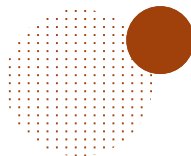





TAIWAN



# Semiconductor 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 in both the foundry and packaging & testing industries by market share; the IC design industry is also ranked second in the world. 2022 will be a turning point for the Taiwan semiconductor industry as it is the year that next-generation AI Edge products based on the 3 nm process will begin to be mass produced for the industry,

The current semiconductor policy of Taiwan calls for the development of smart IC and artificial intelligence (AI) applications that will together establish the critical technologies needed by the 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, from chips, sub-systems and prototype products. An eco-system for IoT and AI industry innovation will be created to maintain and strengthen the advantage enjoyed by Taiwan's semiconductor industry.



The Ministry of Science and Technology drew up the "AI Promotion Strategy" with a total budget of up to NT\$16 billion in 2017 as well. The strategy encompasses the development of AI servers, establishment of the AI Research Center, establishment of the AI Robotics Hub, and the Semiconductor Moon Shot Project. The "AI Research Center" will be budgeted 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 eco-system for AI innovation. The "Semiconductor Moon Shot Project" plans to invest NT\$4 billion over four years to promote R&D into AI Edge production processes and chip systems targeted at the niche market for AIoT (AI + IoT) applications. The project will also draw on 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 AI Edge. The goal of the project is to slingshot Taiwan into the lead as a global hub and supplier of AI edge 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 take advantage of business opportunities from AI applications together.

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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1 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.

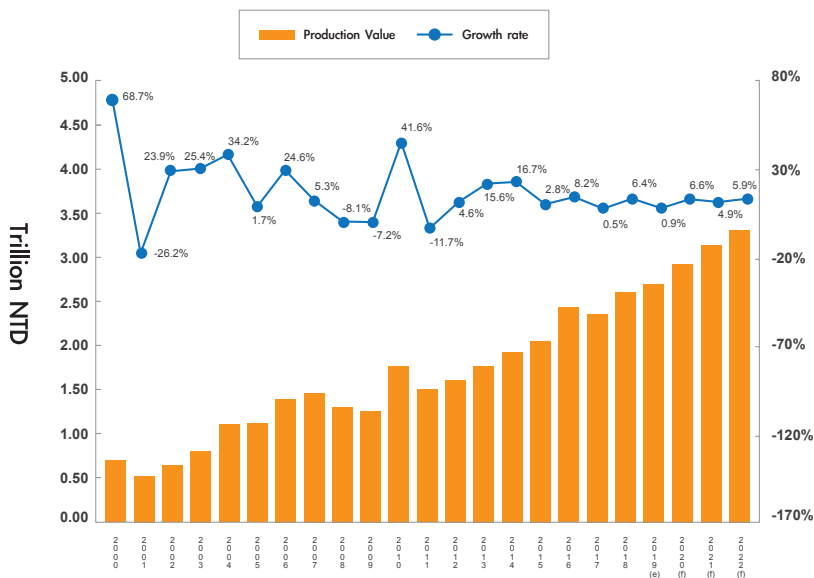


# Overview of Industrial Development

## 1 | Production 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 "industry output", "export ratio" and "investment amount." In 2018, the Taiwan semiconductor industry chain was worth NT\$2.62 trillion (US\$86.8 billion), making it the third largest in the world after the U.S. and Korea.

The semiconductor industry in Taiwan is characterized by vertical specialization and industry clustering. A unique production model is also the reason for Taiwan's advantages such as agility, speed, customized service and low cost. In terms of industry structure, the IC design industry accounts for 24%, the foundry industry accounts for 49%, the IC packaging & testing industry accounts for 19% while the memory industry accounts for 8%. In terms of global market share, the foundry sector is ranked 1st in the world with a value of US\$59.2 billion and a global market share of 72.2%. Taiwan Semiconductor Manufacturing Company (TSMC) is Taiwan's most representative manufacturer and the undisputed world leader in the foundry sector with more than half of the global market share. 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.



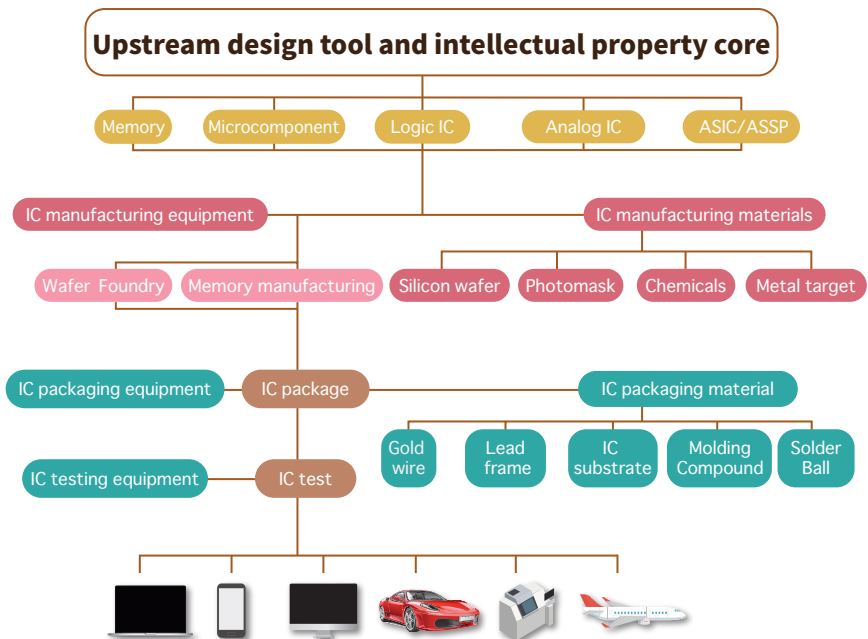
Source: Industry, Science and Technology International Strategy Center, ITRI (Feb 2019).

Figure 1 Production value of Taiwan semiconductor industry between 2000 and 2022

Factors that influence the future development of the semiconductor industry include the slowdown in the global semiconductor industry due to weak growth from smart phones and the US-China trade war in the short-term, as well as increased competition from China's all-out efforts to develop its own semiconductor industry. The development of new technologies such as AI, robots, and IoT as well as the diversity of their product applications nevertheless suggest that market demand for semiconductor products will continue to grow at a high rate. The production value of Taiwan's semiconductor industry is therefore forecast to reach NT\$2.64 trillion in 2019 (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 (Integrated Device Manufacturer for 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: 2018 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 292 semiconductor companies operating in Taiwan and up to 230,000 people are employed in the industry. Most of these companies are concentrated in the Hsinchu Science Park and Taoyuan. To spread the risk from natural disasters such as earthquakes however, new production capacity has been built in the Central Taiwan and Southern Taiwan science parks, while packaging and testing companies are mainly concentrated in Kaohsiung (see Fig. 3).<sup>2</sup>

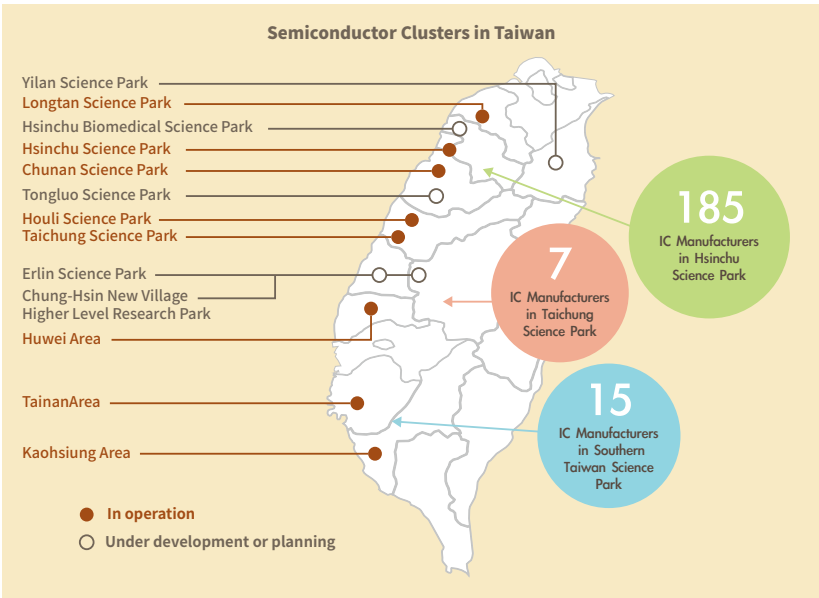


Figure 3 The semiconductor industry clusters in Taiwan

2 Based on the MOEA statement titled "The Semiconductor Industry of 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. The semiconductor industry is also considered a cornerstone of industry development by the government. Every effort will be made to support the development requirements of the semiconductor industry, including the provision of related incentives. 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 of semiconductor equipment and materials

Due to the large number of foundries and packaging plants, 2018 marked the ninth year in a row that Taiwan has been the largest consumer of semiconductor materials in the world with a total value of up to US\$11.4 billion. As the output value of Taiwan's IC industry continues to grow, the demand for new materials and equipment will continue to grow as well.

Specific business opportunities in semiconductor materials: The high-level photo-resist, 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 that international vendors can produce them in Taiwan instead to reduce the supply risk for associated materials. In addition, the 7 nm IC production process recently entered mass production in Taiwan. Greater cooperation with foreign vendors on the high-level IC production and packaging materials needed by the process is therefore desired as well.

In terms of semiconductor equipment investment, a weak overall outlook for the semiconductor industry in 2019 means that Semiconductor Equipment and Materials International (SEMI) only expects growth in three regions, namely Taiwan, Japan and North America. In 2018, total sales in Taiwan were estimated US\$10.1 billion, and this is expected to grow to US\$11.8 billion in 2019. Specific demands in semiconductor equipment: Taiwanese vendors can now supply components and packaging equipment for 6" ~ 8" wafer processes. Nevertheless, they hope to cooperate with upstream vendors in components and advanced packaging equipment for 12" wafer processes so that everyone can grow together. Foreign investment is therefore welcome for: (1) Front-end process equipment: Coating deposition control technology, etch rate consistency control, exposure DUV and EUV laser source technology; (2) Advanced packaging process equipment: Photo-resist application technology, copper electro-plating technology, laser trimming technology.





3

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

IoT, AI, 5G, industrial and service robotics, smart city, smart lifestyle product, automotive electronics and high-speed computing applications all require the support of the semiconductor industry and their future growth potential is very high. Foreign companies can use investments and partnerships in Taiwan to develop emerging business opportunities from new technologies and products.

4

### **Tapping into the fast- growing Asia market**

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

# Investment Incentives

## 1 | Tax incentives |

The corporate income tax rate of Taiwan 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

Encouraged operational activities	Incentives
Establishing operational, R&D, or manufacturing sites in Taiwan	<ul style="list-style-type: none"><li>• Up to 15% of the company's R&amp;D expenditures may be deducted from its corporate income tax that year.</li><li>• Imported machinery that local-manufacturers cannot produce is eligible for duty-free treatment.</li><li>• Royalties paid to foreign companies for new production technologies or products imported from overseas that have patent rights, trademarks, or various concessions are exempted from income tax after gaining approval from the Industrial Development Bureau, MOEA.</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></ul>

Encouraged operational activities	Incentives
Investment in smart machinery/5G	<ul style="list-style-type: none"> <li>• Smart machinery: Automatic, flexible, or mixed-model production that utilizes big data, AI, and IoT.</li> <li>• 5G: Related investment projects include 5G communication systems, 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 corporate income tax (current FY)” or “3% of investment spending deducted from corporate 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 period is from January 1, 2019 to December 31,2021 (smart machinery)/January 1,2019 to December 31,2022 (5G).</li> </ul>
Promoting industrial innovation and industry-academia collaboration	<ul style="list-style-type: none"> <li>• Individuals and creators who receive shares via technology investment, hold the shares for 2 years, and meet conditions for serving in Taiwan may choose to pay taxes based on the price of shares when they were acquired or transferred, whichever is lower.</li> <li>• Limited partnership venture capital that makes a larger lump sum investment may be taxed using the transparent entity concept.</li> <li>• Parent company employees that obtain shares of subsidiaries and vice versa are also eligible to be taxed based on the lower share price.</li> <li>• Companies or limited partnerships that use undistributed earnings to make real investments may deduct it from their undistributed earnings.</li> </ul>
Moving into industrial parks	<ul style="list-style-type: none"> <li>• Companies that move into export processing zones, science-based industrial parks, and free trade zones are exempted from import tariffs on machinery and equipment, raw materials, fuel, supplies, and semi-finished products.</li> <li>• The business tax rate is zero for exporters of goods and labor services.</li> </ul>



## 2 | Subsidies |

### 1. Global Innovation Partnership Initiatives

To encourage foreign companies that complement and mutually benefit Taiwan's industries to engage in R&D and innovation activities in Taiwan, those that: (1) have technologies not yet mature in Taiwan and overseas and will produce strategic products, services, or industries in future industrial development; (2) have potential to let 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; will be eligible for subsidies of up to 5% of total R&D expenditures after gaining approval from the MOEA.

### 2. Integrated R&D Program

Companies that (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 the industry's added value; will be eligible for subsidies of no less than 40% but no more than 50% of total project funding after gaining approval from the MOEA.

### 3. Industrial Upgrade & Innovation Platform Program

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



## 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. 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 electronic materials side, Shin-Etsu Chemical and Tokyo Ohka Kogo 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.

Software-wise, Synopsys is planning to establish an R&D center in Taiwan that will provide vendors with a rapid development and a validation platform for AI chip design. The R&D center will also assist TSMC with accomplishing its advanced process goals. Qualcomm Inc. will establish the “Center for Operations, Manufacturing, Engineering and Testing in Taiwan (COMET)” to serve as the hub of its Qualcomm Technologies’ subsidiaries. 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 eco-system. Micron will expand its Center of Excellence for DRAM in Taiwan to continue upgrading the production technology of its foundry in Taiwan. Fully automated back-end packaging and testing technology will also be introduced to make Taiwan the only Micron production site in the world capable of providing vertical integration of production, packaging and testing.





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