

Growing Semiconductor Industry in India

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Abstract: *This paper delves into the growing semiconductor industry in India, and its importance in every aspect of present and future high data processing speed. Semiconductors are crucial electronic components for quantum computing, artificial intelligence (AI), medical devices, aerospace and defence systems, etc. Thus, the use of semiconductors for these most important and future ease concepts, this paper is an understanding approach to the growing importance of semiconductors in India*

Keywords: Semiconductor, India Semiconductor Mission (ISM), Quantum computing, value chain, Supply Chain, Research and Development

I. INTRODUCTION

India being a developing nation is always up to new self-discoveries, technologies, and skills. Talking about technology, techs such as artificial intelligence (AI), machine learning (ML), data science, space exploration, etc have always been on India's development eyesight, but recently one word has struck every Indian's ear i.e., Semiconductors. Though the semiconductor industry is not new, India has been into semiconductors since 1976 with its first semiconductor laboratory in Mohali, Punjab.

After the success of the 'Make in India' campaign in 2014, the Indian government realized the positive impact of in-house manufacturing on the nation's development and economy. Following that in December 2021, India Semiconductor Mission (ISM) was launched by the government of India's Ministry of Electronics and IT with a budget of Rs.76,000 crore.

II. UNDERSTANDING SEMICONDUCTOR:

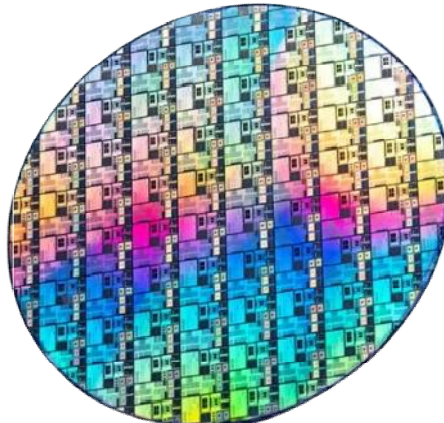


Fig 2.1: Semiconductor Wafer

The above image is a Semiconductor material made from crystalline silicon, which is a substrate for microelectronic devices. These semiconductor wafers are used to make integrated circuits which are the foundation of modern electronics.

Semiconductor wafers go through a complex process called Microfabrication to produce Integrated Circuits (ICs), which involves :

Photolithography, Doping, Deposition, Etching, Planarization. Each one of the processes is very important in the making of ICs. After the Microfabrication the ICs are cut out from the semiconductor wafer and each single IC is covered in a resin package to become a semiconductor product.

The Semiconductor is usually made of crystalline silicon or ultra-pure silicon. Still, there are other materials like germanium (Ge), and gallium arsenide (GaAs), which can also be used as an alternative to silicon. Recently materials like silicon carbide (SiC) and gallium nitride (GaN) have been important. India has reserves of silica (Silicon Dioxide, SiO₂), the raw material for producing silica. India also has small reserves of germanium and gallium.

III. VALUE CHAIN AND SUPPLY CHAIN

The semiconductor industry has become the basis for every digital technology today. It made its presence known in various fields from the transportation industry to the highly developing AI, 5G, and Quantum Computing fields. The driving factor behind the semiconductor industry's success is its massive value chain which is huge and occurs in a comprehensively interwoven network. The phases of this value chain include Research, Design, Manufacturing, Assembly, and Packing.

The universal architecture of the semiconductor supply chain has evolved over the past 40 years, allowing the industry to be prudent and reduce costs on different phases of the value chain, eventually making end-user approval of these digital services a reality. One of the key elements of the semiconductor industry's success can be attributed to the intricate and exceedingly complex products that are the semiconductors themselves. This supply chain includes research and development, fabrication, assembly, testing, and packaging.

The highly specialized international value chain is the result of the broad technical knowledge and magnitude of the semiconductor industry. Depending on their relative advantages, countries perform specific roles in the value chain. All the countries involved in the global semiconductor industry are in a 'give-and-take' relation in the global value chain, using free trade to transport materials and equipment, along with their intellectual properties (IP) and products, around the globe to the ideal region for accomplishing each task.

IV. ECONOMIC GROWTH AND EXCHANGE

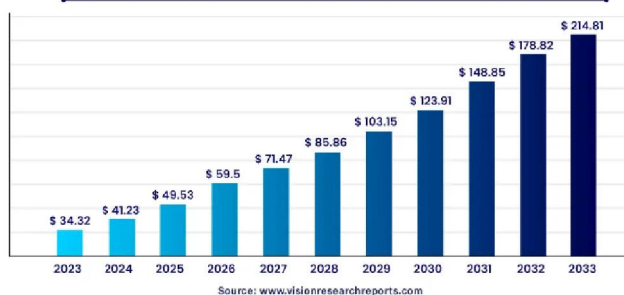


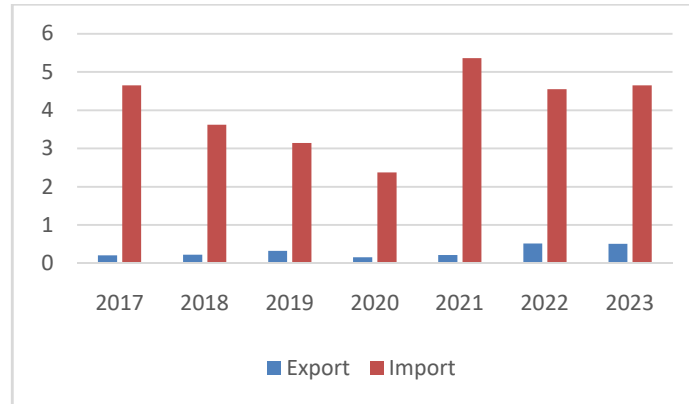
Fig 4.1: Indian Semiconductor Market Size (in US\$ Billion)

In 2023, the Indian semiconductor market was valued at US\$ 34.32 billion and is projected to hit around US\$ 214.81 billion by 2033.

The consumption of semiconductor products has increased because of the rising domestic demands of Indian customers. In India, the reliability of computers and mobile devices has sharply increased. Also, the Indian government's concentration on rural India to adopt digital methods of education and transactions is helping India to go digital. Also in recent years, the number of Indian startups has shot up high, and for all the innovative ideas to come to reality, more and more electronic gadgets are being used.

In 2017, the semiconductor exports from India stood at US\$ 0.21 billion, whereas imports were higher at US\$ 4.65 billion. By 2019, export growth was seen at US\$ 0.33 billion and imports reduced to US\$ 3.15 billion. However, in 2020, India witnessed a downturn in both exports and imports, influenced by global economic disruption, the COVID-19 pandemic. Pent-up demand from the downturn led to exceptional recovery in 2021 and imports reached US\$ 5.36 billion with less exports compared to recent years around US\$ 0.22 billion. From 2022, we saw evidence of India's

efforts to establish itself as a semiconductor hub, with exports reaching an all-time high of US\$ 0.52 billion and reduced imports of US\$ 4.55 billion.



Source: oec.world

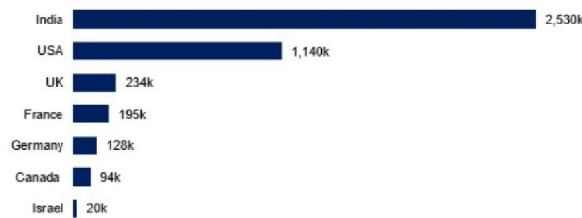
Fig 4.2: Export/Import of Semiconductor Devices (inUS\$billion)

V. FACTORS FAVOURING INDIA:

India being a developing nation, has consistently progressed in recent years. India is a country on the globe with brilliant minds, an encouraging work environment, and many other factors favouring India for the semiconductor market. The factors favouring India include a skilled workforce, cost advantage, policy support, and global supply chain diversification.

Let's take a glance at these factors:

5.1 Skilled Workforce:



Source: Nasscom

Fig 5.1: STEM graduates in 2022-23

India leads the world with a record number of science, technology, engineering, and mathematics (STEM) graduates, which offers a much-needed skilled workforce required in semiconductor design, manufacturing, research, and development. The Indian education system mainly focuses on practical based learning, which includes regular hands-on experience, industrial training, and exposure to real-life applications of technologies. These activities provide the investing industries with skilledworkers.

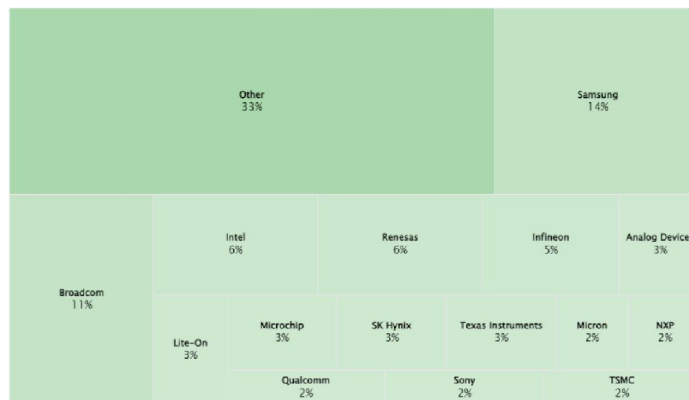
5.2 Cost Advantage

If compared to developed countries, the labour costs are lower in India. This translates to decreased production expenses for semiconductor manufacturers, particularly in labour-intensive processes such as assembly and testing. As India strengthens its semiconductor ecosystem with investment in research and development, infrastructure development, and skill enhancement programmes, the overall cost-effectiveness of semiconductor manufacturing is expected to improve further.

5.3 Policy Support

The Indian government has seized the opportunity following the global semiconductor supply chain glut after the COVID-19 pandemic and showed great intent through policy support for presenting India as an alternative to China in the worldwide semiconductor supply chain.

VI. INVESTMENTS IN THE SEMICONDUCTOR INDUSTRY



Source: statista.com

Fig 6.1: Brand Shares in %, in Indian Semiconductor Market

The above data is for the 2022-23 financial year. We can see that big companies like Samsung, Qualcomm, Intel, Sony, Micron, and NXP have invested in the Indian semiconductor market.

Substantial amounts of investment are being made towards the Indian semiconductor industry to emphasize India's significance in the international scene. Many domestic entities have invested in the Indian semiconductor industry. Tata Electronics has largely invested in its Gujarat and Assam-based semiconductor manufacturing plants. Along with domestic entities, many international entities have also made massive investments. Micron Technology, Applied Materials, Advanced Micro Devices, Foxconn, and Corning have all planned to invest hundreds of millions of dollars over a few years in the Indian semiconductor industry. This reflects the magnitude and goals these companies strive to achieve in India.

These investments are more than mere signs of good faith; they represent the complete confidence of companies in India's potential to become an international hub for semiconductor manufacturing. It also serves to highlight India's significance in the global supply chain. This will attract the attention of potential investors to the Indian semiconductor industry, further enhancing India's ability to be a global centre for semiconductor production.

VII. GOVERNMENT INITIATIVES

India is well on its way to creating a massive semiconductor industry with the arrival of well-planned initiatives by the government like India Semiconductor Mission (ISM) and partnerships with international and domestic companies. The Honourable Shri Narendra Modi, Prime Minister of India announced 50% of financial support from the government for setting up semiconductor manufacturing facilities. Tata Electronics and PSMC are working together in Gujarat, which shows seriousness towards setting up top-grade semiconductor labs. The Japanese and European commissions are also working together with the Indian government, taking forward-looking steps to solidify the international semiconductor network. The current evaluation of the Indian government's semiconductor proposition stands at a massive 21 billion USD. India is solidifying its place as a global semiconductor production centre with prolonged exertion and a cautious stance, which advances and encourages the technological and economic growth of the country.

VIII. CHALLENGES

Currently, India faces challenges, which include i.) high imports and low exports, and ii.) effective semiconductor policy for the state, iii.) lack of semiconductor manufacturing ecosystem, and iv.) competition with Taiwan, China and

other countries in manufacturing and e-design, but the current situation can be changed by considering all the factors responsible for making India the semiconductor hub.

IX. CONCLUSION

While talking about the growth of the semiconductor industry in India, in this paper we have covered areas of Semiconductors and their importance, Economic growth and Exchange, Factors favouring India for the manufacturing of semiconductors, investments in the semiconductor industry and government initiatives.

Key findings covered in this paper are the increasing economic growth of the semiconductor industry in India, its import-export, and the Indian semiconductor market sharing 1% of brand values with key investors like Samsung, Intel, Qualcomm, Micron, NXP, and etc. Also, government initiatives like the India Semiconductor Mission (ISM) and financial support. The graph of the Indian semiconductor market size provided in the paper showcases India's potential for growth in the global semiconductor industry.

These findings matter a lot because not only does this paper talk about the Indian semiconductor market but also it gives a close look at the Interests of foreign investors in India, and the government's seriousness towards the semiconductor sector.

The future of the semiconductor industry will rise high with a US\$ 120 + billion market size by 2030, due to the strong mission and vision towards the country's priorities.

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