



## SEMICONDUCTOR INDUSTRY IN INDIA- USHERING ITS WAY INTO A NEW ERA

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**ABSTRACT**

This paper focuses on the current state of the semiconductor industry at the global level as well as in India. With semiconductor chips emerging as the new gold, its demand is highest now than it was ever before. The demand for semiconductor chips in India is said to reach a figure of whopping US 110 billion dollars by 2030. In recent years, this industry has witnessed a crunch in its supply due to supply-side and demand-side constraints. This paper sheds light on the causes of these limits. Moreover, many countries are acquainted with this industry's scope in the future. India recognizes its dependence on countries like China for semiconductors. So, it aims to become a manufacturing hub for this industry and not just remain a fabless industry. However, India is encountering hurdles in this process. With this perception, this study has tried to explore India's initiatives in this direction. Keeping in mind India's vision of Aatmanirbhar Bharat, it seems like it's a long and rough road ahead to make the semiconductor industry in India, a self-reliant industry. This analytical study infers that overcoming these obstacles is going to become increasingly onerous.

**KEYWORDS :** Semiconductor, demand, supply, manufacturing hub, fabless industry

**INTRODUCTION**

The world has finally woken up to the realization of the importance of the semiconductors and chip industry with its increasing demand in recent years. The past few years have been marked by a shortage of chips in the market which was aggravated by various global factors like COVID-19, Russia-Ukraine war etc.

To start, let's understand what the semiconductor chip industry is all about. Semiconductors are solid substances that form the basis of various electronic devices. Elemental semiconductors include antimony, arsenic, boron, carbon, germanium, selenium, silicon, sulphur and tellurium. Common semiconductor compounds include gallium arsenide, indium antimonide and most metals' oxides. The most used substances to make semiconductors are Germanium, Gallium Arsenide and Silicon. However, due to the low cost of silicon and its availability in abundance, it is favoured by manufacturers. Semiconductors have conductivity and resistivity in between conductors of electricity and resistors. They can control the number and flow of charge carriers through them. This makes them suitable for making electronic chips, which are made for computing components and a variety of electronic devices.

The supply chain of the semiconductors industry includes a network of companies involved in their design, manufacturing, testing, packaging, and distribution. It is based on the interdependence of all these industries within the semiconductors industry. Semiconductors are used in a variety of electronic devices that includes diodes, transistors, laptops, smartphones, computers, medical diagnostics equipment etc.

The demand for semiconductor chips is seeing a rightward shift all over the world. It has been forecasted that in India itself it is going to grow to approximately 110 billion dollars by 2030. This is because of the growing AI industry, IoT industry and advancement in wirelessly connected devices. It is to be noted that AI and IoT industries are increasingly becoming an indispensable part of our lives. It is used for various purposes- be it in the health sector, manufacturing industries, service sector, defence, or even agricultural sector. The other contributors to the growing demand are a surge in population, increasing disposable income levels and increasing urbanization.

When COVID-19 hit the world in 2020, it led to a global supply chain bottleneck of semiconductors. Semiconductor manufacturers either shut down during the COVID pandemic

or had to decrease production. Production had to be reduced because of the supply-side bottleneck effects of inputs required in the semiconductors industry. It exposed India's heavy dependence on countries like China, Taiwan etc.

India is an important global importer of semiconductor chips from across different countries. It is heavily dependent on China for imports of semiconductor chips. As per statistical data, in the year 2022, India imported around 4.3 billion dollars worth of semiconductor devices from China alone. Currently, India comprises fabless industries and doesn't manufacture semiconductor chips. Fabless industries include industries that make designs for these chips but don't build them. Instead, they outsource their design or fabrication to manufacturing plants, also known as foundries.

It is the need of the hour for India to become self-reliant in manufacturing semiconductor chips. Amidst the backdrop of a hostile neighbour like China, India needs to find ways to attract investment in this sector. More manufacturing bases need to be opened in India in order to reduce imports from China.

In light of the growing significance of the semiconductor industry in the contemporary world, this paper makes an attempt to investigate the following:

- Major contributors at the global level
- Semiconductor industry from the Indian perspective
- Causes of Semiconductor shortages
- Indian government's initiatives
- Challenges faced by India
- India's prospects of becoming a manufacturing hub

**Semiconductor Industry At The Global Level**

Across the world, only a fraction of countries is efficient in the production of semiconductor chips. The major players include South Korea, Taiwan, China, USA etc. As a result, majority of the countries have become importers. India is no foreigner to this and is also a heavy importer of semiconductor devices.

Over the past two decades, the semiconductor industry's market share has significantly shifted from American and European countries to Asian countries due to an increase in electronic equipment production in these countries. Asian countries such as China, Taiwan, South Korea and Japan are emerging as the biggest producers of semiconductor chips in the world accounting for almost 86% of the global market.

As per the empirical data, during the periods 2021 to 2022, South Korea and Taiwan remain the key play cards of

semiconductor manufacturing. USA although being the pioneer of the semiconductor industry has shown a decline in its global manufacturing share.

China from almost zero semiconductor production in 1990 seems to have surpassed USA with a global share of 16% in 2021(Figure 2). It is expected that by 2030, China's market share may reach 25%<sup>3</sup>.

**Semiconductor Industry From The Indian Perspective**

As for India, there is no manufacturing hub. India is mainly a fabless industry. About 20-25% of the design of semiconductors happens in India.

Even today, India is a heavy importer of semiconductor chips and devices from across the globe. One of the major reasons for heavy dependence on imports is that the semiconductor chip industry is a highly capital-intensive industry which requires adequate access to water and power. These structural constraints have withheld many major Indian industries from investing in the semiconductor industry and they are highly reliant on imports.

As is evident from the graph given below, there has been a huge increase in the demand for imports with a mild drop during the period 2019-20 because of the pandemic.

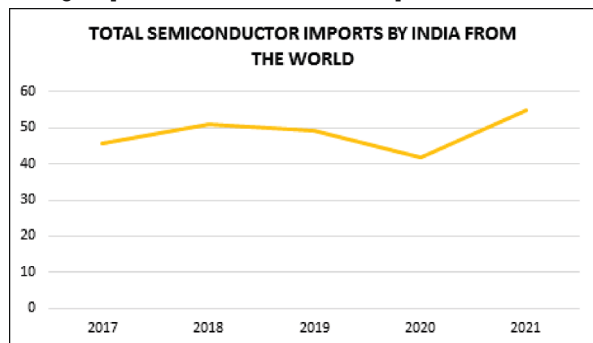


Figure 1: Semiconductor Imports by India from the World, 2017-2021

Source: Based on data source ITC Trade map (Values in US \$billion)

India imports semiconductors the most from China. As per Figure 2, it is clear that almost 50% of the imports come from China followed by other countries like Germany, Japan and USA.

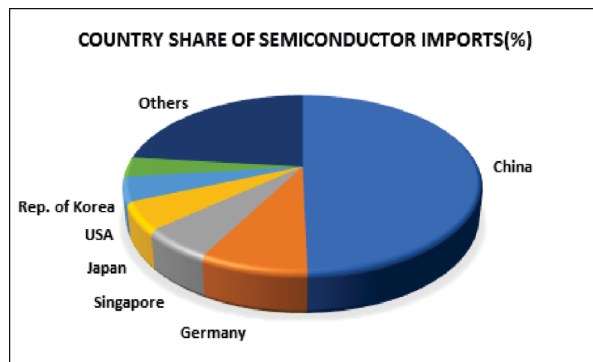


Figure 2: Country-wise share of Semiconductor Imports (%), 2021

Source: Based on Data Source Connect2India- Semiconductor Import to India, 2021

**Causes Of Semiconductor Shortage**  
*Demand and Supply Side Factors-*

The semiconductor industry is extremely volatile and vulnerable to disruptions in the market. The major concern that the world is facing right now is the increasing demand and insufficient supply of semiconductors.

There are numerous demand-side factors that are leading to the shifting of the demand curve rightwards. They include increasing population, increasing disposable income and urbanisation. The advancement of sectors like AI, IoT etc are also major driving forces. Even the government sector and enterprise companies are consuming more and more servers for electric components. This demand is to see only growth in the upcoming years.

On the other hand, the supply-side factors act as restraining elements in its growth. The supply chain is also marked with shortages. There are a range of factors which explain the supply crunch faced in recent years.

This industry has been predominantly dependent on USA. Hence, any disruption in this industry in USA starts a ripple effect all over the world. The increasing tensions between USA and China have led to the current USA government to take stringent actions. USA has started to impose trade restrictions on China. As a result, USA had to suffer a decrease in its market share. Tariffs on the import and export of components that are used to make semiconductors, have also affected its production.

The unprecedented COVID-19 in the year 2020 was a blow to the industry. It led to massive layoffs causing a decrease in production. The lockdowns also posed trade barriers which led to shortages, especially in countries like India, which are heavily dependent on the manufacturing hubs. There was a shortage in raw materials because of trade restrictions and the inclination of many countries towards 'protectionism of trade'. Many firms also had to be shut down during this period because they were incurring irretrievable losses.

Structural weaknesses in the system have also only aggravated the crunch in the industry.

Moreover, weather adversities also halted operations which reduced its production.

The Russia-Ukraine war, which began in February 2022, has the potential to worsen semiconductor supply chain issues and the chip shortage that has impacted the industry for the past two years. The most immediate risk is to the supply of specific raw materials used in semiconductor manufacturing such as neon and palladium.

It needs to be noted that the dominance of Indo-Pacific countries as players in the semiconductors market may also pose a problem. While the semiconductors industry is global, the Indo-Pacific is its critical region. Taiwan, Japan, China, and South Korea all play pivotal roles in the Indo-Pacific and particularly the global semiconductor landscape. A supply-side constriction in these countries can adversely affect their supply all over the world.

**India's Initiatives**

In light of the demand and supply side constraints which have created shortages in the semiconductor industry, the pressing priority for India is to revamp itself into a manufacturing hub. Given the heavy dependence on the imports of China and the worsening ties between the two countries, India needs to shift its focus on becoming Aatmanirbhar or self-reliant. Unless a miracle occurs, there is not much hope for the sour relations between India and China to improve. The growing reliance of India on manufacturing hubs of the world poses a threat to the growth of the Indian economy in the future. Many Indian

economists opine that setting up an optimistic environment for MNCs and investments is imperative.

During the COVID period, the Indian government recognised semiconductors as a strategic raw material for any intelligent electric component. So, India has come up with new policies to incentivise foreign companies to set up their manufacturing centres in India and also for local companies to open and expand their centre.

One of the schemes introduced is the Production Linked Incentive. Production Linked Incentive or PLI scheme is a scheme that aims to give companies incentives on incremental sales from products manufactured in domestic units. The scheme invites foreign companies to set up units in India. However, it also aims to encourage local companies to set up or expand existing manufacturing units and also to generate more employment and cut down the country's reliance on imports from other countries.

Another initiative in the form of DLI (Design Linked Incentive) scheme aims to offer financial incentives as well as design infrastructure support across various stages of development.

In 2021, India came out with a USD 10 billion incentive programme. The central Government set up an India Semiconductor Mission within the Ministry of IT and Electronics in 2021 to enable India's emergence as a global manufacturing and design hub. With this aim, the budget of FY 2022-23 approved 50% of capital expenditure along with Research and Development support (Economic Survey, 2022-23) as incentives under the semiconductor scheme. As a result of this incentive scheme, India is expected to attract a total investment of at least 25 billion US dollars to boost the local manufacturing of chips. Moreover, the government increased the fiscal support for compound semiconductors and semiconductor facilities from 30% to 50%.

All these initiatives come at a time when tech companies all around the world are struggling with chip shortages. It is evident that India sees an opportunity in the rift or cold war going on between China and USA.

### Challenges In This Competitive Game Of Chips

The above-mentioned initiatives have faced criticisms as well. India recently denied crucial funding to the chip venture by Anil Aggarwal's Vedanta and Taiwanese company Foxconn. The government won't be providing any incentives to make these 28 nanometre chips as it hasn't met the criteria set up by the government. Also, a 3 billion US dollars proposal that had an Israeli foundry Tower Semiconductor Ltd. as a tech partner has also been stalled. At the same time, a third plan is stuck because Singapore based IGSS Ventures Pte wants to resubmit its application for incentives. All this doesn't give a good look to India.

India's labour laws are also stricter vis a vis country like USA. Many MNCs find this hard to accommodate.

Another challenge that India faces is that although India is full of intelligent and young minds, it has a lack of credible experienced talent when it comes to manufacturing these chips.

But at the same time, one can't forget the massive opportunities and advantages that the companies will have by opening their manufacturing operations here.

India is home to a huge and ever-growing population of over 1.25 billion people. Also, these people have started to become more affluent. This makes India an extremely attractive market for MNCs. Hence, they are keen on taking advantage

of this. The most cost-effective way to do so is to start manufacturing in India. As a result, it is likely that the increased consumption will drive the evolution of manufacturing operations in India.

Manufacturing facilities are huge and extremely cost intensive. Companies are usually never keen to open their manufacturing hubs unless they are sure that their investments will be safe. So, when it comes to safety and security, India does have an upper hand over its neighbouring rivals. China's oppressive regime, Pakistan's and Bangladesh's terrorism and political instability make them unappealing markets.

Once operations start in India, these MNCs can also have access to the markets of India's neighbouring countries.

### India's Prospects Of Reaching Its Target

Many MNCs are adopting the China+1 strategy and looking for nurturing markets. India is thus an apt choice. Moreover, the initiatives taken by the Centre are also in their favour. In addition to this, to accommodate the rising demand, scientists have started experimenting to make semiconductors using other materials to reduce dependency on silicon. Some of them include Tin Oxide, Pyrite etc. Thus, investments in Research and Development will ensure that India does not face an adverse crisis of chip shortage in the future. Several economists are optimistic that India is in the right direction and a push will only make things better.

India has shown to be perseverant in its efforts and there definitely is great potential for the semiconductor industry to grow in the forthcoming years. It seems to be just a matter of time and opportunities.

### CONCLUSION

Semiconductors are key to economic growth and development in this digital age. Economies all over the world recognize that semiconductor is the new oil. So, they are ready to heavily invest in this sector. The volatile nature of the industry, the supply side and demand side constraints, and the inclination towards reducing dependence on foreign imports of semiconductors are reasons for economies to adopt new strategies. India too has its eye on the semiconductor industry and understands its critical role.

India is a growing country with immense opportunities. It is in the centre stage of the world and the spotlight is on us. Even in times of global economic slowdown, India has performed much better than many other developed economies. This highlights India's true potential. Lately, a positive environment has been created which has attracted foreign investments in this sector.

With a vision of Aatmanirbhar Bharat, the Indian government has taken significant initiatives to boost and encourage the manufacturing of semiconductor chips in the country.

Many MNCs recognize the huge market that India offers. Moreover, it is convenient for them to open their operations in India because of the huge supply of labour. However, there are a few constraints to this as well. India's labour force is not trained to manufacture these chips. Many have also questioned the credibility of the schemes offered by the government to increase production.

Steps need to be taken to develop vocational skills among students such that they can contribute to the semiconductor chip industry. India must take informed and careful decisions when it comes to accepting investments in the country. Since India is still a new entrant in this sector, one wrong step can prove to be a push factor for investments. Research and

Development should also be encouraged so that India can be on the world round table of discussions regarding the semiconductors industry. It is a rough road ahead, but India is a resilient country and will be able to grow through it.

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