

# Semiconductor Chip Production - A Strategic Necessity for India

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**Abstract:** A semiconductor chip is an electric circuit with many components such as transistors and wiring formed on a semiconductor wafer. These chips have been used in a variety of electronic products and are very essential in our everyday life. This paper focuses on the need for India to set-up industrial-scale semiconductor wafer fabrication (FAB) units and develop self-reliance to meet the import challenges with the changing geopolitical scenario.

**Keywords:** FABs, IC-Fabrication, IC-Chips, semiconductors

## 1. Background

The digital age has propelled the world into consuming electronics at an unprecedented scale. Worldwide shipments of devices - PCs, tablets and mobile phones reached a total of **2.2 billion** units in 2019. All these gadgets require semiconductor chips to function and economies with a large production base of these chips have benefited the most in terms of enhancing their GDP. Countries like USA, Taiwan, South Korea, Japan and China are large producers of semiconductor chips and have a strong foothold on the global economy.

In 2018, semiconductor chips had a total trade of **\$619B**. Top exporters were South Korea (\$113B), Taiwan (\$110B), China (\$90.9B), Singapore (\$61B), and Malaysia (\$55.5B).



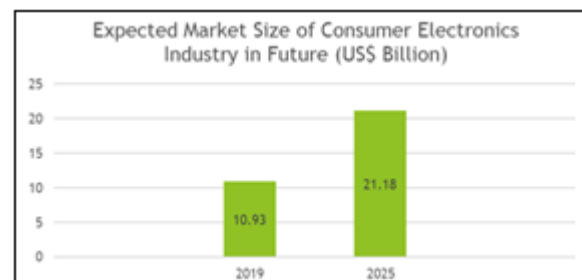
**Figure 1:** Export data of semiconductor chips

India had an export of worth **just \$0.296B** and import of worth **\$7.29B**. These figures are clearly not good given the potential of India.

## 2. Need for Self-Reliance

While India has done well in terms of chip design and electronics manufacturing, there have been challenges in setting up of semiconductor wafer fabrication (FAB) units for a long time.

The growth of digitalization in India is increasing consumer demand for electronics, thus making India a large net importer of semiconductor chips. In fact, experts say that India is spending more money on import of semiconductor than on oil.



**Figure 2:** Expected growth in consumer demands of India

The way to reduce the dependency on chip imports is to create semiconductor manufacturing units within the country. Hence, there is an urgent need to set up large scale FAB units to meet the import challenges. Also, from the country's strategic point of view, this bulk of consumer demand must not be met through imports alone. Hence, the case for a self-reliant, indigenous, industrial-scale production of semiconductor chips in India is much needed.

## 3. Present Scenario

The Indian semiconductor component market is expected to be worth **\$32.35 billion** by 2025, growing at a compounded annual growth rate of **10.1%** between 2018 and 2025, according to the Indian Electronics and Semiconductor Association (IESA), an industry body [2].

India has been taking steps towards indigenous chip design capability for a few years now. There have been attempts to set up semiconductor FAB units here by private companies in the past as enumerated below:

- 1) Early attempts were made by the government in undivided Andhra Pradesh to promote the semiconductor industry and identified 1,200 acres in Srinagar and Raviryal villages of Ranga Reddy district (now in Telangana) for setting up a manufacturing unit for wafer fabrication and others to be developed as FAB City (fabrication facility). However, the FAB City project fails to take off and caused state exchequer to suffer a loss of Rs 100 crore.
- 2) Hindustan Semiconductor Manufacturing Corporation (HSMC), a consortium of companies that included ST Microelectronics and Silterra Malaysia was aiming chip manufacturing plant in Gujarat, a project worth **₹30,000**

crore[1]. The government in 2019 cancelled the letter of intent granted to HSMC stating that the consortium could not submit the required documents.

- 3) Then there was another consortium led by Jaiprakash Associates, which partnered with IBM and Tower Semiconductor of Israel to start chip manufacturing in UP [1]. JP Associates later withdrew its proposal for the semiconductor plant as it was not commercially viable.

As of now, India does manufacture chips at a small scale under government organizations for sensitive areas like defense and space, some of these are listed below:

- 1) Society for Integrated Circuit Technology and Applied Research (SITAR) is a Government of India organization. SITAR has two units, one in Bangalore (STARC) and the other in Hyderabad (GAETEC).
  - a) Semiconductor Technology and Applied Research Centre (STARC) established in 2003 has CMOS, ASIC and MEMS fabrication and IC assembly facilities.
  - b) Gallium Arsenide Enabling Technology Centre (GAETEC) was established at Hyderabad in 1996 later merged with SITAR in April 2004. It is gallium arsenide foundry presently running 0.7 and 0.5-micron MESFET technologies.
- 2) Semi-Conductor Laboratory (SCL) is an autonomous body setup at Mohali under Department of Space in 2006. It has 8-inch wafer fabrication facility to produce chips of 0.18-micrometer size.

But manufacturing chips at a large scale for consumer electronics and other high-tech industries is still a challenging task as India looks homegrown chip program as a strategic necessity.

#### 4. Challenges Ahead

India has been a service-oriented market, it needs to transform itself into product-oriented market and for that there is lot more which needs to be done by the government, business leaders, entrepreneurs and the people in general, to change the mindset to take up ownership.

One of the biggest challenges in setting up FAB units is the fact that it requires massive investment (**\$3 - \$5 billion**). In addition to the huge cost, manufacturing even a single chip requires hundreds of gallons of pure water, uninterrupted power supply. The heart of the issue is that India is still not upto the par in terms of the basic infrastructure needed to venture in the chip manufacturing race. Also, there is constant price pressure from other global players, particularly China which is also building a homegrown chip program for the adoption of local semiconductors in **70%** of its products by 2025.

#### 5. Measures by Government

The Union Cabinet had recently approved three schemes to boost large-scale electronics manufacturing in India, namely Performance Linked Incentive (PLI), Promotion of Electronic Components and Semiconductors (SPECS) and Electronics Manufacturing Clusters 2.0 (EMC2).

These schemes could potentially help a **\$1-2 billion** FAB to start [3]. One week after the announcement of these schemes, reactions have been mixed. While many have welcomed the move after decades of inaction, others argue that further reforms are vital. Some examples of potential special incentives include low tax rates for FABs, long term sovereign guarantees, introducing duty on the parts that are currently being imported by the Assembly, Testing, Marking and Packaging (ATMP) units, and broadening conditions for CapEx reimbursement [3].

#### 6. The Road Ahead

Steady rise in semiconductor design market clearly indicates the availability of talent in India.

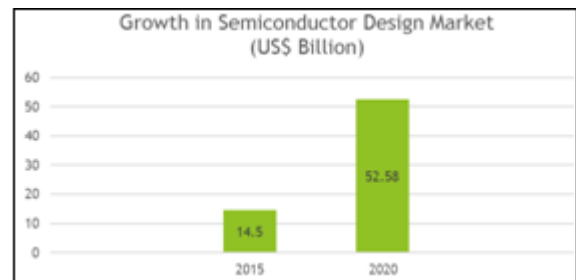


Figure 3: Rise in semiconductor chip design market

Yet, the country has struggled to find a way to establish FAB units needed for large scale manufacturing.

It is a strategic necessity for India, on multiple levels, to have independent FAB facilities given the evolving geopolitical scenario in the world today. To achieve this, we need to take following steps:

- 1) FAB setup is highly capital-intensive, it must be backed with a long-term financial plan with suitable backing to the entrepreneurs by the banks and the government both.
- 2) Exclusive land allocation process for FABs along with pre-approved clearances for environment, water and power. Also, advance approvals to build roads and other logistic supports.
- 3) Dedicated skilled labors to be developed as high level of sophistication is required in the fabrication process.
- 4) Supply of critical high purity raw material, technology for sensitive finished parts and machineries to be ensured from advanced countries.
- 5) Support for a very high-end R&D set-up with capability to do research to change the process flow as per market trends and customer requirement.

#### 7. Conclusion

For India to reach a 'Superpower' status and be able to compete with other developed countries of the world, it is high time to start taking productive steps in this direction.

#### References

- [1] Vishal Chawla. "Why Has India Lagged Behind in Semiconductor Chip Manufacturing," analyticsindiamag.com, para. 4, Aug. 21, 2019. [Online]. Available: <https://analyticsindiamag.com/india->

semiconductor-chip-manufacturing/. [Accessed: July. 28, 2020].

- [2] Anandi Chandrashekhar, Priyanka Sangani. "Inside India's push to build an indigenous semiconductor design ecosystem," tech.economictimes.indiatimes.com, para. 11, May. 3, 2019. [Online]. Available: <https://tech.economictimes.indiatimes.com/news/technology/inside-indias-push-to-build-an-indigenous-semiconductor-design-ecosystem/69153368>. [Accessed: July. 29, 2020].
- [3] Arun Mampazhy. "An inflection point for India's semiconductor fab ambitions," orfonline.org, para. 4, Jun. 14, 2020. [Online]. Available: <https://www.orfonline.org/expert-speak/an-inflection-point-for-indias-semiconductor-fab-ambitions-67822/>. [Accessed: July. 29, 2020]

## Author Profile



**Rahul Shashaank Nath** is an aspiring engineer who is currently pursuing his bachelor's degree (B. Tech) in Electronics and Instrumentation at renowned Manipal Institute of Technology, Manipal, India. He has gained experience about functioning and application of ICs along his course. His interest areas are electronics, control systems and virtual instrumentation.