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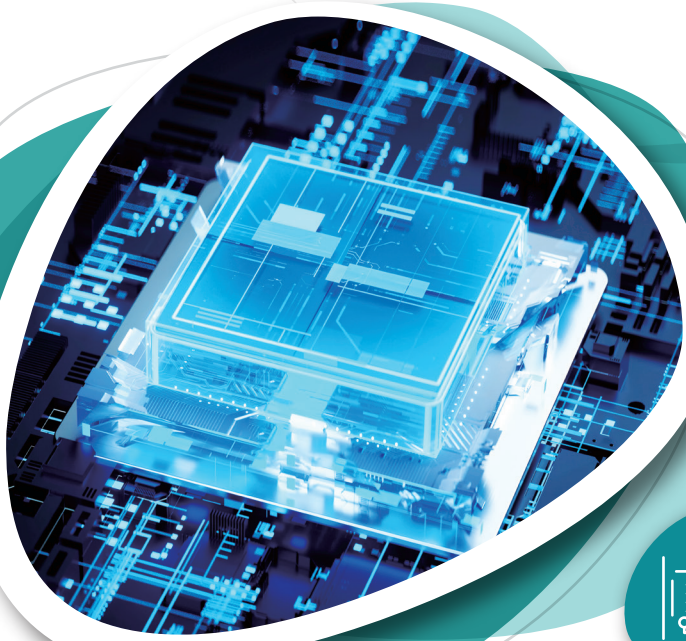
Key Innovative Industries in Taiwan

Semiconductors



Information Security	New Generation Automobiles	Communications Industry	Circular Economy	Green Energy
Biopharmacy	Smart Machinery	Semiconductors	Internet of Things	International Logistics and E-commerce

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Policy Initiatives —

Semiconductor Industry Development Program

The semiconductor industry in Taiwan is a global leader and ranked first by market share in both wafer manufacturing and packaging & testing. Taiwan also ranks second in IC design, while 92% of global leading-edge chip manufacturing capacity is concentrated in Taiwan. In particular, the US-China trade war and the pandemic have highlighted Taiwan's important position in the semiconductor industry. In response to changing global trends, the Taiwan government is actively establishing an advanced semiconductor ecosystem, and strives to achieve sub-nanometer technology by 2030.

Taiwan's current semiconductor policy is focused on the development of AI chips and artificial intelligence (AI) applications to establish critical technologies that industries need to build smart system applications. The government’s technology policies have prioritized "IC design and pioneering semiconductor technologies." Taiwan shall continue to leverage its heft in the semiconductor industry to support the 5+2 Industrial Innovation Plan and tap into its wealth of outstanding semiconductor talents to transform Taiwan into a hub for advanced semiconductor processing. To achieve this, Taiwan will be employing a four-pronged approach:

1 Ensuring a Sufficient Supply of Semiconductor Talent

The "National Key Fields Industry-University Cooperation and Skilled Personnel Training" passed earlier this year and, together with a number of deregulatory measures, has paved the way for closer cooperation between higher education and industry. The competent authority may set up research institutes at select national universities to conduct research in key national fields, fostering collaboration between universities and enterprises to cultivate key industrial talent. At the same time, the government is advocating for companies and universities to set up about three to five semiconductor R&D centers together to strengthen cooperation between academia and industry. We expect to train some 10,000 additional semiconductor professionals per year, thus helping the strive towards sub-nanometer technology.

2 Strengthening Leading Edge Semiconductor R&D Efforts

Silicon-based semiconductors: Taiwan is pursuing the Angstrom Semiconductor Initiative (2021-2025) in order to explore cutting-edge devices, circuits, processes, and testing technologies that will satisfy the needs of the semiconductor industry for the next decade. The program is expected to develop breakthrough solutions for key barriers on the road to mass production of sub-nanometer semiconductor technology by 2030, as well as help Taiwan maintain its lead in the semiconductor industry. The program also seeks to accelerate efforts by domestic firms to obtain certification from well-known manufacturers of key front-end equipment for 12-inch wafers and 3D IC packaging equipment. At the same time, program grants are awarded to makers of processing elements who independently produce regulated materials and are capable of developing high speed and low power consumption processing elements for use in computers, mobile devices, automobiles, etc.

Compound semiconductors: Taiwan is going to launch a Compound Semiconductor Project (2022-2025), which will involve the participation of firms in every part of the semiconductor value chain - upstream to downstream. The objectives are to accelerate the development of key 8-inch wafer equipment

and pursue independent production of silicon carbide (SiC) powders (a type of third-generation semiconductor material) and 8-inch SiC wafers. In addition, firms are working to find applications for high-power devices in electric vehicles (motorcycles and automobiles) and green energy (wind power), as well as applications for high-frequency devices in communications (5G/6G) and low-orbit satellites.

Quantum technology: Taiwan has launched a Quantum Technology Program (2021-2025), under which some NT$8 billion will be spent over five years to establish a national quantum computer team so that Taiwan can maintain a critical position in the field of quantum technology. The Quantum Technology Program will focus on quantum computing and quantum communications in order to develop silicon-based technologies to meet quantum computing demands in ten years. Accomplishing this will create more room for further development of Taiwan's semiconductor industry.

3 Promoting Semiconductor Clusters in Southern Taiwan

The government is leveraging Kaohsiung's key advantages, which include material and petrochemical clusters, strong circular technology, and ongoing plans to establish Kaohsiung as a major hub for high-value materials. These factors promise to generate greater employment in the city's material and petrochemical industries and trigger an upgrading of related R&D capabilities. A comprehensive semiconductor supply chain, including TSMC, Advanced Semiconductor Engineering, Winbond Electronics, and WIN Semiconductors is being planned for Southern Taiwan at the former site of the Kaohsiung Oil Refinery in Nanzi, with .

ITRI announced the Southern Rainforest Program in September 2021 to set up the first Compound Semiconductor and Application Industry Zone in Liujia and Shalun, Tainan. The goal is to help automotive parts manufacturers create an ecosystem for compound semiconductor power components - from design, manufacturing, and packaging and testing, to components and modules, and connections to automotive electronics. The short-term objective is to run trials for mass production, and the long-term objective is to enter markets

such as high-voltage railcars, industrial motors, and renewable energy grids. The program will provide advanced technologies for the automotive industry and create an important supply chain of compound semiconductors for the international automotive industry.

4 Further Industrial Development, More Incoming FDI

To help the semiconductor industry set deeper roots in Taiwan and spur further development of our AI, big data, cloud computing, and autonomous vehicle industries, governments at both the central and local levels are making a concerted effort to optimize the investment environment. The government's upcoming renovation of phase 3 to phase 5 standard factory buildings at the Hsinchu Science Park is expected to enable companies in the Park to hire an additional 6,000 employees. At the same time, the government is taking all necessary steps to ensure that companies in the Park have dependable access to land, water, power, materials, and talent. In addition, the government plans to build three new science parks in Kaohsiung's Qiaotou District (investment and site selection implemented at the end of 2021), Chiayi (preparatory office set up in April 2022), and Pingtung (preparatory office set up in March 2022) and expand the Tainan Science Park. These undertakings will elevate Taiwanese industry to a higher level of critical mass.

Overview of Industrial Development

1 | Output Value |

The semiconductor industry is a key pillar of economic growth in Taiwan and is one of Taiwan's most important industries in terms of output value, share of exports, and amount of investments. In 2021, Taiwan's semiconductor industry outperformed the global industry, posting 26.7% year-on-year growth by achieving output value of NT$4.08 trillion (US$145.8 billion), making it the second largest in the world with 26.2% of the output of the global semiconductor industry. Memory products had the highest growth with annual growth exceeding 50%. The IC design industry also grew by more than 40% compared to the previous year. IC manufacturing had the highest output with NT$2.23 trillion, including NT$1.94 trillion in wafer foundry services.

As the pandemic persisted into 2021, it continued to power the demand for remote work products. On the other hand, the market demand for 5G and other application products also gradually recovered and increased the demand for ICs such as driver IC, power management IC, microcontrollers units (MCU), and CIS sensors. Taiwan's semiconductor foundry sector operated at full capacity. The IC design industry mainly benefited from 5G smart phones, networking products, and an increase in consumer electronics demand. Taiwan's IC design output exceeded NT$1 trillion for the first time with an unprecedented NT$1.21 trillion (US$43.4 billion), up 42.4% from 2020. The output of the IC manufacturing industry continued to increase and reached NT$2.22 trillion in 2021 due to the strong demand for 5G smart phones, high-efficiency computing, and automotive electronics, and the rise in demand for microcontrollers for IoT and healthcare applications. The production capacity utilization rate of the IC packaging testing industry remained high in 2021 and the output was NT$638.4 billion.

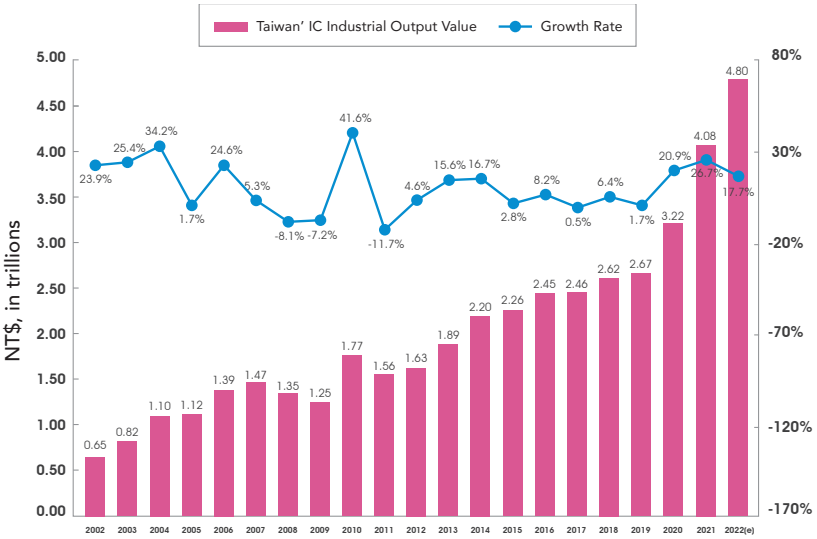
The semiconductor industry in Taiwan is characterized by vertical integration and industry clustering. A unique production model gives Taiwan

the advantage of flexibility, speed, service customization, and low costs. In terms of industry structure, the IC design industry accounts for 30%, the IC manufacturing industry accounts for 55% (of which the foundry model accounts for 48% and the memory industry accounts for 7%), and the IC packaging & testing industry accounts for 15%. In terms of global market share, the foundry sector has been the most outstanding performer with a global market share of over 60%. Taiwan Semiconductor Manufacturing Company (TSMC) is Taiwan's best-known manufacturer and the undisputed world leader in the foundry sector with a global market share of more than 55% in 2021. Other key companies include MediaTek in the IC design sector, Advanced Semiconductor Engineering (ASE) in the IC packaging and testing sector, and Nanya Technology in the memory sector.

Total sales of the global semiconductor chip market grew by 13% in 2020 and 26% in 2021, and two-digit growth of 11% is also projected for 2022. The demand for products such as automobiles, 5G, network communication, servers, edge computing, and data centers remains strong and continues to power growth in the semiconductor industry. As tech companies such as Meta, Microsoft, and Google expand investments in the metaverse, the development of technologies such as augmented reality (AR), virtual reality (VR), mixed reality (MR) that incorporates the functions of AR and VR, and even extended reality (XR), have encouraged semiconductor companies from design to packaging and testing to actively develop high-performance chips in response to the demand for high-performance chips for the metaverse.

Taiwan's continuous development of high-end processes and the continued growth of markets for equipment and materials will help consolidate Taiwan's lead in semiconductor industry development in 2022. These factors will also solidify Taiwan's key position in the global semiconductor market and

continue the strong growth in 2021. The output value of Taiwan's semiconductor industry is forecasted to increase by 17.7% and reach NT$4.8 trillion in 2022 (see Fig. 1).



Source: Industry, Science and Technology International Strategy Center, ITRI (Feb 2022).

Figure 1 Production value of Taiwan semiconductor industry between 2002 and 2022

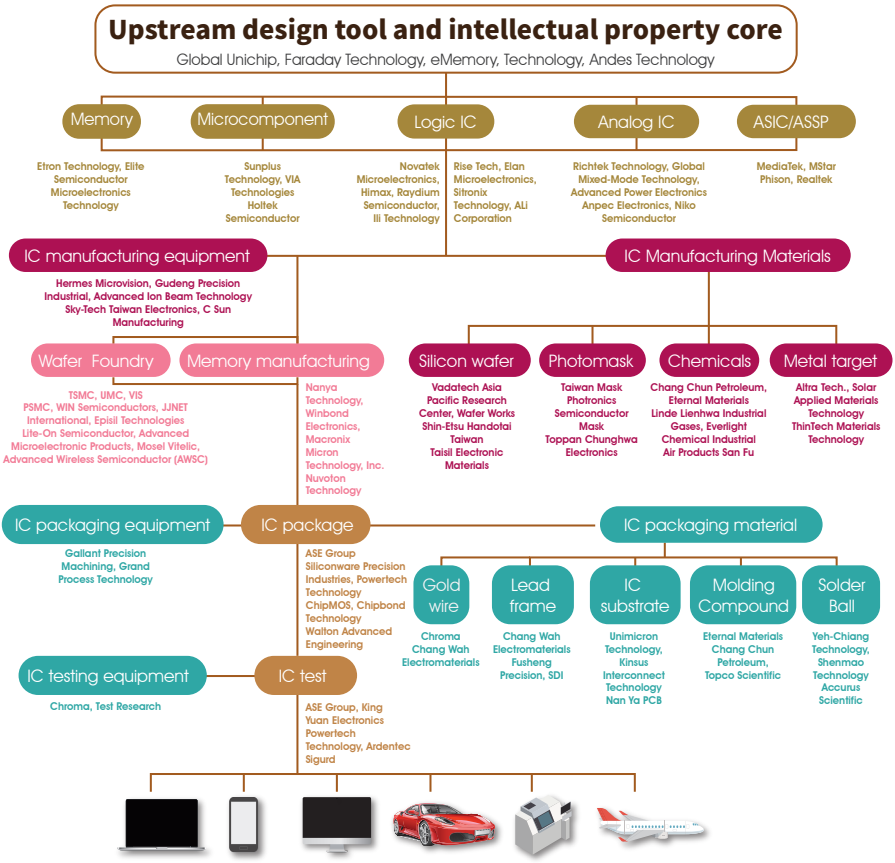
2 | Industry Value Chains |

Taiwan is home to the most complete semiconductor industry clusters and specializations in the world and has world-class companies in all the various sub-fields of the semiconductor industry. In the upstream segment, industry value chains include chip design and silicon intellectual property cores, and these industries can be further broken down, on the basis of differing functionality, into still narrower fields of specialty, such as memories, micro-components, logic chips, and analog chips. Leading chip design firms include MediaTek, Novatek Microelectronics, Realtek Semiconductor, Etron Technology, and Sunplus Technology. These companies are all well-known both in Taiwan and overseas. Leading firms in the area of silicon intellectual property cores include Andes Technology, eMemory Technology, Global Unichip, and Faraday Technology.

TSMC, the most prominent of Taiwan's midstream chipmakers, commands the No.1 share of the global foundry market and has highly advanced semiconductor processes, but in addition to TSMC there are also United Microelectronics, Vanguard International Semiconductor, and Powerchip Semiconductor, each of which possesses outstanding manufacturing capabilities with respect to certain processes and products. These companies maintain a very impressive device yield of above 95%. And other companies that produce silicon wafers, photomasks, chemicals, and metal target materials also link up with strong overseas partners. The above factors ensure that the Taiwan semiconductor industry's midstream supply chain is quite sound and comprehensive.

In the downstream packaging and testing segment, Taiwan has a host of home-grown packaging and testing firms with giant international reputations, including Advanced Semiconductor Engineering, Siliconware Precision, and Powertech Technology. With the development of advanced foundry processes, firms like these rely on their particular strengths to continually develop and improve corresponding packaging and testing technologies. In addition, there are also quite a few firms that supply the materials needed for packaging. Examples include Chang Wah Electromaterials (which produces gold wire and leadframes), Unimicron and Kinsus (IC carrier boards), Eternal Materials (molding, and filling materials), and Yeh-Chiang Technology and Shenmao Technology (tin lead solder paste). These firms combine to support development of Taiwan's packaging and testing industry.

The core value of Taiwan's unique model of specialization lies in the very high degree of integration among the upstream, midstream, and downstream segments of industry. Each segment of industry contributes its own irreplaceable value to the semiconductor industry that has arisen in Taiwan.

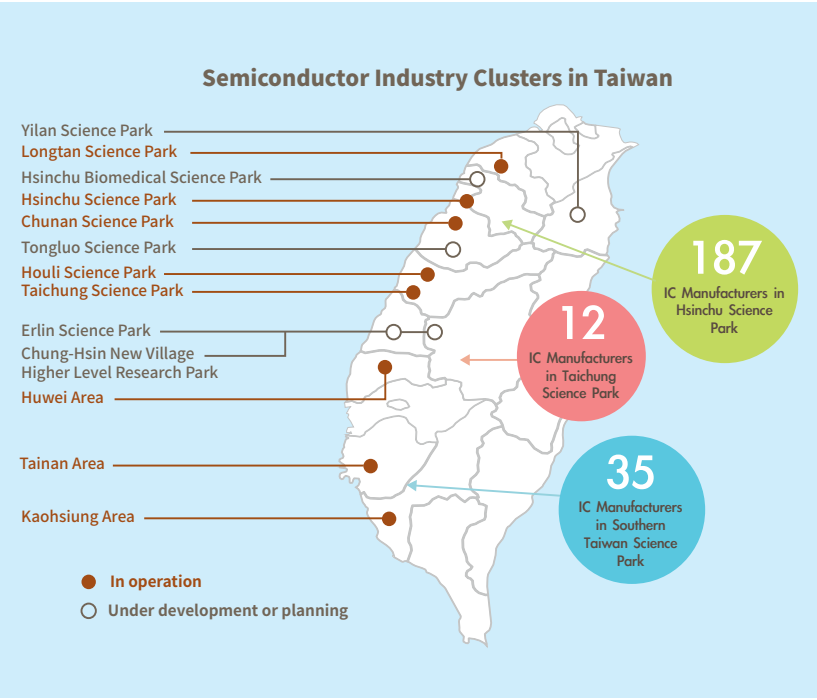


Source: 2021 Semiconductor Industry Yearbook, Department of Industrial Technology, Ministry of Economic Affairs.

Figure 2 The Overall Structure of Taiwan's Semiconductor Industry

3 | Industrial Clusters |

According to the 2020 Semiconductor Industry Yearbook, the 288 semiconductor firms currently operating in Taiwan employ some 250,000 persons. Most of these firms are concentrated in the Hsinchu Science Park and Taoyuan. However, in order to disperse risks associated with earthquakes and other natural disasters, a big share of more recently added production capacity has been built in science parks in central and southern Taiwan, while packaging and testing firms are mainly concentrated in Kaohsiung (see Fig. 3).



Note: Only the numbers of semiconductor manufacturers located in the three major science parks are shown.
Source: Compiled the data from the Science Park Administration.

Figure 3 Semiconductor Industry Clusters in Taiwan

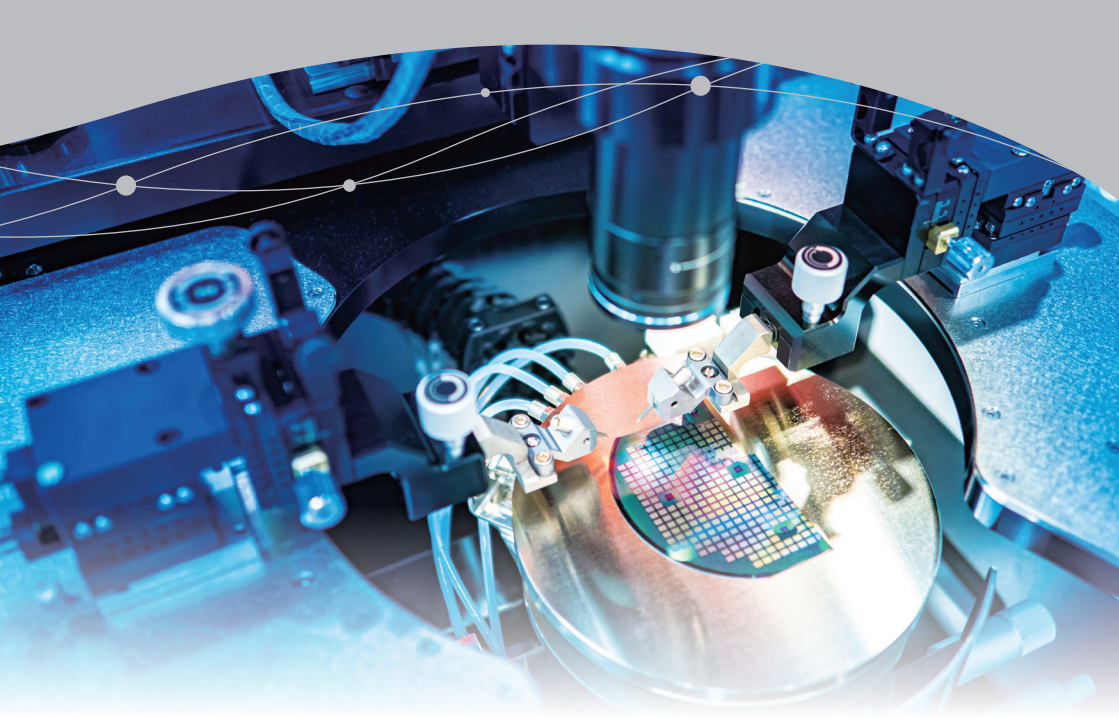
Potential Investment and Collaboration Opportunities in Taiwan

1 Joining the Core Cluster of the Global Semiconductor Industry

The complete semiconductor industry chain, production clusters, and R&D capability in Taiwan will generate synergies for foreign businesses that set up R&D centers or production sites in Taiwan. They will monitor the latest development in advanced processes and the experimental sites for advanced equipment and materials to gain first-hand information. The semiconductor industry is a cornerstone of Taiwan's industrial development in the digital age. Every effort will be made to support the development requirements of the semiconductor industry, including adoption of related measures.

In terms of human resources, more than 10,000 people graduate from IT-related programs in Taiwan and join the workforce every year. OECD data shows that Taiwanese students are ranked 4th in the world in science education. Taiwan AI Academy was also established in 2017 to cultivate talent for the AI industry. Taiwan has a big competitive advantage in edge computing and AI chips, and by tapping into the strengths of our country's very capable software/hardware vendors, Taiwan has succeeded in building up a very complete supply chain system.

In addition, Taiwan also passed the National Key Fields Industry-University Cooperation and Skilled Personnel Training act in May 2021 to allow companies and national universities to jointly develop talent in key sectors. Four national universities including National Taiwan University, National Tsing Hua University, National Yang Ming Chiao Tung University, and National Cheng Kung University, have set up semiconductor colleges and begun recruitment in accordance with their plans to strengthen basic research and the partnerships necessary for industrial development.



The AI on Chip Taiwan Alliance (AITA) formed in July 2019 is composed of local and foreign semiconductor and ICT vendors, local universities, and national research institutions such as ITRI. Four "key technology committees" in AITA focus on AI system applications, heterogeneous integration, emerging architectures, and AI system software. AITA will be building on Taiwan's existing advantages by moving from horizontal division of labor to vertical integration. It will also help the industry reduce its R&D costs for AI chips by 90% and shorten their development time by over 6 months.

In addition, information security has become critical as the globe embraces smart manufacturing and digitalization. SEMI, an international semiconductor industry association, published the first information security standards for semiconductor wafer equipment in Taiwan in December 2021 and organized the inauguration of the Semiconductor Supply Chain Information Security Alliance. The event was attended by representatives of major semiconductor plants in Taiwan and foreign countries such as TSMC, ASE, and Applied Materials. Information security standards were jointly decided by semiconductor companies in Taiwan, which demonstrates Taiwan's key position in the global semiconductor industry. In the future, the aim is for foreign companies to form technical partnerships with Taiwanese businesses to invest in the development and application of semiconductor industries.

2 Exploring the Growing Market for Semiconductor Equipment and Materials

IoT, AI, 5G, industrial and service robotics, smart city initiatives, smart lifestyle products, automotive electronics, and high-speed computing applications all require the support of the semiconductor industry. The future growth potential is considerable, and further growth in demand for semiconductor products is expected. Due to the large number of foundries and packaging plants, Taiwan has been the largest consumer of semiconductor materials in the world for 12 consecutive years. Total market value reached US$14.7 billion in 2021, putting Taiwan ahead of South Korea and mainland China. As the output value of Taiwan's IC industry continues to grow, the demand for new materials and equipment will continue to increase as well.

Currently in the field of semiconductor materials, high-performance photoresists, metal target materials, coating agents, and specialty reactive gases used in IC production processes, as well as wire bonding, molding, and filling materials used in IC packaging, are all imported. IC companies are hoping international vendors can produce those materials in Taiwan instead to reduce the supply risk. In addition, the 5nm and 7 nm IC production process recently began mass production in Taiwan as R&D for 2nm technology continues. Apple and Intel are expected to commence risk trial production by the end of 2024, and mass production is expected to commence in the second half or the end of 2025.

Taiwan has high demand for high-level IC production and packaging materials and hopes to enhance cooperation with foreign vendors. Among front-end wafer process materials, items in strong demand include metal sputtering deposition materials (target materials, parts/accessories), EUV photoresists, cleaning chemicals, and CMP slurry. As for back-end packaging and testing process materials, there is demand for high-end solid-state/liquid-state molding compounds, IC substrate materials with a low thermal expansion rate and a high heat dissipation rate, high-definition/low-stress buildup materials, die attach materials, flip chip underfill, and solder resist ink.

In terms of semiconductor equipment, the industry has benefitted from growth in the demand of semiconductor front-end-of-line processes including wafer manufacturing, wafer plants facilities, and mask equipment, as well as rear-end-of-the-line assembly, packaging, and testing equipment. By 2021, Taiwan had the second highest equipment expenditures in the world, with sales amounting to US$24.94 billion, and is expected to return to the global lead in 2022.

Taiwanese vendors are capable of supplying equipment for conventional packaging processes and components for wafer production equipment and also has many leading global chip manufacturers. This makes Taiwan a great experimental site for the latest equipment, and Taiwan can update equipment suppliers on the latest changes in the semiconductor industry. The aim is to cooperate with international upstream equipment vendors on advanced packaging equipment and equipment for 12-inch wafer processes. Foreign vendors in the following areas are therefore invited to invest in Taiwan:

1. Front-end wafer production equipment:

Deposition technology, dry etching technology, DUV and EUC exposure technology, photoresistor coating and developing technology, chemical-mechanical polishing technology.

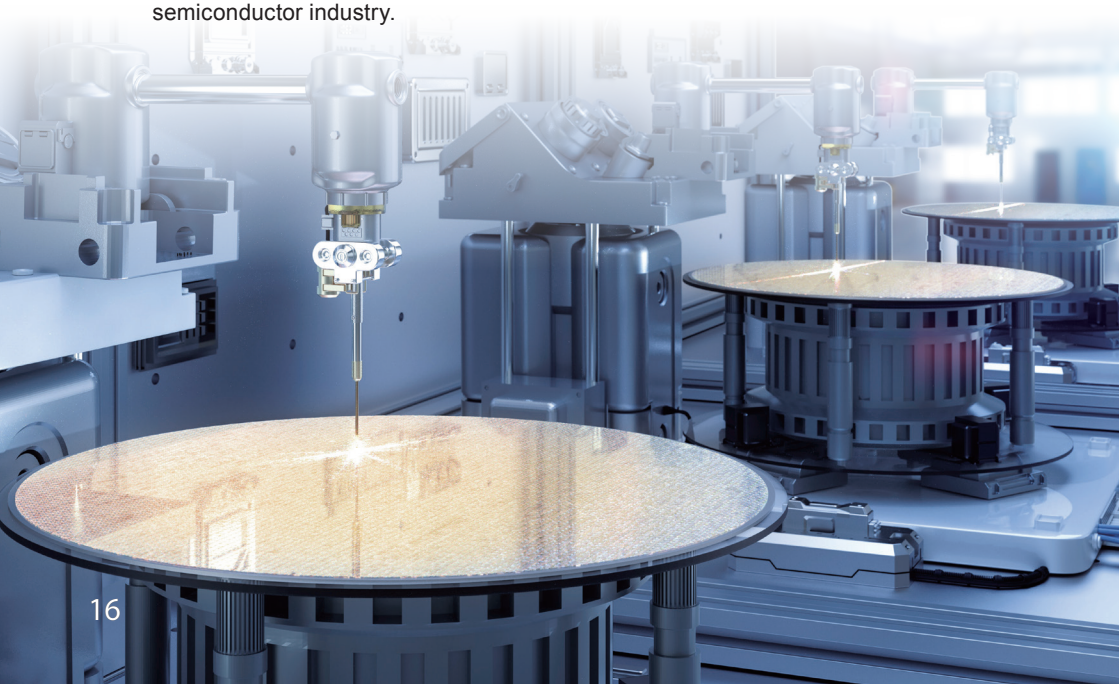
2. Advanced packaging process equipment:

Exposure technology, copper-plating technology, deposition technology, and dry etching technology.

3 Tap into the Fast-growing Asia Market, Establish Operations Centers with Different Functions

The global semiconductor industry is moving in the direction of regionally defined development, with specific foundries in different regions churning out specific types of wafers. At the same time, this trend is generating demand from manufacturers for after-sales service. Mainland China, Taiwan, and South Korea remain the top three countries for equipment expenditures in 2021. Beyond that, the production in the semiconductor industry is expected to take on a role of greater importance in Japan. Countries of Southeast Asia will continue to develop stronger packaging and testing capabilities.

In light of the trends described above, foreign firms can use Taiwan as a hub for servicing their Asia markets. They can set up equipment repair and refurbishment facilities in Taiwan, training facilities, experimental sites, and logistics centers for parts and modules. This approach is a good way for foreign firms to take advantage of opportunities afforded by the growth of the Asian semiconductor industry.



Investment Incentive Measures

1 | Tax Incentives |

The income tax rate for profit-seeking enterprises in Taiwan is 20%. To encourage foreign investments in Taiwan, support industrial innovation, and promote industry-academia collaboration, Taiwan offers the following preferential taxes to foreign companies (Table 1):

Table 1 Preferential Taxes

Item	Preferential Measures
Research, Development, or Introduction of Technology or Machinery Equipment	• Up to 15% of the company's R&D expenditures may be deducted from its profit-seeking enterprise income tax for current year; or up to 10% of such expenditures may be credited over three years against the profit-seeking enterprise income tax payable by the company. • Royalty payments to foreign companies for imported new production technologies or products that use patents, copyrights, or other special rights owned by foreign companies is, with the approval of the Industrial Development Bureau, MOEA, exempt from the corporate income tax. • Companies are exempt from import tariffs for any machinery equipment that local manufacturers cannot produce.

Item	Preferential Measures
Investment in Smart Machinery / 5G / Information Security	● Smart machinery: Use of big data, AI, and IoT in brand-new hardware, software, technology, or technical services for automatic schedules, flexible, or mixed-model production lines. ● 5G: Investments in new hardware, software, technology, or technical services that are related to 5G communication systems. ● Information security: Companies' investments and purchases of brand-new hardware, software, technology, or technical services for information and communication security products or services are included in the scope of investment offsetting. ● For investments between NT$1 million and NT$1 billion, companies can choose from either "5% of investment spending deducted from profit-seeking enterprise income tax (current FY)" or "3% of investment spending deducted from profit-seeking enterprise income tax, if the total spending spread is over three years" may be selected, but the total amount deducted may not exceed 30% of corporate income tax that year. ● Applicable until December 31st, 2024.
Employee Stock Compensation	● A company employee who has obtained stock compensation worth a combined total of less than NT$5 million and continuously held the stock while remaining in the company's employ for at least two years may choose to be taxed on the market price of the stock at either the time the stock was obtained or the time the stock is sold, whichever is lower.

Item	Preferential Measures
Special Foreign Professionals	• Special foreign professionals who meet certain criteria are eligible for a 50% deduction of total income tax for amounts exceeding NT$3 million.
Industry Park Locations	• Companies that set up operations in export processing zones, science industrial parks, or free trade ports are eligible for exemptions on import duties, commodity tax, and business tax for the import of machinery and equipment, ingredients, fuel, materials, and semi-finished products for their own use.
Others	• Companies that use undistributed earnings to engage in substantive investments may exclude the invested amount when calculating their profit-seeking enterprise income tax.

2 | Subsidies |

1. Global Innovation Partnership Initiatives Program

Foreign companies that complement Taiwan's industries are encouraged to invest Taiwan's R&D innovation and work with Taiwanese companies to jointly develop forward-looking technologies, key technologies, or integrated technologies beyond our current capacities. Such businesses could exert a key influence on Taiwanese industry by: (a) inspiring R&D work on industrial technologies as well as the establishment and development of supply chains; (b) improving R&D efficiency; (c) accelerating the timetable from R&D to production; and (d) contributing actively to the expansion of international markets. Foreign companies successful in endeavors relating to this program will be eligible, upon approval from the MOEA, for subsidies of up to 50% of total R&D expenditures.

2. Pioneers for Innovation Leadership on Technology Program

The program aims to transform Taiwan into a high-tech R&D center and encourage leading international manufacturers to establish cutting-edge R&D bases in Taiwan, empowering their work in forward-looking technologies in Taiwan and connecting with Taiwan's supply chain, thereby creating a division of labor in the areas of research, co-creation, and development, with an eye to strengthening the technological competitiveness of Taiwan's leading industries and accelerating the formation of clusters in emerging industries. Program funding of up to 50% of total expenditures may be granted for any project that has been approved by the Ministry of Economic Affairs.

3. Industrial Upgrading Innovation Platform Guidance Program

To guide industries in Taiwan to develop high-value products and encourage corporations to enter the high-end market to increase the industry's added value, the Industrial Development Bureau, Ministry of Economic Affairs, and the Ministry of Science and Technology are promoting the "Taiwan Industry Innovation Platform Program". The program provides companies that have R&D teams in Taiwan with funding of up to 40%-50% of the project budget for themed R&D projects and funding of up to 40% for projects independently conducted by corporations.

Leading Taiwanese Companies

1 | IC Design |

Four Taiwanese companies were ranked among the world's top ten largest IC design firms in 2021, including MediaTek, Novatek, Realtek, and Himax.

1. MediaTek Inc. (MediaTek)

MediaTek is the 4th largest IC design firm in the world and the world's 8th largest semiconductor firm. MediaTek continues to introduce products in new fields. In 2020, the company launched its Dimensity series of 5G chips. In 2021, it benefited from the increase in 5G penetration rate and shipments of Dimensity 9000 series, which increased revenue. Almost immediately after launching, MediaTek's Wi-Fi 6 solutions were migrated across platforms into high-end smartphones, high-end routers, Gigabit-capable passive optical networks (GPON), and high-end TV.

MediaTek has also embarked upon applications in new fields, and its products go into the production of many different notebook computers, as well as Chromebooks. In terms of new products, MediaTek is actively expanding in the United States, Europe, India, and other emerging markets, and is expected to commence mass production and product launches in the second half of 2022.

2. Novatek Microelectronics Corp. (Novatek)

Novatek Microelectronics is the second largest supplier of LCD drivers in the world and has long conducted R&D on image display and digital AV multimedia technologies. Novatek's main products, in addition to flat panel display controllers, are digital AV and multimedia single-chip solutions for mobile devices and consumer electronics. In response to the accelerated adoption of 5G networks and smartphones in global markets, Novatek gained a significant lead by launching 120Hz AMOLED driver ICs and FTDI 120Hz driver ICs. As for automotive touch and display driver integration (TDDI) solutions, the company

has successfully developed automotive TDDI chips that feature a high signal-to-noise ratio, low electromagnetic radiation, and EMI resistance. As AMOLED products entered brand company markets in 2021 and gradually replaced LCD as the mainstream product, Novatek will actively expand applications for mobile phone and tablet OLED products to power the next wave of growth.

3. Realtek Semiconductor Corp. (Realtek)

Realtek Semiconductor is one of the world's leading chip suppliers with an operating revenue that saw its global ranking rise to number eight among IC design firms in 2021. Realtek designs and develops IC products for wired and wireless communications networks, computer peripherals, consumer electronics, and multimedia applications. One of the company's competitive advantages derives from its advanced core technologies, and it is especially good at developing products with a high cost-benefit ratio that facilitate the production of high value-added systems integration solutions.

4. Himax Technologies (Himax)

Himax is an IC design company focused on image display processing technologies. It replaced Dialog, which was acquired, and became the 10th largest IC design company in the world in 2021. Himax's main products include display driver IC and serial controller IC, which are widely adopted in TV, computers, mobile phones, and other consumer electronics. Himax has a diverse range of other products including touch panel controllers, CMOS image sensors, and wafer-level optics. It also provides customized image processing IC solutions and licensing for semiconductor intellectual property. Himax's vehicle-mounted display IC currently has a global market share of over 40% and ranks first in the world.

2 | IC Manufacturing |

In the wafer foundry field, Taiwanese firms command a global market share of greater than 60%. TSMC single-handedly controls more than a 90% share of the global market for sub-10nm high-end processes. In 2021, four of the world's ten largest wafer foundries are based in Taiwan (TSMC, UMC, PSMC, and VIS).

1. Taiwan Semiconductor Manufacturing Co. (TSMC)

TSMC has had record-breaking operating revenues consecutively for the past 12 years. In 2020, sales of advanced process wafers (16nm or below) accounted for 58% of the company's total wafer sales. Using 281 different processes in all, TSMC manufactured 11,617 different products for 510 customers. TSMC has successfully ramped up cutting-edge 5nm (N5) processes for mass production, thus facilitating customer efforts to introduce innovations into their smartphones and high-performance computing (HPC) applications.

Moving forward, 3nm (N3) processes will replace N5 as the next full node process. TSMC's N3 process technology will offer the most advanced PPA and transistor technology. The development progress has met expectations, and TSMC will provide a comprehensive platform to support mobile communication and high-performance computing applications. Mass production is scheduled to start in the second half of 2022. In addition, the company has also introduced TSMC 3DFabric, which integrates today's rapidly growing 3DIC solutions to achieve performance improvements at reduced power and smaller footprint than conventional two-dimensional processes.

2. United Microelectronics Corp. (UMC)

UMC's advanced technology platforms, including 14FFC (14nm FinFET Compact), 22nm ultra-low power (22ULP), 22nm ultra-low leakage (22ULL), and 28nm High Performance Compact (28HPC+) process technologies, have already entered mass production. Other newly released processes include mmWave using 55nm, 40nm, and 28nm platforms to fulfill high-performance and low-power requirements for mobile devices, Internet of Things (IoT), 5G, automotive electronics, and industrial radar devices that use mmWave.

In response to the rise of AIoT, 5G, edge computing, and self-driving vehicle markets, UMC has actively prepared special processes to provide design companies with total solutions for chip development. In April 2022, UMC announced a partnership with Denso, Japan to create the first 12" wafer process for insulated-gate bipolar transistor (IGBT) in UMC's plant in Japan to create a new business model for special process chips in the automotive market.

3. Powerchip Semiconductor Manufacturing Corp. (PSMC)

PSMC's main products are manufactured using 28nm and more mature processes, and include IoT products as well as industrial and automotive electronics applications. PSMC is planning to use memory and 3D Interchip technologies to develop OEM manufacturing platforms for a wide range of high-

performance, low-power consumption, highly integrated products, and will also embark upon various new product lines, including ultra-low-power special memory applications, BSI image sensors, and GaN/SiGe power devices.

4. Vanguard International Semiconductor (VIS)

The world's leading-edge products are concentrated especially in such fields as power management, panel displays, automotive electronics, fingerprint recognition, IoT, and microelectromechanical systems (MEMS). Looking ahead to the age of IoT, VIS continues to invest resources in the development of embedded flash memory. The 0.18 micrometer process has been introduced to the production of general MCU and touch control IC products since 2017, whereas development of the 0.11 micrometer process continues.

3 | IC Packaging and Testing |

Taiwan is also a global heavyweight in the field of IC packaging and testing. Taiwan accounted for 5 of the world's 10 largest packaging and testing firms in 2021. Most notable among them are ASE, SPIL, and PTI.

1. Advanced Semiconductor Engineering (ASE)

ASE continues to lead the semiconductor industry with its cutting-edge IC packaging technologies to meet the requirements of high-performance electronics products. Services from front-end engineering testing, wafer probing, package design, substrate design and manufacturing, and finished product testing are fully integrated onto a single supply chain. ASE provides the very latest in advanced package processes, such as Cu wire bonding, wafer bumping, Cu pillar bump, flip chip, wafer level CSP, chip scale package (CSP), MEMS & sensor packaging, fan out, 2.5D/3D IC packaging, green packaging, and 300mm turnkey backend solutions.

2. Siliconware Precision Industries Co., Ltd. (SPIL)

SPIL focuses on IC packaging and testing services, including wafer bumping, wafter testing, IC packaging, IC testing, and direct delivery. In order to meet demand for packaging and testing many types of products, SPIL has a wide range of technologies and provides diverse packaging and testing services, including advanced leadframe and substrate packages.

3. Powertech Technology Inc. (PTI)

As a world leader in the field of IC packaging and testing, PTI provides such services as wafer bumping, wafer probing, IC packaging and testing, and burn-in, as well as packaging and worldwide shipments of finished products and solid-state hard drives. In the area of R&D, PTI has completed a test lab for Antenna in Package (AiP) and Radio Frequency (RF) to provide certification services for 5G products.

As for CMOS image sensors (CIS), PTI has high-quality through-silicon via (TSV) technology, which features a high technical barrier to market entry, and applies it to wafer-level chip-scale packaging of medical, surveillance, and automotive chips. In the area of fan-out panel level packaging (FOPLP), PTI works closely with customers on related product development and certification.

4 | Semiconductor Equipment |

1. Grand Process Technology Corporation (GPTC)

GPTC is Taiwan's leading brand in the semiconductor wet processing equipment industry. Founded in 1993, the company's metal etching equipment, metal plating equipment, and cleaning equipment for 8- and 12-inch single wafers are highly prized by major international high-tech manufacturers. GPTC's main products are wet processing equipment used for downstream packaging purposes. The company is currently developing 200mm to 300mm wet stations and single-wafer cleaning equipment. GPTC's wet processing equipment solutions are top of the line in Taiwan's semiconductor industry.

2. Skytech

Established in 2002, Sky-Tech started out as a maker of semiconductor equipment parts and components. In 2017, Sky-Tech designed its first complete semiconductor fabrication unit, the Nexda PVD. Then in 2019, working in collaboration with Taiwan Instrument Research Institute (TIRI), Sky-Tech designed a complete ALD process unit, the Atomila 300. It followed up in 2020 by developing a multi-dimension wafer bonder. In 2021, Sky-Tech overcame the bottleneck in the indigenous production of high-end semiconductor equipment and successfully developed Atomic Deposition Layer (ALD) equipment, which was verified and adopted by Epistar, the global leader in LED chips.

3. C Sun Manufacturing (C SUN)

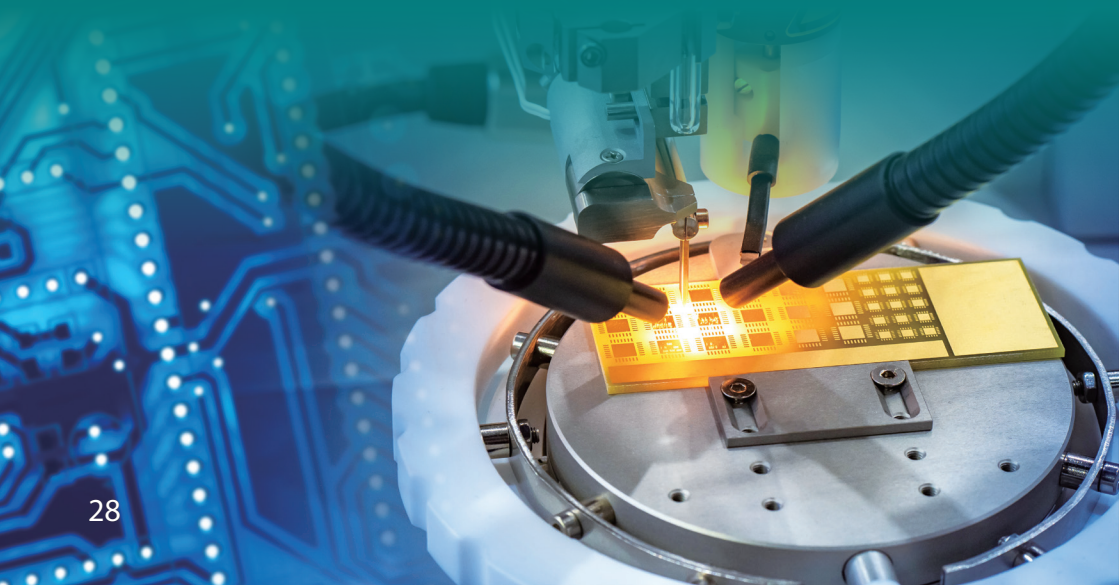
C Sun Manufacturing was founded in 1966 and has successfully developed business based on light and heat to research the following five core technologies: UV processes, thermal processes, lamination & coating, wet processes, and plasma processes. The company serves various industries, including firms involved in printed circuit boards, touch panels, semiconductors, electronics assembly, printing, coating, and shoe making. Meanwhile, C Sun's main semiconductor equipment are concentrated in the areas of thermal processes, ion cleaning, and molding.

Examples of Successes Achieved by Foreign Companies

The pandemic spurred a big increase in global demand for semiconductor products, and foreign firms in the semiconductor industry continued to increase investments in Taiwan. Investments in Taiwan by foreign firms fall into three categories:

1 Expansion of Capacity to Meet Market Demand

Entegris, a leading American maker of semiconductor materials, announced plans in December 2020 to invest US$200 million in a plant in Kaohsiung. It went on to announce in December 2021 that it will increase its investment in Taiwan to US$500 million in the next three years to set up brand-new plants with the most advanced technologies. The plant will produce gas



delivery systems, advanced materials, and other products and technologies for use in high-end semiconductor processes.

In late 2020, SUSS MicroTec, a German maker of lithography equipment, formally opened its first manufacturing center in Asia at the Hsinchu Science Park. The new facility will focus especially on the manufacture of photoresist coaters/developers, scanners, photomask process equipment, and other such high-precision lithographic process equipment. These new investments will ensure that Taiwan's semiconductor supply chains continue to grow stronger.

German company Merck Group announced in December 2021 that it will invest approximately NT$17 billion in Taiwan to expand its new production line for electronics technologies as Merck's first large-scale semiconductor production and application R&D Mega Site. The new facilities will incorporate Merck's comprehensive range of semiconductor solutions including film materials, special gases, and graphic and flat materials, and provide key materials for advanced semiconductor production processes.

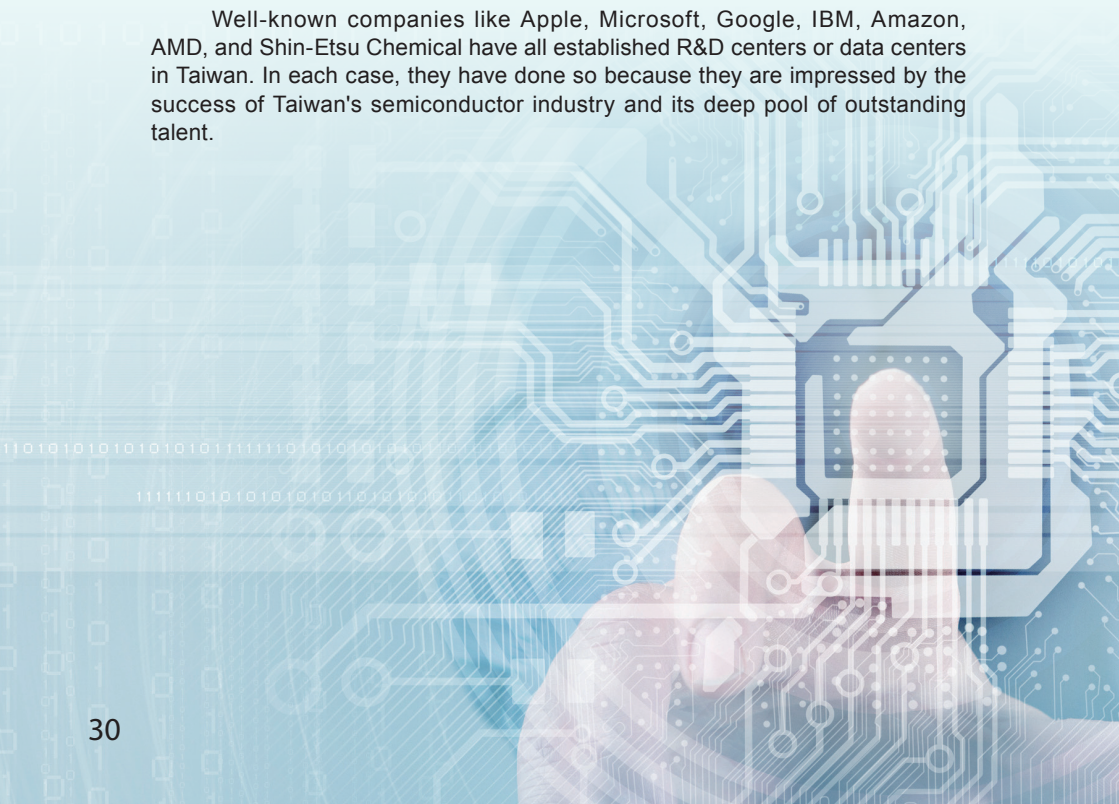
In light of the 5G communication, AI, and metaverse application fields that increased the demand for semiconductor chips in Taiwan, Japanese company ADEKA announced the construction of new machinery equipment and plants for high-end logic IC materials in February 2022. They are scheduled to commence operations in April 2024. ADEKA's plant in Taiwan is its second overseas production site after the construction of its plant in South Korea. It hopes to enter Taiwan's logic IC market with this investment and expand the scale of its semiconductor operations in Taiwan.

In addition, Diodes Technologies (a semiconductor design firm from Luxembourg), KIOXIA Corporation (a memory manufacturer headquartered in Japan), Mitsubishi Chemical (a leading chemicals manufacturer), Tokuyama Corporation (a major international maker of isopropyl alcohol), VALQUA (a Japanese maker of seal products), Sumitomo Bakelite (a Japanese company), and Air Liquide Far Eastern (ALFE, a French company) have all set up new factories in Taiwan to meet demand in the semiconductor market.

2 Establishment of R&D Center (Laboratory) / Development Platform in Taiwan

Applied Materials from the US expanded in Southern Taiwan Science Park with its second display equipment production center to meet customer demand. It set up a R&D laboratory with two clean rooms and one laboratory to support the display technology ecosystem in Taiwan. German semiconductor and electronic packaging material company Heraeus also announced at the end of 2021 that it will set up an innovation laboratory in Tai Yuen Hi-Tech Industrial Park, Zhubei. It will become its fifth global innovation center dedicated tot he development of electronic products to provide customer with collaborative R&D and innovation and better technical services.

Well-known companies like Apple, Microsoft, Google, IBM, Amazon, AMD, and Shin-Etsu Chemical have all established R&D centers or data centers in Taiwan. In each case, they have done so because they are impressed by the success of Taiwan's semiconductor industry and its deep pool of outstanding talent.



3 Operations Centers with Different Functions

Foreign firms have increasing numbers of customers and devices in Taiwan and neighboring Asian countries, which means they will set up equipment repair and refurbishment facilities, as well as training facilities and logistics centers for parts and modules in Taiwan. ASML, a world leader in lithography technology, has set up an EUV Training Center in the Southern Taiwan Science Park. ASML's first such facility anywhere in the world outside the Netherlands, this training center will help Taiwan to train EUV equipment specialists, and it will continue to expand its customer support team in Taiwan.

In addition, Applied Materials has established its newest global training center at the Hsinchu Science Park, the world-famous memory manufacturer, Micron Technology, has decided to establish its global Center of Excellence for DRAM in Taiwan. It also plans to expand investments to US$150 billion in the next 10 years to maintain its technical lead and capacity for large-scale manufacturing of DRAM. The investments in new processes will increase the future demand for equipment, materials, and clean rooms.

Also, in preparation for business opportunities likely to arise in connection with the high-end processes required for 5G and high-performance computing (HPC) applications, TRUMPF Laser, a world leader in the field of laser applications, is working with Taiwan's Industrial Technology Research Institute (ITRI) and the Taiwan Association of Machinery Industry (TAMI) to establish the Taiwan Semicon & Electronic Industries Laser Application Service Center. This new center will provide Taiwan's semiconductor equipment firms advanced technical services.

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