



Key Innovative Industries in Taiwan

# Semiconductor Industry



Information  
Security

Next-Generation  
Vehicle

Communications  
Industry

Internet  
of Things

**Semiconductor  
Industry**

Biopharmacy  
Industry

Smart  
Machinery

Circular  
Economy

Green  
Energy

Service  
Industry



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## Policy Initiatives —

# Semiconductor Industry Development Program

The semiconductor industry cluster in Taiwan plays a leading international role as it is ranked first in the world by market share in both the foundry industry and the packaging & testing industry. In the IC design industry, it is ranked second. 2022 will be a turning point for the Taiwan semiconductor industry as it is the year which next-generation Edge AI products based on 3nm technology begin to mass produce.

The current semiconductor policy of Taiwan calls for the development of smart chips in combination with artificial intelligence (AI) applications to establish the critical technologies needed by industry for smart system applications. The government has already prioritized "IC design and pioneering semiconductor technologies" in its technology policy. Taiwan's strengths in the semiconductor industry will continue to be leveraged in support of the 5+2 Industrial Innovation Plan.

The Ministry of Economic Affairs (MOEA) launched the "Chip Design and Semiconductor Technology Development and Application Plan" in 2018 based on the findings of the 2017 "Strategic Review Board Meeting for the Smart System and Chip Industry" conducted by the Executive Yuan. Under the plan, Taiwan will build an integrated industry chain for Internet-of-Things (IoT) and AI, including chips, sub-systems, and prototype products. An eco-system for IoT and AI industry innovation will be created to maintain and strengthen the advantages enjoyed by Taiwan's semiconductor industry. Key tasks planned for 2020 include the AI on Chip Program for Intelligent Devices, the 5G+ System and Application Advancement Project, Technology Development of PV Module Redesign for High-performance, Easy-disassembly, and High-Value Circulation Project, the Hybrid Operating Room System for Intelligent Hospitals, and the Development Project for Application of AI Systems to Intelligent Robots and Manufacturing. The projects will hopefully energize the development of industries related to wireless communications, artificial intelligence, smart manufacturing, smart medical devices, and the circular economy.



The Ministry of Science and Technology in 2017 also drew up an "AI Promotion Strategy" with a total budget of NT\$16 billion. The strategy encompasses the development of AI servers, establishment of an AI Research Center, establishment of an AI Robotics Hub, and a Semiconductor Moon Shot Project. The "AI Research Center" will be invested with NT\$5 billion over five years to encourage academic research in AI technologies and applications such as: chips, cloud computing systems, algorithms, deep learning, big data prediction and analysis, as well as smart applications for health, transport, finance, and manufacturing to build a pool of AI talent for Taiwan and an ecosystem for AI innovation. The "Semiconductor Moon Shot Project" will invest NT\$4 billion over four years to promote R&D into Edge AI production processes and chip systems targeted at the niche market for AIoT (AI + IoT) applications. The project will also join forces with the "5+2 Industrial Innovation Plan" to construct an eco-system for semiconductor industry innovation focusing on the development of pioneering semiconductor production processes and chip systems for Edge AI. The goal of the project is to slingshot Taiwan into the lead as a global hub and supplier of Edge AI talent and critical components by 2022.<sup>1</sup> Foreign companies can form partnerships with local universities through industry-academia cooperation programs on AI-related semiconductor production processes, chip designs, technology R&D or talent development in order to jointly take advantage of AI application business opportunities.

The central and local governments are also working to optimize the investment environment for businesses in terms of talent, manpower, water, electricity, and land. Every effort is being made to promote the development of the semiconductor industry and related emerging industries such as AI, big data, cloud computing, and autonomous vehicles.

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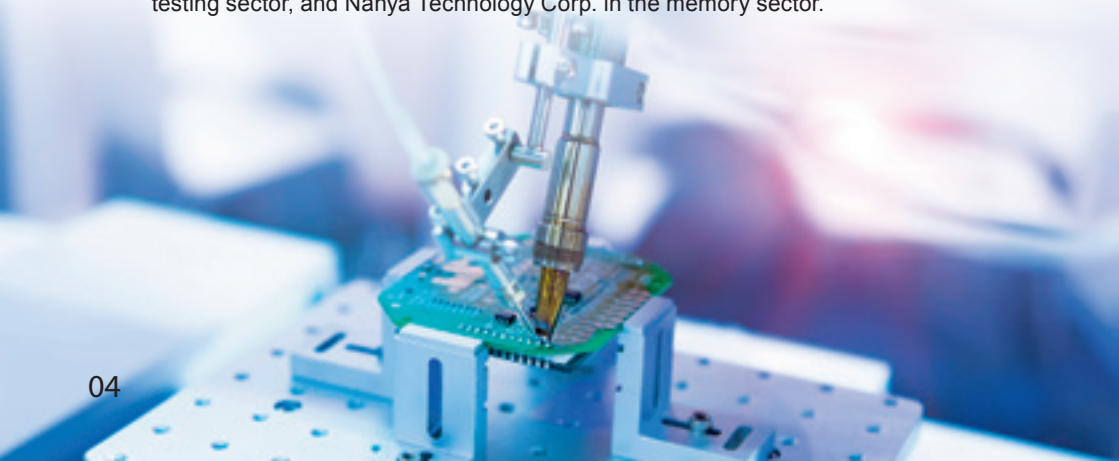
<sup>1</sup> AI Edge technologies include: Cognitive computing and AI chips, next-generation memory design, production processes and materials for critical sensor components, unmanned vehicles, AR/VR applications, IoT systems and security.

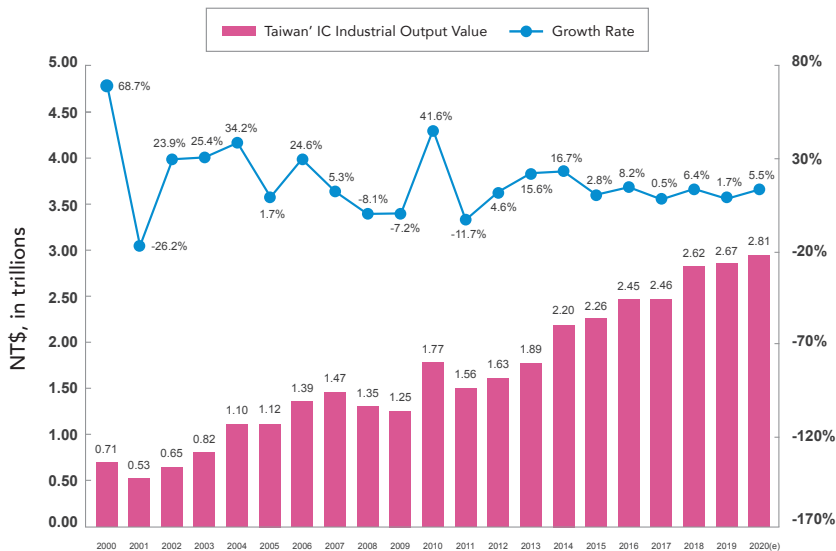
# Overview of Industrial Development

## 1 | Output Value |

The semiconductor industry is a key pillar of economic growth in Taiwan. It is one of Taiwan's most important industries in terms of "output value", "share of exports," and "investment amount." In 2019, Taiwan's semiconductor industry chain was worth NT\$2.67 trillion (US\$86.3 billion), making it the second largest in the world after the U.S.

The semiconductor industry in Taiwan is characterized by vertical integration and industry clustering. A unique production model gives Taiwan production advantages such as flexibility, quickness, customized service, and low costs. In terms of industry structure, the IC design industry accounts for 26%, the foundry industry accounts for 49%, the IC packaging & testing industry accounts for 19%, and the memory industry accounts for 6%. In terms of global market share, the foundry sector has been the most outstanding performer with a global market share of over 70%. Taiwan Semiconductor Manufacturing Company (TSMC) is Taiwan's best-known manufacturer and the undisputed world leader in the foundry sector with more than half of the global market share in 2019. Other key companies include MediaTek in the IC design sector, Advanced Semiconductor Engineering, Inc. (ASE) in the IC packaging and testing sector, and Nanya Technology Corp. in the memory sector.





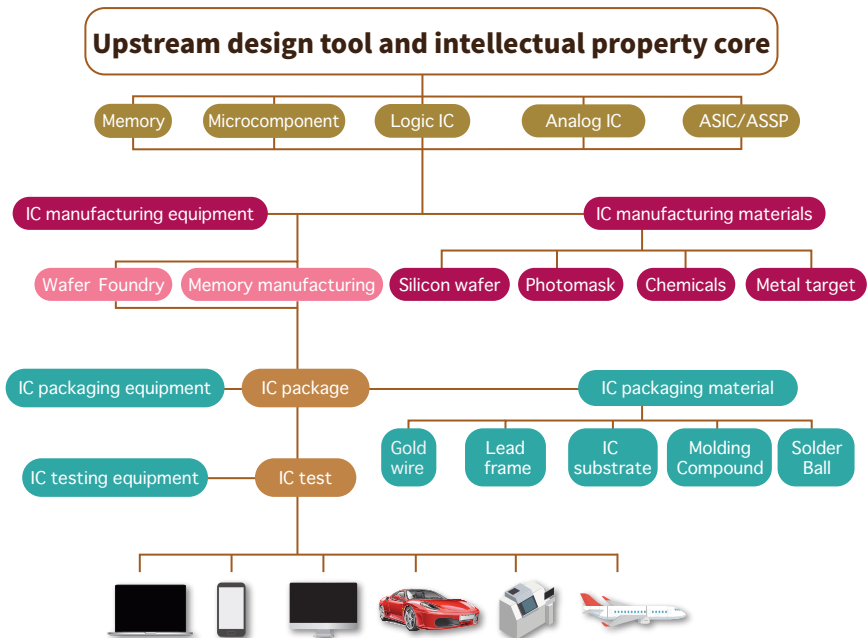
Source: Industry, Science and Technology International Strategy Center, ITRI (May 2020).

**Figure 1 Output Value of Taiwan's Semiconductor Industry, 2000-2020**

Several factors will influence the future development of the semiconductor industry. COVID-19 has dealt a heavy blow to the global economy, while the US-China trade conflict has caused a slowdown in global economic and trade activity. As a result, the pace of growth in the global semiconductor industry has slowed. Taiwan is also facing increased competition due to China's all-out effort to develop new semiconductor industry technologies of its own, such as AI, robotics, 5G, IoT, and the Internet-of-Vehicles, and smart applications. The pandemic also stimulated demand for working from home, tele-education, and servers. This has boosted shipments of epidemic prevention-related chips such as micro-controllers, temperature sensors, and ventilator chips. Market demand for semiconductor products is expected to post strong growth. Therefore, the output value of Taiwan's semiconductor industry is forecast to increase by 5.5% and reach NT\$2.81 trillion in 2020 (see Fig. 1).

## 2 | Industrial Clusters |

Taiwan is home to the most complete semiconductor industry clusters and specializations in the world. Once an IC design house completes a product design, it can be passed to a foundry or IDM (an Integrated Device Manufacturer provides everything from IC design, manufacturing, packaging, testing, to final sale) to be produced into semi-finished wafers. After front-end testing, dicing, and packaging are carried out by a packaging company, a testing company then performs the back-end testing. Final products that pass testing are supplied to system vendors through sales channels to be assembled into system products (see Fig. 2).



Source: 2019 Semiconductor Industry Yearbook, Department of Industrial Technology, Ministry of Economic Affairs

Figure 2 The overall structure of Taiwan's semiconductor industry



Records indicate that there are currently 290 semiconductor companies operating in Taiwan, and they employ nearly 230,000 people. Most of these companies are concentrated in the Hsinchu Science Park and Taoyuan. In order to spread the risk from natural disasters such as earthquakes, new production capacity has been built in science parks in central and southern Taiwan, while packaging and testing companies are mainly concentrated in Kaohsiung (see Fig. 3).

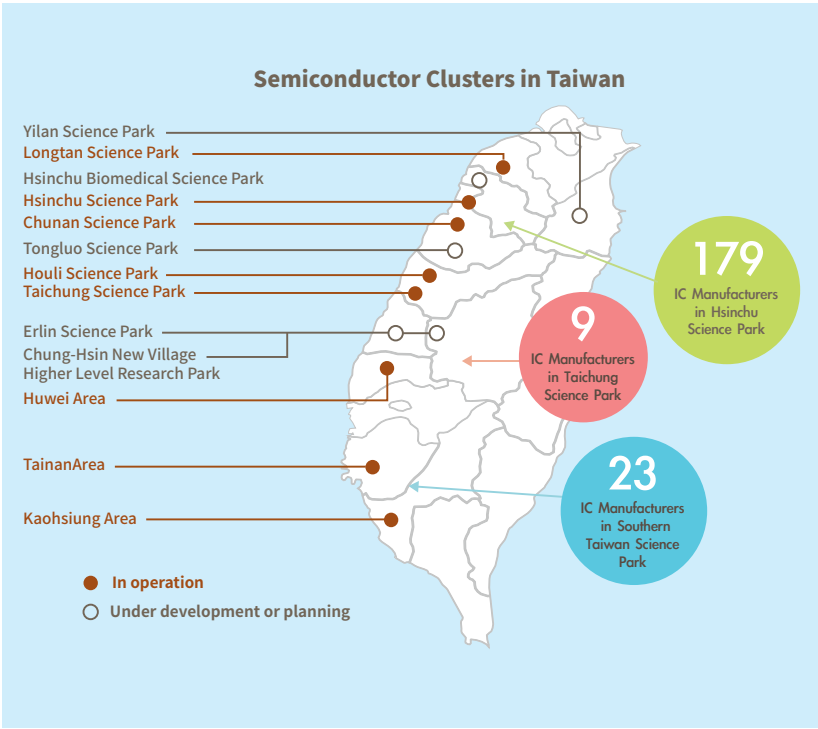


Figure 3 Semiconductor industry clusters in Taiwan



# Potential Investment and Collaboration Opportunities in Taiwan

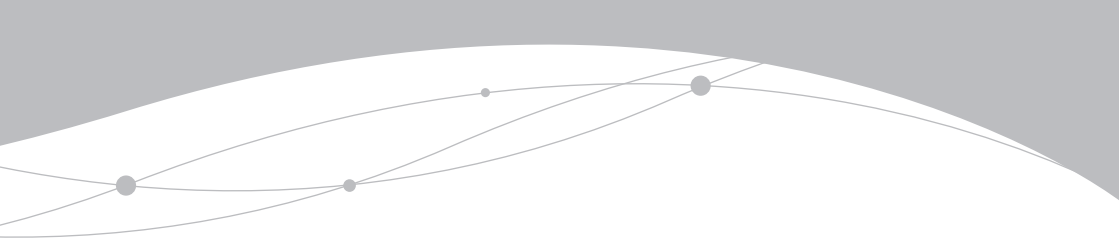
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## Joining the core cluster of the global semiconductor industry

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. The semiconductor industry is also regarded by the government as a cornerstone of Taiwan's industrial development. Every effort will be made to support the development requirements of the semiconductor industry, including the provision of related incentives.

In terms of human resources, more than 10,000 people graduate from IT-related faculties in Taiwan and join the workforce every year. OECD data shows that Taiwanese students are ranked 4th in the world in science education. The "Taiwan AI Academy" was also established in 2017 to cultivate talent for the AI industry to ensure that "inability to find the right people" will no longer be a factor that hinders the development of AI technologies. 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.

The "AI on Chip Taiwan Alliance" (AITA) formed in July 2019 is composed of local and foreign semiconductor and ICT vendors, local universities, as well as national research institutions such as the ITRI. Four "key technology committees" were also established within AITA on the four topics of "AI system applications," "heterogeneous integration," "emerging architectures," and "AI system software." The alliance will be building on Taiwan's existing advantages by helping the industry reduce its R&D costs for AI chips by 90% and shorten their development time by over 6 months.



It is hoped that foreign companies can form technical partnerships with Taiwanese businesses to accelerate the development and application of semiconductor industries, and work together to build a new future for Taiwan's semiconductor industry.

## 2

### Exploring the growing market for semiconductor equipment and materials

Due to its large number of foundries and packaging plants, Taiwan has been the largest consumer of semiconductor materials in the world for 10 consecutive years. Total market value reached US\$11.3 billion in 2019, which put Taiwan ahead of Korea and 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.

Specific business opportunities in semiconductor materials: The 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 by Taiwan are currently all imported from overseas. IC companies are hoping international vendors can produce those materials in Taiwan instead to reduce the supply risk. In addition, 5nm and 7nm IC production processes have now entered mass production in Taiwan while a 3nm process is now under active development, as well. Greater cooperation with foreign vendors on high-performance IC production and packaging materials is therefore desired.

In terms of investment in semiconductor equipment, Taiwan will remain the world's largest market due to investments by semiconductor vendors such as TSMC, Winbond, and Micron. Total financing demand is expected to exceed US\$15 billion. Taiwanese vendors are now capable of supplying equipment for conventional packaging processes and components for some wafer production equipment. Nevertheless, they hope to cooperate with international upstream equipment vendors on advanced packaging equipment and equipment for 12" wafer processes and work together in the future. Foreign vendors in the following areas are therefore welcome 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, dry etching technology.

3

### Seizing the business opportunities of new technologies and products

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 and their future growth potential is considerable. Foreign companies can use investments and partnerships in Taiwan to develop emerging business opportunities from new technologies and products.

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### Tapping into the fast-growing Asia market

Taiwan's advanced semiconductor production technology, as well as its unique vertically integrated industrial structure, offer more than just a complete industry chain that runs from upstream IC design to downstream packaging & testing. It is also a home for world-leading enterprises which can provide foreign companies with high quality service and manufacturing capacity. Taiwan is also located in the heart of the fast-growing Asia market, making it the perfect place to explore regional business opportunities.




# Investment Incentive Measures

## 1 | Tax incentives |

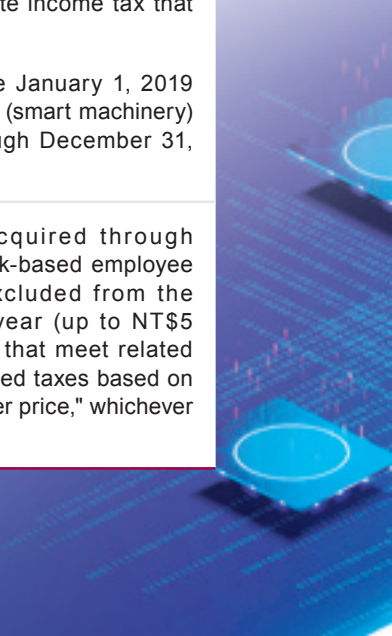
Taiwan's profit-seeking enterprise income tax rate is 20%. To encourage foreign companies to invest in Taiwan, support industrial innovation, and promote industry-academia collaboration, foreign companies are eligible for the following preferential taxes (Table 1):

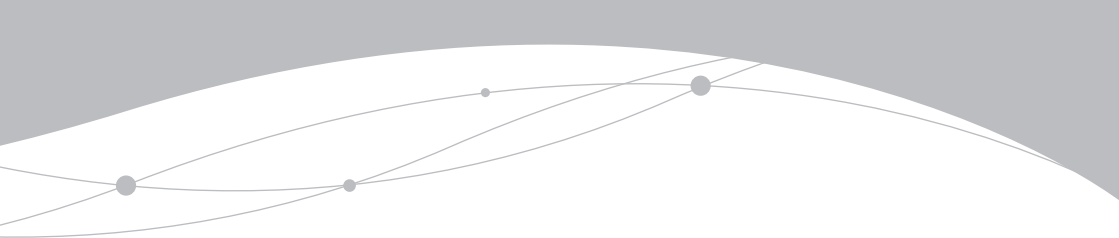
**Table 1 Preferential taxes**

Item	Incentives
R&D and introduction of technology or mechanical equipment	<ul style="list-style-type: none"><li>• Up to 15% of the company's R&amp;D expenditures may be deducted from its profit-seeking enterprise income tax for current year.</li><li>• 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.</li><li>• Imported machinery which local manufacturers cannot produce are eligible for duty-free treatment.</li></ul>

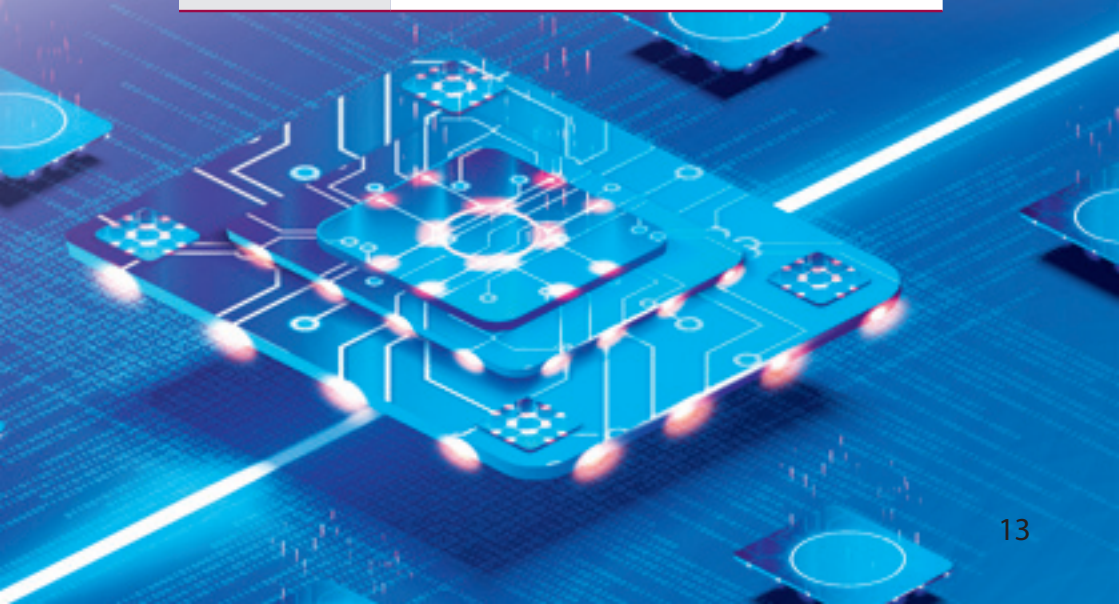


Item	Incentives
Investment in smart machinery / 5G	<ul style="list-style-type: none"> <li>● Smart machinery: Automatically scheduled, flexible, or mixed-model production lines that utilize big data, AI, and IoT.</li> <li>● 5G: Related investment projects include 5G communication systems, and new hardware, software, technology, or technical services.</li> <li>● For investments of no less than NT\$1 million and no more than NT\$1 billion, 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 total spending spread over three years" may be selected, but the total amount deducted may not exceed 30% of corporate income tax that year.</li> <li>● The applicable periods are January 1, 2019 through December 31, 2021 (smart machinery) and January 1, 2019 through December 31, 2022 (5G).</li> </ul>
Technology investment / Stock-based employee compensation	<ul style="list-style-type: none"> <li>● The worth of shares acquired through technology investment/stock-based employee compensation can be excluded from the taxable income for that year (up to NT\$5 million). In addition, those that meet related criteria are eligible for reduced taxes based on "acquisition price" or "transfer price," whichever is lower.</li> </ul>





Item	Incentives
Foreign Special Professionals	<ul style="list-style-type: none"> <li>Foreign special professionals who meet criteria are eligible for a 50% deduction of total income tax for amounts exceeding NT\$3 million.</li> </ul>
Setting up operations in industry parks	<ul style="list-style-type: none"> <li>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.</li> </ul>
Others	<ul style="list-style-type: none"> <li>Companies that use undistributed earnings to engage in substantive investments may exclude the amount when calculating their profit-seeking enterprise income tax.</li> </ul>



## 2 | Subsidies |

### 1.The Global R&D Innovation Partner Program

Some foreign companies have a high degree of complementarity with Taiwan's industries. To encourage them to engage in R&D and innovation activities in Taiwan, such companies, after gaining approval from the MOEA, will be eligible for subsidies of up to 50% of total R&D expenditures if they: (1) have technologies that are not yet mature in Taiwan or overseas, and could create strategic products, services, or industries over the course of future industrial development; (2) have potential to help Taiwan produce leading technologies or significantly enhance the competitiveness and increase the added value of important industries; or (3) engage in key and common technology R&D, vertical or horizontal technology integration, and can create an industrial value chain.

### 2.Integrated R&D Program

Companies, once approved by the MOEA, will be eligible for subsidies of no less than 40% but no more than 50% of total project funding if they: (1) engage in key and common technology R&D, vertical or horizontal technology integration, and can create an industrial value chain; (2) establish industry standards, protocols, or platforms; or (3) establish applications, services, and innovative business and marketing models with technological content, and increase industry's added value.

### 3.Taiwan Industry Innovation Platform Program

The MOEA Industrial Development Bureau and the Ministry of Science and Technology are jointly implementing the "Taiwan Industry Innovation Platform Program" to guide industries to develop towards greater value, and to encourage companies to enter high-end product application markets to increase industry's overall added value. For companies owning R&D teams in Taiwan, the program provides 40-50% of the funding required for theme-based R&D projects, and up to 40% of funding for R&D projects proposed by the companies themselves.





# Successful Examples of Foreign Companies

External environmental factors have slowed the growth of the global semiconductor industry slightly over the last two years, but foreign investment in Taiwan's semiconductor industry is still continuing to increase. On the semiconductor equipment side, ASML from the Netherlands, as well as Applied Materials and Lam Research from the U.S., have all set up R&D centers or training headquarters in Taiwan. On the electronic materials side, Merck from Germany, Shin-Etsu Chemical and Tokyo Ohka Kogyo from Japan, as well as Dow Chemical and Cabot Microelectronics from the U.S., have all built new plants or expanded their operations in Taiwan. Key vendors such as Micron and Qualcomm have all continued to increase their investments in Taiwan, as well. Micron will expand its Center of Excellence for DRAM in Taiwan to make Taiwan the only Micron production site with vertically integrated DRAM manufacturing, packaging, and testing. Qualcomm will also establish the "Center for Operations, Manufacturing, Engineering and Testing in Taiwan (COMET)" in Hsinchu Science Park to serve as the hub of its Qualcomm Technologies subsidiary. COMET will be responsible for overseas operations such as supply chain, engineering, and business development, with an emphasis on stimulating the development of Taiwan's semiconductor industry and the 5G mobile ecosystem.

Lam Research is planning to invest in semiconductor equipment refurbishing and new equipment production lines in Taiwan as well, a move that will expand their operations several-fold. On the software side, Synopsys has invested more than NT\$14.4 billion in Taiwan to date including research into sub-micron EDA technology and EDA for advanced processes. In July 2019, Synopsys also joined the Advanced Semiconductor Design Automation and AI Chip R&D Partnership Program and expects to invest a further NT\$800 million over the next 2 years. Other well-known enterprises including Apple, Microsoft, Google, IBM, Amazon, and AMD have all set up research centers, data centers, or expanded their facilities in Taiwan based on Taiwan's success in the semiconductor industry and its pool of talent.



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