

Prospects of Semiconductor Industry in Indonesia: Technology and Foreign Investment

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Introduction

Semiconductor industry is a crucial component of modern technology, driving the development of everything from computers and smartphones to electric vehicles and medical equipment.¹ Semiconductors are essentially tiny electronic components that allow the flow of electricity to be controlled and manipulated in very precise ways, making them essential for the functioning of many electronic devices.² The industry is therefore a significant contributor to global economic growth and has become an important part of the industrial landscape in many countries.³

Began in 2020 and continues into 2023, the global chip shortage has highlighted the critical importance of semiconductors in modern technology.⁴ The shortage is a result of a number of factors, including increased demand for electronic devices during the COVID-19 pandemic, disruptions to supply chains due to the pandemic, and the concentration of semiconductor production in a few key countries. The shortage has had significant impacts on a wide range of industries, including automotive, consumer electronics, and medical equipment. Many companies have been forced to cut back production or delay the release of new products due to a lack of available semiconductors, including Indonesian manufacturers that rely on semiconductors for their products, have also been hit hard by the chip shortage. Car and motorcycle manufacturers have been forced to cut production or even halt production temporarily due to a lack of available chips.⁵ This has resulted in a decline in sales and revenue for these companies.

In response to the chip shortage, Indonesian manufacturers are looking for alternative suppliers, diversifying their supply chains, and reducing their dependence on a single supplier. Some are also exploring the possibility of manufacturing their own chips or investing in chip-making facilities to become more self-sufficient. Indonesian Government also concerns regarding this issue and has taken significant steps necessary to establish important industry that support the roadmap of “Making Indonesia 4.0” which also focuses on (i) reducing the import of electronic components, (ii) developing electronic component industry within the country, and (iii) increasing the skilled workers as well as R&D.⁶ By 2025 and 2030, the Government aims to reach ASEAN top 3 manufacturer for smartphone, IoT (Internet of Things) components, and having established semiconductor manufacturing (foundry), respectively. In this article, the technology and prospects of the semiconductor industry in Indonesia as well as the factors that are driving its growth are explored.

Semiconductor Technology and Global Outlook

Semiconductor technology refers to the manufacturing and use of semiconductor materials and devices, which are widely used in electronics and computing. Semiconductors are materials that have electrical conductivity between that of a conductor and an insulator. They are used to create electronic components such as transistors, diodes, and integrated circuits. Semiconductor manufacturing is a complex process that involves a series of steps to create the desired semiconductor device. The process starts with the creation of a silicon wafer, which is then processed to create the individual devices. The manufacturing process includes steps such as cleaning, deposition, lithography, etching, and doping.

The cleaning process involves removing any impurities from the surface of the silicon wafer. Deposition involves adding various materials onto the surface of the wafer, while lithography involves creating a pattern on the surface of the wafer using light. Etching is the process of removing material from the surface of the wafer, and doping involves introducing impurities into the silicon to create specific electronic properties. Semiconductor technology and process are crucial for the creation of electronic components and devices that power our modern world. Advances in semiconductor technology have led to the development of faster and more efficient electronic devices that have revolutionized industries such as computing, telecommunications, and transportation.

The global semiconductor industry outlook is expected to remain positive in the coming years.⁷ The demand for semiconductors is growing across a range of sectors, including consumer electronics, automotive, and industrial automation. This growth is driven by the increasing adoption of connected devices, the Internet of Things (IoT), artificial intelligence (AI), and other emerging technologies. In terms of regional outlook, Asia-Pacific is the largest market for semiconductors, accounting for more than 50% of global semiconductor sales.⁸ China is the world's largest consumer of semiconductors, and the country is also investing heavily in the development of its domestic semiconductor industry. North America and Europe are also significant markets for semiconductors, with a strong presence of leading semiconductor companies. The semiconductor industry is expected to continue to grow in the coming years, driven by technological advancements and increasing demand for semiconductors in various sectors. However, supply chain challenges and geopolitical tensions could pose potential risks to the industry's growth in the short term.

Indonesia's Semiconductor Industry and R&D

In 2020, Indonesia semiconductor exports reached \$8.38 billion, up from \$7.34 billion in 2019. While these figures are still relatively small compared to global semiconductor exports, they indicate that Indonesia's semiconductor industry is on an upward trajectory. The Indonesia semiconductor industry revenue also increased year by year and it is predicted to grow in the coming years (Figure 1).⁹ More recently, Indonesia has been actively investing in the development of its semiconductor industry in recent years.

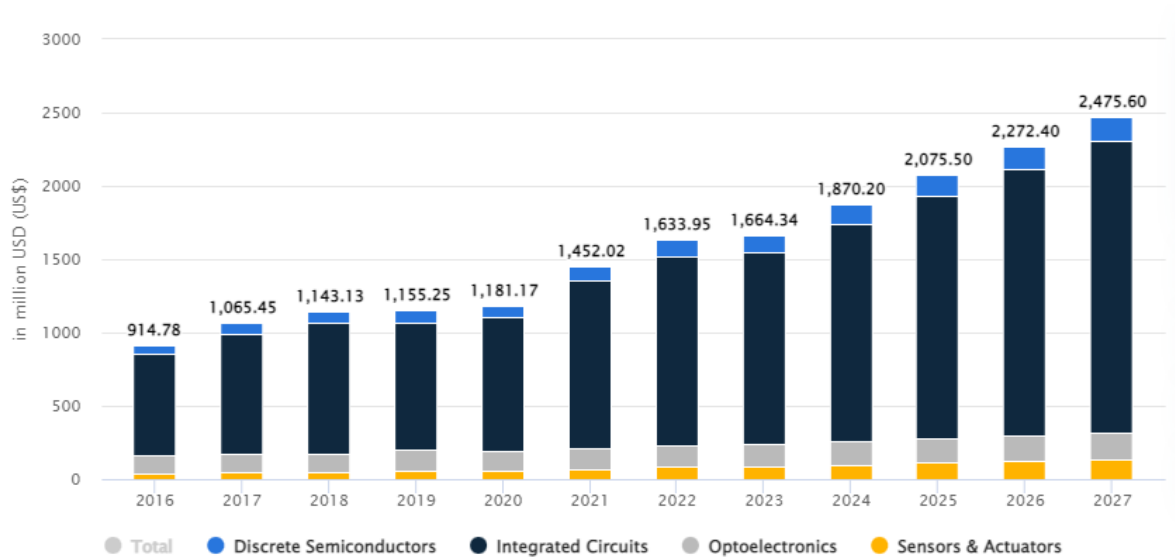


Figure 1. History and projection of Indonesia semiconductor industry's revenue.⁹

The Indonesian government has identified the semiconductor industry as a key sector for economic development, with the potential to create high-skilled jobs and drive technological innovation. Therefore, the Government has been promoting the growth of this sector through various initiatives and policies, such as tax incentives for semiconductor manufacturers and the establishment of science and technology parks. The Indonesian government has also expressed its determination to establish a strong semiconductor ecosystem in the country. The semiconductor industry is a vital component of the global technology supply chain and has significant potential to contribute to Indonesia's economic growth and development. One notable example of this is the construction of a semiconductor wafer fabrication facility in Batam (Infineon Technologies). The facility, which includes manufacturing buildings, is close to Infineon's existing operations and will double the company's production area when fully operational by 2024.¹⁰

Another key player in the Indonesian semiconductor/chip industry are Samsung Electronics Indonesia, NEC Semiconductors Indonesia, Toshiba Semiconductor Indonesia, and Sharp Semiconductor Indonesia. Additionally, there are several universities and research institutes in Indonesia that are involved in semiconductor/chip research. For example, the Bandung Institute of Technology (ITB)¹¹ has a Microelectronics Center that focuses on research in the field of semiconductor devices and integrated circuits, Lembaga Elektronika Nasional (LEN), and several research groups at National Research and Innovation Agency (BRIN). While the semiconductor industry in Indonesia is still in its early stages of development, there are promising signs of growth and investment in this area.

Foreign Investment and Challenges Facing Indonesia's Semiconductor Industry

There are several factors that are driving the growth of the semiconductor industry in Indonesia. One of the most significant is the country's large and rapidly growing consumer electronics market. Indonesia is the fourth most populous country in the world, with a population of over 270 million people. As the country's middle class continues to expand, so too does demand for consumer electronics, including smartphones, laptops, and other devices that rely heavily on semiconductors. In addition to its large domestic market, Indonesia is also strategically located within the ASEAN region, which is home to a combined population of over 600 million people. This makes Indonesia an attractive location for semiconductor companies looking to expand their operations in the region. Therefore, Indonesia has been actively seeking foreign investment in the semiconductor manufacturing industry as it looks to diversify its economy and reduce its reliance on natural resources.

The government has implemented various policies and incentives to attract foreign investors to the country's semiconductor sector, such as tax holidays, import duty exemptions, and simplified business procedures.⁶ Specifically, the government provides a 100% tax holiday for up to 20 years for certain semiconductor investments, and a 100% import duty exemption for machinery, equipment, and raw materials used in semiconductor manufacturing. Another advantage is Indonesia's abundance of natural resources, particularly tin, nickel, copper, and gallium (from bauxite), which are essential materials for semiconductor manufacturing. In specific, gallium is often used as a semiconductor dopant, which means that it is added in small amounts to a semiconductor material to change its electrical properties. Gallium is also used in the production of LEDs (light-emitting diodes) and solar cells, while Aluminum is a key material used in the production of semiconductors, particularly for packaging and interconnects. Additionally, the country has a competitive labor force with relatively low wages compared to other countries in the region.

South Korea is one of the world's leading semiconductor manufacturers and has been at the forefront of the industry for several decades. The country has several companies that are global leaders in semiconductor manufacturing, including Samsung Electronics and SK Hynix. Samsung is the world's largest memory chip maker and has a significant presence in the global market, accounting for more than 20% of the world's semiconductor sales. SK Hynix is the second-largest memory chip maker in the world and is also a major player in the global semiconductor market. In terms of technology maturity, Korean semiconductor manufacturers are generally considered to be among the most advanced in the world. They have been early adopters of advanced manufacturing technologies, such as extreme ultraviolet (EUV) lithography, which enables the production of smaller and more complex chips. Korean semiconductor manufacturers are also investing heavily in research and development to stay ahead of the competition. For example, Samsung Electronics has announced plans to invest \$151 billion over the next decade in areas such as semiconductor research and development, as well as in expanding its manufacturing capacity.¹² There are opportunities for semiconductor investment in Indonesia, as the country has been working to develop its semiconductor industry and attract foreign investment. Korea, as a major player in the semiconductor industry, could

potentially benefit from these opportunities.

It is also worth considering that to some extent, Indonesia's semiconductor industry may face several challenges, including: (i) Lack of infrastructure: The country's infrastructure is not as developed as some of its regional competitors, which can make it challenging to attract investment and develop supply chains. (ii) Limited research and development: There has been limited investment in research and development in Indonesia's semiconductor industry, which can hamper innovation and the development of new technologies. (iii) Shortage of skilled labor: Indonesia's semiconductor industry suffers from a shortage of skilled labor, particularly in the areas of design, engineering, and manufacturing. The industry requires highly skilled workers in areas such as engineering, design, and manufacturing. Indonesia's education system has not traditionally emphasized these areas, and the country's labor force is relatively unskilled in these areas. To address this challenge, the government has been promoting the development of vocational training programs and partnerships between universities and industry to develop a skilled labor force for the semiconductor industry. (iv) Low productivity: The productivity of Indonesia's semiconductor industry is relatively low compared to other countries in the region, which can limit its competitiveness.

It is also worth mentioning that other technical challenges that need to be considered to further develop the semiconductor industry in Indonesia such as improving intellectual property rights protection, developing a robust supply chain, and attracting more foreign direct investment. Addressing these challenges will require a concerted effort from government, industry, and other stakeholders to invest in infrastructure, education and training, research and development, and other areas critical to the growth and competitiveness of Indonesia's semiconductor industry.

Concluding Remarks

In conclusion, Indonesia's semiconductor industry has the potential to become a significant player in the global market. The country has a large population, a growing middle class, and a favorable location for trade with other Asian economies. Additionally, the government has implemented policies to promote the growth of the industry, such as tax incentives and investment support. However, there are still some challenges that need to be addressed, such as the lack of skilled labor and infrastructure. The industry also faces competition from other countries in the region, particularly from China and Taiwan. Despite these challenges, the semiconductor industry in Indonesia is growing steadily, with several local and international companies investing in the country. If the government can continue to provide the necessary support and address the challenges, Indonesia's semiconductor industry has the potential to become a key player in the global market, contributing to the country's economic growth and development.

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