subsidy projects and their scope, as of June 2025, most EU-funded projects concentrate on application areas where Europe already holds long-term competitive advantages, such as automotive electronics, industrial solutions, and energy sectors.

For example, STMicroelectronics, one of Europe's leading semiconductor manufacturers, has had three investment projects approved under the European Chips Act, demonstrating strong EU policy support for domestic companies and high prioritization of automotive and industrial applications.

TSMC, Taiwan's leading foundry, remains the only confirmed advanced-node semiconductor manufacturer investing in Europe. Together with Bosch, Infineon, and NXP, TSMC established European Semiconductor Manufacturing Company (ESMC) in Dresden, Germany, focusing on producing mature-node chips for automotive and industrial uses.

To further strengthen semiconductor supply chain resilience, the EU is also making strategic investments in backend manufacturing processes. Singapore-based semiconductor company Silicon Box received US$ 1.42 billion (€ 1.3 billion) in subsidies to build Europe's first advanced packaging and testing facility in Novara, Italy. The plant will adopt panel-level packaging technology, focusing on chiplet integration and 3D packaging, and is expected to reach full-scale operation by 2033. This investment marks Europe's first facility with panel-level advanced packaging capabilities, representing a significant move to boost the resilience and autonomy of Europe's semiconductor supply chain.

Table 4: Semiconductor Facility National Subsidy Projects Approved by the European Chips Act

Company	Project	Investment (Euros)	Subsidy (Euros)	Significance
STMicroelectronics	Produce high-performance SiC epitaxial wafers.	€ 730 Million (US$ 795.7 million)	€ 292.5 Million (US$ 318.8 million)	Meets the needs of electric vehicles, charging stations, renewable energy, and industrial application sectors.
ST Micro & GlobalFoundries	Produce 18nm chips for automotive and IoT applications, with a special focus on chips based on FD-SOI technology.	€ 7 .5 Billion (US$ 8.18 billion)	€ 2.9 Billion (US$ 3.16 billion)	Meets European market demand for energy-efficient and secure chips in sectors like automotive, industrial, communications, and defense.
STMicroelectronics	Establish integrated manufacturing for SiC power devices and develop next-generation 8-inch SiC technology.	€ 5 Billion (US$ 5.45 billion)	€ 2 Billion (US$ 2.18 billion)	Meets the needs of automotive, industrial, and cloud infrastructure applications; the Catania campus will become Europe's first integrated Silicon Carbide (SiC) manufacturing plant.
ESMC (J.V. TSMC + Bosch/Infineon/NXP)	Produce chips with 28/22nm and 16/12nm process technologies, focusing on production for automotive and industrial applications.	€ 10 Billion (US$ 10.90 billion)	€ 5 Billion (US$ 5.45 billion)	Meets the demand for automotive and industrial applications, while deepening long-term partnerships with European semiconductor partners.
Silicon Box	Adopt panel-level advanced packaging, supporting chiplet integration and 3D packaging technology.	€ 3.2 Billion (US$ 3.49 billion)	€ 1.3 Billion (US$ 1.42 billion)	Meets the demand in application areas such as automotive, AI, and the Internet of Things (IoT).
Infineon	Produce discrete power components and analog/mixed-signal ICs.	€ 3.5 Billion (US$ 3.82 billion)	€ 920 Million (US$ 1 billion)	Meets the demand in industrial, automotive, and consumer application areas.
ams Osram	Combines CMOS technology with through-wafer via technology and integrates optical filters.	€ 567 Million (US$ 618 million)	€ 227 Million (US$ 247.4 million)	Meets the needs of the automotive, consumer, industrial, and medical market sectors.

Source: Chia-Chen Lee, "Semiconductor Policy Developments and Industry Deployment in Major Economies," IEK, ITRI, July 2, 2025 pp. 5-6.

Although the European Commission has achieved some initial progress in promoting the development of the semiconductor industry, the European Court of Auditors (ECA) evaluation report released in April 2025 indicated that the European Chips Act is unlikely to meet its original targets within the planned timeframe.

The European Chips Act faces major delays across all three pillars. Pillar One lacks a clear execution timeline and is unlikely to be fully operational by the end of 2025. Pillar Two's slow investment pace makes it improbable that Europe will reach its ambitious goal of 20% global semiconductor production by 2030. Pillar Three remains in early development, the full realization of its practicality remains some time away.

Ministry of Economy, Trade and Industry (METI) building in Tokyo
Image Credit: Creative Commons

1.3 Progress of Japan's Semiconductor Policy

Since Japan's Ministry of Economy, Trade and Industry (METI) released the Semiconductor and Digital Industry Strategy in 2021, Japan has made significant progress in strengthening its domestic semiconductor manufacturing capabilities. With decisive and swift government support, combined with strong local customer demand, Japan successfully attracted multiple leading international semiconductor companies to establish advanced manufacturing and R&D facilities in the country. Companies such as TSMC and Micron have made major investments under this policy initiative.

In addition to actively attracting foreign investment to ensure domestic access to advanced semiconductor manufacturing capabilities, Japan has also simultaneously promoted the development and mass production of homegrown advanced technologies. In August 2022, several Japanese companies jointly invested US$ 50.4 million to establish Rapidus, a semiconductor company aimed at entering the advanced-node foundry business and building domestic R&D and manufacturing bases. Rapidus has adopted a dual-track strategy in its advanced process development: on one hand, collaborating with Japan's Leading-edge Semiconductor Technology Center (LSTC), and on the other hand, forming partnerships with international leaders such as IBM and imec (Belgium) for technology licensing and joint research. Rapidus is currently constructing an advanced wafer fab in Hokkaido, with its first 2nm pilot production line introduced in April 2025, and plans to achieve mass production by 2027.

To support Rapidus in building its advanced semiconductor capabilities from the ground up, the Japanese government has continuously provided funding and resources. In March 2025, the government announced an additional subsidy of US$ 5.54 billion for Rapidus, including US$ 4.7 billion for front-end advanced semiconductor processes and equipment, and US$ 0.88 billion for backend processes such as chip packaging and testing. This reflects the growing trend of advanced process manufacturers expanding into backend assembly and testing to strengthen integration between front-end and backend technologies. As of June 2025, the Japanese government has provided approximately US$ 11.9 billion in total subsidies to support Rapidus' R&D and mass production ambitions in advanced semiconductors.

Table 5: Japan's Subsidies for Advanced Semiconductor Manufacturing and Backend Process R&D Projects

Company	Subsidy Year	Subsidy Amount (USD Billion)	Project
Rapidus	2023	2.28	Hokkaido Chitose IM-1 Fab: 2nm process fab
	2024	4.07	
	2025	5.54	
Intel	2024	0.14	Semiconductor backend process automation and standardization technology research association
TSMC	2021	0.13	3D IC R&D Center (Tsukuba, Ibaraki)
	2022	3.28	Kumamoto Fab 1: 12-28nm
	2024	5.05	Kumamoto Fab 2: Expanding process to 6/7nm
Micron	2022	0.32	Hiroshima Fab: Expand 1β (1-beta) DRAM production
	2023	1.15	Hiroshima Fab: Introduce EUV equipment, conduct 1γ (1-gamma) DRAM design and HBM R&D
Kioxia / Western Digital	2022	0.64	Yokkaichi Fab: 3D NAND flash memory chips
	2024	1.03	Yokkaichi and Kitakami Fabs: Latest NAND products and capacity expansion
Samsung	2023	0.14	Advanced chip packaging R&D center (Yokohama)

Source: Chia-Chen Lee, "Semiconductor Policy Developments and Industry Deployment in Major Economies," IEK, ITRI, July 2, 2025, p. 8.

Japan's semiconductor policy has historically focused primarily on manufacturing. However, as several production projects began operations in 2024 and 2025, Japan has started to expand its support beyond domestic manufacturing initiatives like Rapidus, extending it to IC design and packaging/testing fields. With semiconductor process technology approaching physical limits, traditional chip miniaturization methods are becoming increasingly challenging. Advanced packaging technologies have emerged as a new solution to improve chip performance and reduce power consumption.

Japan holds a competitive advantage in advancing backend process R&D due to its world-leading substrate, materials, and equipment manufacturers. This has attracted and secured government subsidies for companies like TSMC and Samsung Electronics to establish advanced packaging R&D centers in Japan.

In November 2024, the Japanese government announced its support for the formation of the Semiconductor Assembly Test Automation and Standardization Research Association (SATAS), jointly established by Intel and several Japanese equipment and material manufacturers. SATAS will focus on assembly and testing stages, aiming to develop fully automated systems and standardized interfaces necessary for next-generation semiconductor backend manufacturing.

In addition to subsidizing international companies to set up R&D centers—allowing local equipment and materials firms to integrate more deeply into major players' advanced packaging supply chains—Japan has also been actively promoting homegrown advanced packaging technologies. Since 2024, Rapidus has allocated part of its funding to chiplet integration and advanced packaging R&D, and is constructing a pilot R&D line for backend semiconductor processes in Hokkaido, aiming to build its own advanced packaging capabilities. As leading-edge foundries increasingly expand into backend assembly and testing to strengthen their competitive advantage, Rapidus' investment in packaging R&D and front-to-backend process integration is a strategic move to secure future market opportunities.

Moreover, Japan's share of the global IC design market remains relatively low, and without strong government policy intervention, its competitiveness in this field is difficult to improve. To address this, the government has introduced several semiconductor design projects focused on next-generation chip development, including:

- **A collaboration between LSTC and U.S.-based Tenstorrent to develop edge AI semiconductors.**
- **The formation of ASRA (Advanced SoC Research for Automotive), comprising Japanese automotive and semiconductor firms working on state-of-the-art chips for autonomous driving applications.**

Beyond supporting chip design initiatives, talent development has also become a priority for Japan's government. Training programs are being established for students and corporate researchers, covering IC design skills from foundational to advanced levels, aiming to expand the domestic talent pool to meet future industry demand.

In November 2024, the Japanese government launched the "AI and Semiconductor Industry Infrastructure Enhancement Framework," a mid- to long-term public investment roadmap to support the semiconductor and AI sectors. Under this framework, the government plans to invest over US$ 69 billion by fiscal year 2030, including US$ 41.4 billion for R&D and production subsidies and US$ 27.6 billion through debt guarantees and investments via government agencies. This mechanism not only diversifies funding sources but, more importantly, sends a strong and stable policy signal, demonstrating the government's long-term fiscal commitment to encouraging private sector participation in semiconductor and AI development.

Furthermore, in April 2025, the Japanese House of Councillors passed an amendment to the Act on Promotion of Information Processing. This amendment provides a legal foundation for the new policy framework, allowing the Information-Technology Promotion Agency (IPA)—an independent administrative body under METI—to establish financial functions. This enables the government to directly invest in next-generation semiconductor companies such as Rapidus and become a shareholder. IPA can also offer guarantees for corporate loans from private financial institutions, reducing investor risk and facilitating easier access to funding for semiconductor companies.

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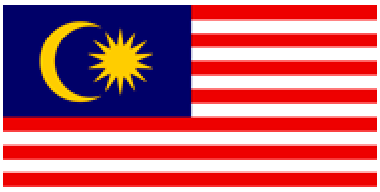
1.4 Trends in Semiconductor Manufacturing Deployment in Southeast Asia

Among Southeast Asian countries, Singapore, Malaysia, and India have demonstrated strong growth potential in semiconductor industry development. While Singapore does not have a dedicated semiconductor industry policy, its "Advanced Manufacturing 2030 Vision" covers semiconductor-related sectors. The government has actively invested in advanced manufacturing infrastructure and offers a stable, highly efficient operating environment.

With its well-established industrial clusters and excellent infrastructure, Singapore has attracted many international semiconductor companies to expand their investments. In 2024, Taiwan's Vanguard International Semiconductor Corporation (VIS) and NXP Semiconductors announced a joint investment of US$ 7.8 billion to establish a joint venture company, VSMC, in Singapore, building a 12-inch wafer fab utilizing 130–40nm process technologies to produce mixed-signal, power management, and analog products.

India, leveraging its large domestic market and strong policy support, has become a global focus in recent years. In 2023, the Indian government revised the India Semiconductor Mission (ISM), offering substantial subsidies for wafer fabrication, packaging, and testing sectors, aggressively attracting foreign investments to establish local fabs and accelerate the development of a domestic supply chain ecosystem.

Under the support of the ISM program, Tata Electronics (TEPL) announced in 2024 an US$ 11 billion investment in collaboration with Taiwan’s Powerchip Semiconductor Manufacturing Corporation (PSMC) to establish India’s first 12-inch semiconductor fab for producing 28nm wafers. In May 2025, Taiwan’s Foxconn and Hindustan Computers Limited (HCL) also received government backing to form a joint venture worth approximately US$ 435 million to build a new fab for display driver IC production.



Malaysia has long been a global hub for semiconductor packaging and testing, benefiting from a mature OSAT (Outsourced Semiconductor Assembly and Test) industry ecosystem and a cost-competitive labor force. In mid-2024, the Malaysian government launched the National Semiconductor Strategy (NSS), pledging an investment of US$ 5.5 billion, focusing on semiconductor design, front-end and back-end manufacturing, and equipment industry development, while strengthening technology R&D and talent cultivation to upgrade the overall industry.

Malaysia’s position as a key global OSAT hub continues to attract international investment. Texas Instruments and Micron both announced capacity expansions at their Penang packaging and testing facilities in 2023. In 2024, Taiwanese firm SPIL (Siliconware Precision Industries Co., Ltd.) invested US$ 1.276 billion to establish a new packaging and testing plant in Penang.

Adapted and translated from Chia-Chen Lee “Semiconductor Policy Developments and Industry Deployment in Major Economies,” IEK, ITRI, July 2, 2025

1.5 Observations on the Development of the Semiconductor Equipment Industry in Singapore and Malaysia

All of the world's top 25 semiconductor companies have established a presence in the ASEAN region. In recent years (2020–2024), 21 of these top 25 companies have continued to invest in ASEAN to increase production capacity, develop new business functions, or expand their regional footprint[1]. More than half of these investments came from U.S.-based companies, while other significant investments originated from European Union firms, as well as Japanese, South Korean, and Taiwanese companies. The presence and competition of these leading global semiconductor companies have further helped attract additional investments into the ASEAN region.

The semiconductor industry in Southeast Asia plays a crucial role in the global supply chain, particularly with significant strengths in back-end processes such as packaging, testing, and assembly, while gradually expanding into front-end wafer fabrication. Front-end semiconductor manufacturing requires highly skilled engineering talent, well-developed and reliable infrastructure (such as water and power supply), and large-scale capital investment. As a result, only a limited number of countries can meet these stringent requirements, inevitably narrowing the selection of viable manufacturing locations.

Globally, the distribution of front-end and back-end semiconductor production capacity shows that front-end capacity is mainly concentrated in Singapore and Malaysia, with a significant proportion of 8-inch fabs. Major semiconductor manufacturers, including Micron Technology from the United States, both United Microelectronics Corporation (UMC) and VIS from Taiwan, have established fabrication facilities in these regions. For back-end production, Southeast Asia accounts for 18% of global capacity, ranking third after China (31%) and Taiwan (21%).

In recent years, alongside the increasingly mature semiconductor manufacturing clusters in ASEAN countries, semiconductor equipment manufacturers have also been expanding their presence in the region (Table 6). Among the companies that have established production bases in ASEAN, those from the United States, Europe, and Japan are the main players, using these locations as manufacturing hubs, service and maintenance centers, as well as sales offices.

1 The ASEAN Secretariat and United Nations Trade and Development, ASEAN Investment Report 2024, Jakarta, Indonesia, October 2024, pp. 120-122.

Table 6. Major Manufacturing Sites of International Semiconductor Equipment Companies in Southeast Asia

Company	Headquarters	Process	Product Category	Manufacturing Sites in Southeast Asia
Applied Materials	USA	Front-end	Front-end equipment including coating, ion implantation, CMP, metrology tools	Singapore, Malaysia, Philippines
ASML	Netherlands	Front-end	Lithography, metrology equipment	Singapore, Malaysia
Lam Research	USA	Front-end	Etching, deposition, metal etching, etc.	Singapore, Malaysia
Tokyo Electron	Japan	Front-end Back-end	Photoresist coating, inspection, temporary bonding equipment	Singapore, Malaysia, Philippines
KLA	USA	Front-end	Metrology and inspection equipment, optical measurement systems	Singapore, Malaysia
Disco	Japan	Back-end	Wafer dicing, wafer grinding, CMP, etc.	Singapore, Philippines
ASM International	Netherlands	Front-end	Atomic Layer Deposition (ALD), epitaxy equipment	Singapore
Kulicke & Soffa	Singapore	Back-end	Wire bonding, flip chip bonding equipment	Singapore
Cohu	USA	Back-end	IC handlers, burn-in testers, mixed-signal test equipment, line testers	Malaysia, Philippines
BESI	Netherlands	Back-end	Die bonding equipment, packaging equipment	Singapore, Malaysia
TOWA	Japan	Back-end	Automatic mold presses, CSP dicing equipment	Malaysia
SCREEN Semiconductor Solutions	Japan	Front-end	Etching, thin film deposition, cleaning equipment	Singapore
Canon	Japan	Front-end	Photolithography, stepper equipment	Malaysia
Advantest	Japan	Back-end	Wafer testing, system-level test equipment	Singapore
Teradyne	USA	Back-end	Automated test equipment	Singapore Malaysia Philippines

Source: Wen-Chi Chang and Yu-Ting Chen, "Observations on the Development of the Semiconductor Equipment Industry in Singapore and Malaysia," IEK, ITRI, July 10, 2025, p. 4.

An overview of the strategic approaches of the world's top 10 semiconductor equipment companies toward the Southeast Asian market shows that these manufacturers have positioned Southeast Asia as a strategic growth region for the semiconductor industry. Their goal is to expand market presence by increasing capital investment, responding to the rising demand for artificial intelligence, strengthening technical support in specific locations, and promoting supply chain diversification.

Although individual companies may adopt different strategies, overall, their investment expansion in Southeast Asia is driven by five main factors:

1. ***Southeast Asia is regarded as a key growth region for the semiconductor industry.***
2. ***Expectations of increased capital investment and market expansion.***
3. ***AI and high-performance computing (HPC) demand are fueling growth.***
4. ***Enhanced services and technical support tailored to regional characteristics.***
5. ***The pursuit of supply chain diversification and risk mitigation.***

Additionally, foreign semiconductor equipment giants investing in Singapore have attracted related supply chain players to establish a presence in the region. For instance, in 2024, the Dutch semiconductor equipment company NTS built a manufacturing facility in Singapore dedicated to ultra-precision components and module production. NTS specializes in mechatronic integration, serving major clients such as Lam Research, Applied Materials, Thermo Fisher, and ASML.

Adapted and translated from Chang Wei-Chi and Chen Yu-Ting, "Observations on the Development of the Semiconductor Equipment Industry in Singapore and Malaysia," IEK, ITRI, July 10, 2025.

2

2. Analysis of the Global IC Design Industry Landscape

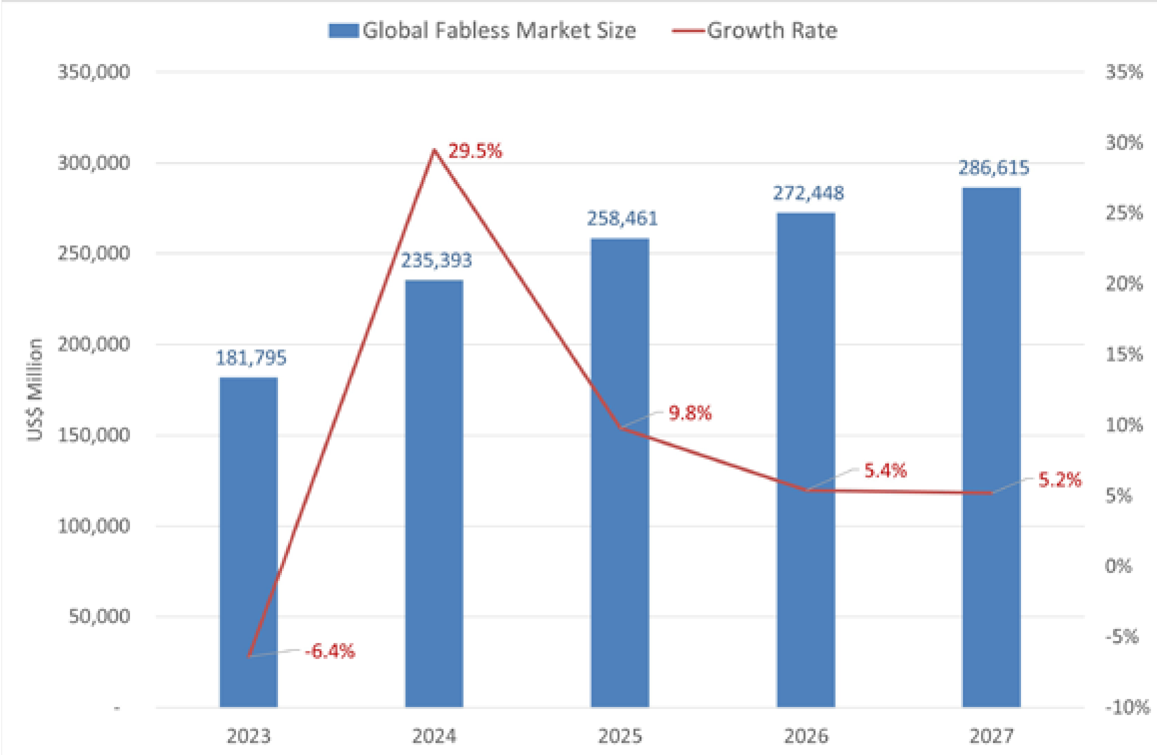
2.1 Global IC Design Industry Market Trends and Developments

In 2024, the global IC design industry experienced a significant rebound, mainly driven by the rapid growth in demand for applications such as generative AI, AI-powered PCs, AI smartphones, and high-performance computing. As inflationary pressures eased and major central banks slowed their pace of interest rate hikes, the global consumer electronics market gradually recovered, leading to stabilized end-user demand and a corresponding uptick in upstream chip design requirements. Furthermore, inventory adjustments across the supply chain have nearly reached their end, providing additional support for the industry's overall revenue momentum to rebound.

In 2024, the global IC design industry experienced a significant rebound, reaching a market size of US$ 235.39 billion with an impressive annual growth rate of 29.5%. Among the key growth drivers, revenue contributions from AI-related chips rose rapidly, becoming the core momentum propelling the industry forward. As the AI device industry chain continues to integrate, the global IC design sector is witnessing a trend of cross-industry competition.

Looking ahead, major international companies are expected to pursue mergers, acquisitions, and cross-domain collaborations to build more comprehensive chip platforms and solutions. According to IEK forecasts, the global IC design market size will further expand to US$ 258.46 billion in 2025, achieving an annual growth rate of 9.8%.

Figure 1. Global IC Design Industry Market Size Trends Over the Past Five Years



Source: Shu-Ting Chung, "Global Fabless Industry Trends in 2024 and Outlook for 2025," IEK, ITRI, July 1, 2025, p. 1.

2.2 Global Top 10 IC Design Companies

In 2024, NVIDIA continued to dominate the global IC design industry. The demand for AI computing propelled NVIDIA to double its revenue for the second consecutive year as cloud service providers and data centers sought to expand their AI server deployments and computational capabilities.

An overview of the global top 10 IC design companies in 2024 shows that U.S.-based firms occupied six spots (NVIDIA, Qualcomm, Broadcom, AMD, Apple, Marvell), Taiwanese companies secured three positions (MediaTek, Realtek, Novatek), and one China-based company (HiSilicon). The global IC design industry remains highly concentrated in the U.S. and Taiwan, with a combined market share exceeding 85%. U.S. IC design firms continued to dominate the global market with the highest overall revenue share, while Taiwan ranked second with a 16.8% market share, demonstrating strong competitiveness.

Among the top 10 IC design companies in 2024, two firms achieved revenue doubling, namely NVIDIA and HiSilicon. NVIDIA benefited from the rapid growth of generative AI applications, with skyrocketing demand for high-performance AI chips.

Its premium-priced, high-margin data center AI chip product line delivered substantial profits, while its chip performance and AI software ecosystem cemented its position as the leading supplier of AI infrastructure solutions.

HiSilicon, on the other hand, capitalized on the strength of China's domestic market and the aggressive expansion of its parent company Huawei in AI server and automotive markets, driving its annual revenue to double and making it the largest IC design company in China.

Taiwanese IC design companies' main markets are in smartphone and consumer electronics. In 2024, the launch of new products such as global smartphones and AI PCs boosted the demand for related chips. Additionally, communication technology upgrades spurred equipment replacement needs, supporting growth in Taiwan's IC design sector, particularly in AI and communications fields. However, Novatek's overall performance was still affected by fluctuations in end-market demand, making it the only company among the global top 10 fabless firms to record negative growth.

Table 7. Top 10 Global IC Design Companies in 2024

US Million

2024 Rank	2023 Rank	Company Name	2023 Revenue	2024 Revenue	Growth Rate
1	1	NVIDIA	34,846	76,692	120.1%
2	2	Qualcomm	29,229	32,976	12.8%
3	3	Broadcom	25,613	27,801	8.5%
4	4	AMD	22,307	24,127	8.2%
5	5	Apple	18,052	20,510	13.6%
6	6	MediaTek	13,451	15,934	18.5%
7	7	Marvell	5,450	5,637	3.4%
8	8	HiSilicon	2,332	4,785	105.2%
9	9	Realtek	3,047	3,524	15.7%
10	10	Novatek	3,515	3,165	-10.0%

Source: Shu-Ting Chung, "Global Fabless Industry Trends in 2024 and Outlook for 2025," IEK, ITRI, July 1, 2025, p. 2.

2.3 Future Outlook: AI as the Key Driver of IC Design Industry Growth and Transformation

AI is not only reshaping the direction of technological development in the IC design and semiconductor industry but also restructuring business operations as firms upscale with new AI infrastructure.

Firstly, AI is significantly boosting market demand and application breadth. AI applications will continue to penetrate personal devices, edge computing, and cloud environments, becoming the main momentum for IC design industry growth. In particular, Generative AI (GenAI) is developing at the fastest pace, with IEK forecasting a compound annual growth rate (CAGR) of 73.5% between 2023 and 2028.

The adoption of large language models is greatly increasing the demand for AI computing. Rapid growth in AI PCs, AI smartphones, and high-performance computing is driving a strong market rebound, further pushing up demand for chips such as SoCs, ISPs, and AI accelerators. Enterprises are actively investing in AI infrastructure, especially edge IT spending to handle the increased inference workloads from GenAI. This simultaneously places greater pressure on data center energy consumption. AI is evolving from narrow applications to widespread adoption, eventually realizing “AI Everywhere”, unlocking new use cases for enterprises.

In tandem, AI is also driving overall growth in chip design and the semiconductor sector. According to IEK, the global IC design industry is projected to reach nearly US$ 235.4 billion in 2024, representing a 29.5% annual growth rate, and is expected to expand further to US$ 258.5 billion in 2025 with a 9.8% annual growth rate. Compute-based semiconductors will play the most crucial role, with IEK estimating 53.9% growth in 2024 and forecasting strong growth of 19.4% in 2025, making it the most promising segment. AI semiconductors, including GPUs and AI accelerators, will be the primary growth drivers of the semiconductor market, with advanced custom ASIC AI accelerators seeing increasing adoption among hyperscalers.

Taiwan’s IC design industry is benefiting from several factors: the surge in AI smartphone shipments, demand generated by the transition to Wi-Fi 7 standards, and continued orders for AI-related ASIC design services. IEK estimates Taiwan’s IC design production value to reach NT$ 1.2721 trillion in 2024, with a 16.0% growth rate, and forecasts it to NT$ 1.4495 trillion in 2025, also growing 13.9%. Taiwan’s global IC design market share is expected to recover to 18.7% in 2025, ranking second globally only behind the United States.

Adapted and translated from Chung Shu-Ting, “Global Fabless Industry Trends in 2024 and Outlook for 2025,” IEK, ITRI, July 1, 2025

3

3. Global Semiconductor Manufacturing Industry

3.1 Global IDM Market Size Rebounded in 2024 and Is Expected to Grow by 14.4% in 2025

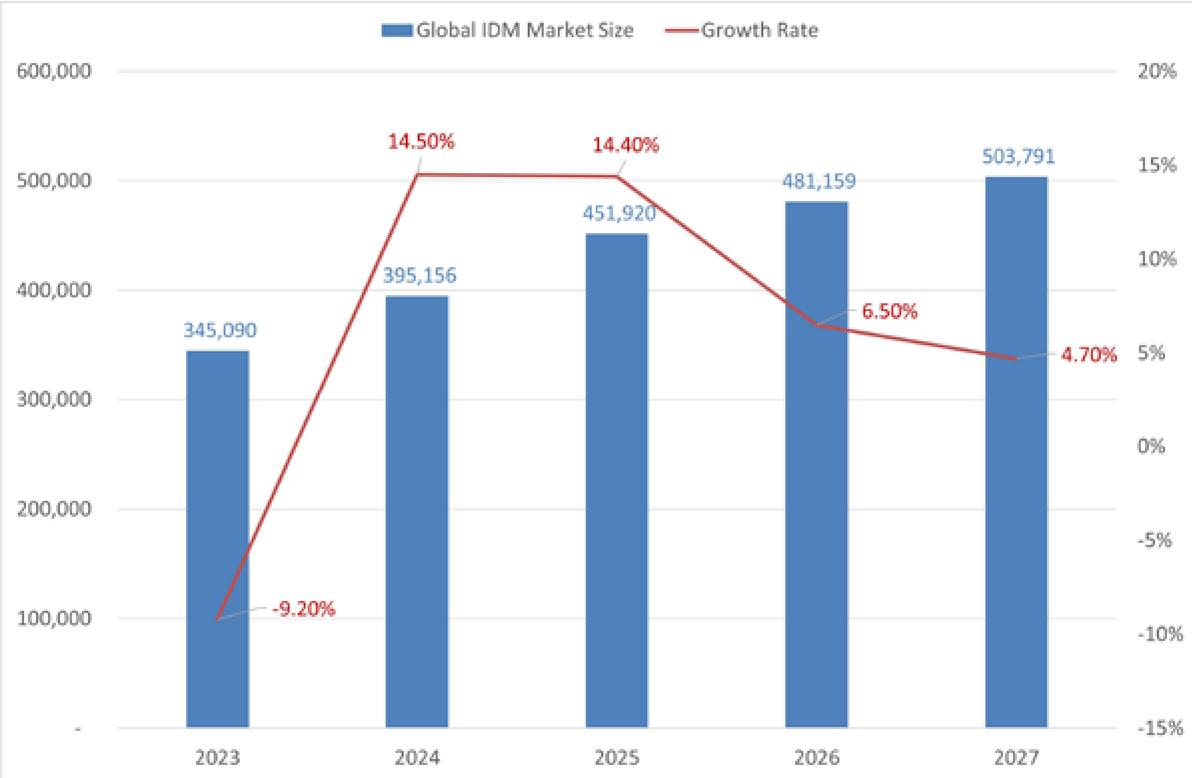
Integrated Device Manufacturers (IDMs) are companies that own their own wafer fabrication plants and market products under their own brand names.

In 2024, the global IDM market size reached US$ 395.16 billion, representing a 14.5% increase compared to 2023. The strong demand for AI-related applications drove robust performance across semiconductor manufacturers, while the rapid expansion of the High Bandwidth Memory (HBM) market further supported overall growth in the memory sector.

The semiconductor industry entered a recovery phase in 2024. According to IEK forecasts, 2025 will see another surge in global semiconductor market growth under the momentum of AI-related applications, with logic ICs and memory products serving as the primary growth drivers.

Over the long term, IEK remains optimistic that AI-related applications and High-Performance Computing (HPC) will continue fueling demand, advancing both IC manufacturing technologies and overall industry development. However, factors such as geopolitical tensions and U.S. tariff policies will need to be carefully considered. IEK projects that by 2025, the global IDM market size will expand to US$ 451.92 billion, marking a 14.4% increase compared to 2024.

Figure 2. Global IDM Market Size Trends, 2023–2027



Source: Hui-Hsiu Huang, "2024 Review and 2025 Outlook for the Global Semiconductor Manufacturing Industry," IEK, ITRI, July 1, 2025, p. 1.

3.2 Revenue Performance of the Top 10 Global Semiconductor Manufacturers in 2024: TSMC Ranked First

In 2024, the combined revenue of the world's top 10 major semiconductor manufacturers (including both IDMs and foundries) reached US$ 357.27 billion, representing a 22.2% increase from US$ 292.28 billion in 2023. Among them, TSMC's revenue stood at US$ 90.08 billion, growing 30.0% year-over-year, mainly driven by strong AI demand that kept advanced process node capacity fully utilized, fueling overall revenue growth.

Regarding the 2024 ranking of manufacturers, the top ten companies were, in order: TSMC, Samsung, Intel, SK Hynix, Micron, Infineon, Texas Instruments, STMicroelectronics, NXP, and Sony. Among these leading manufacturers, three are headquartered in the United States, three in Europe, two in South Korea, one in Japan, and one in Taiwan.

Notably, memory manufacturers, after experiencing a sluggish market in 2023, saw substantial revenue growth in 2024, benefiting from high-value-added products such as High Bandwidth Memory (HBM) and increased demand for enterprise SSD-related NAND flash applications.

Table 8. Major Global Semiconductor Manufacturers in 2024 (Including IDMs and Foundries)

US Million

2024 Rank	2023 Rank	Company Name	2023 Revenue	2024 Revenue	Growth Rate
1	1	TSMC	69,276	90,083	30.0%
2	3	Samsung	50,904	66,969	31.6%
3	2	Intel	54,228	53,101	-2.1%
4	4	SK Hynix	25,006	48,431	93.7%
5	8	Micron	16,711	29,777	78.2%
6	6	Infineon	17,364	15,796	-9.0%
7	5	Texas Instruments	17,519	15,641	-10.7%
8	7	STMicroelectronics	17,239	13,256	-23.1%
9	9	NXP	13,033	12,385	-5.0%
10	10	Sony	10,997	11,832	7.6%

Source: Hui-Hsiu Huang, "2024 Review and 2025 Outlook for the Global Semiconductor Manufacturing Industry," IEK, ITRI, July 1, 2025, p. 2. 1, 2025, p. 1.

3.3 Performance of the Global Foundry Industry in 2024: Overall Revenue Grew by 22.3%

Table 9 below lists the revenue rankings of the major global pure-play foundry companies. Among the top six foundries in 2024, two are headquartered in Taiwan, two in China, one in the United States, and one in Israel. The total combined revenue of the global pure-play foundry sector reached US$ 122.69 billion in 2024, representing a 22.3% year-over-year growth compared to 2023.

Table 9. Ranking of the Top 10 Global Foundries in 2024

US Million

2024 Rank	Company Name	2024 Revenue	Growth Rate	Market Share
1	TSMC	90,083	30.0%	73.4%
2	SMIC	8,184	29.5%	6.7%
3	UMC	7,235	1.2%	5.9%
4	GlobalFoundries	6,750	-8.7%	5.5%
5	Huahong Grace	2,004	-12.3%	1.6%
6	Tower	1,436	0.9%	1.2%
Others	Others	7,000	7.7%	5.7%
Total	Total	122,692	22.3%	100.0%

Source: Hui-Hsiu Huang, "2024 Review and 2025 Outlook for the Global Semiconductor Manufacturing Industry," IEK, ITRI, July 1, 2025, p. 3.

intel

In April 2025, Intel hosted the "Intel Foundry Direct Connect 2025" event, announcing key milestones in its core foundry technologies and U.S. advanced manufacturing roadmap. Regarding process technology, Intel 18A entered the risk production phase, with full-scale production expected in 2025. For the next-generation process node, Intel confirmed ongoing collaborations with major customers on Intel 14A, the successor to 18A.

SAMSUNG

In June 2024, Samsung held its annual "Samsung Foundry Forum", unveiling multiple innovations in foundry solutions under the theme "Empowering the AI Revolution", outlining its future technology vision.

For advanced nodes, Samsung announced that it will launch the next-generation 2nm (SF2) process in H2 2025. Additionally, Samsung reported that development of its 1.4nm (SF1.4) process is advancing steadily, with mass production slated for 2027, aiming to set new benchmarks in both performance and yield.

In 2024, TSMC achieved revenues of US$ 90.08 billion, representing 30.0% year-over-year growth, capturing a dominant 73.4% share of the global pure-play foundry market. The revenue breakdown by process technology for 2024 was as follows: 18% from 3nm (a significant increase compared to 6% in 2023), 34% from 5nm, 17% from 7nm, 8% from 16nm, 7% from 28nm, and 4% from 40/45nm nodes.

The share of advanced nodes (7nm and below) increased from 58% in 2023 to 69% in 2024. By application platform, 51% of TSMC's 2024 revenue came from High-Performance Computing (HPC), 35% from smartphones, 6% from IoT, 5% from automotive electronics, 1% from digital consumer electronics, and 2% from other categories.

Looking ahead to 2025, TSMC is expected to continue benefiting from strong AI-driven demand, with IEK projecting around 25% annual revenue growth, consistently outperforming the overall foundry industry average. Demand for advanced nodes fueled by AI applications and increased customer pull-in for 3nm are expected to be the core growth engine for TSMC's revenue and capacity expansion over the next few years, while other application segments are expected to see a moderate recovery.

In terms of advanced process technology, TSMC's 3nm technology entered mass production in 2022, quickly achieving high-volume production and high yields, setting an industry benchmark. 2nm production is planned for H2 2025, followed by A16 nodes in H2 2026. At its May 2025 Technology Symposium, TSMC announced that the A14 node is planned to start production in 2028.

3.4 AI-Driven Memory Market Recovery in 2024 with Continued Growth Expected in 2025

According to TechInsights, the global DRAM market reached US$ 98.62 billion in 2024, up 87.1% from US$ 52.70 billion in 2023. The market size is projected to reach US$ 130.54 billion in 2025.

In 2024, the top five DRAM vendors accounted for 98.4% of the global market. Samsung ranked first, followed by SK Hynix (33.3%), Micron (21.0%), CXMT (3.1%), and Nanya Technology (1.1%). The DRAM market remained highly concentrated among U.S. and South Korean companies.

Similarly, the global NAND Flash market was valued at US$ 65.15 billion in 2024, up 69.1% from US$ 39.12 billion in 2023. With the steady recovery of the memory market, TechInsights expects it to reach US$ 67.99 billion in 2025.

In 2024, the top five NAND Flash vendors captured 84.9% of the global market. Samsung ranked first with US$ 23.38 billion in revenue (35.3% share), followed by Kioxia (US$ 9.79 billion, 14.8%), Micron (US$ 8.34 billion, 12.6%), SK Hynix (US$ 7.63 billion, 11.5%), and SanDisk (US$ 7.02 billion, 10.6%).

Adapted and translated from Hui-Hsiu Huang "2024 Review and 2025 Outlook for the Global Semiconductor Manufacturing Industry", IEK, ITRI, July 1, 2025.

4. TaiwanPlus Videos on Semiconductor

114/7/7
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HOW INDIA IS BECOMING A FABLESS SEMICONDUCTOR POWERHOUSE

India's semiconductor dreams are heating up. Can the chip design powerhouse become a global superpower? With 20% of the world's chip designers, India is already a fabless giant, and its new US$ 435 million joint venture with Taiwan's Foxconn could be a game changer.

In this conversation, we unpack India's fabless revolution, Taiwan's role in the equation and what it means for the global tech race.

114/7/29
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Why does Taiwan struggle to scale AI globally? How is Nvidia's arrival reshaping the local talent race? We discussed the next five years in AI with iKala CEO Sega Cheng, whose company went from providing online karaoke to delivering AI-powered transformation services online karaoke to delivering AI-powered transformation services.

CAN TAIWAN LEAD IN AI? IKALA CEO ON GLOBAL EXPANSION & NEXT BIG TRENDS | CONNECTED ON TAIWANPLUS

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SHOULD YOU GO TO 'SEMICONDUCTOR SCHOOL'? TRAINING FOR THE CHIP INDUSTRY

Over 2 million people work in semiconductors worldwide. And over 1 million more jobs are expected by 2030. But who will fill them? Experts from two chip powerhouses (Taiwan and the Netherlands) explain how they're training the next generation for the trillion-dollar industry.

114/07/13
Taiwan Talks

'A CHIP ODYSSEY': AN EXCLUSIVE INTERVIEW WITH DOCUMENTARY'S PRODUCER | TAIWAN TALKS W18

"A Chip Odyssey" is a groundbreaking documentary that chronicles the unlikely rise of Taiwan's TSMC to become the world's leading semiconductor manufacturer. The film, which took more than five years to make, premiered in June. In this special weekend episode, Taiwan Talks speaks with the film's producer about the making of the documentary and about what he discovered about the country's chip sector along the way. What factors paved the way for Taiwan's emergence as a high-tech powerhouse? What does this mean for the country's future? And can Taipei successfully protect its economic advantages in chip manufacturing while also boosting cooperation with its main security guarantor, the United States?

Join us as we journey through the past, present and potential future of TSMC and the Taiwan semiconductor industry.