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A General Analysis of the Indian Semiconductor Industry

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Abstract

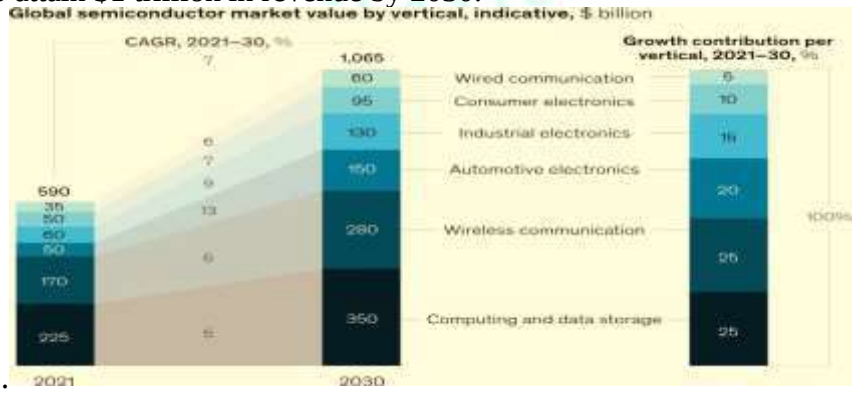
Electronic gadgets are constructed using semiconductor-based chips. Semiconductors are crucial for the functionality of practically all contemporary devices, including automobiles, mobile phones, computers, and aircraft, hence forming the cornerstone of the economies of all nations, including India. We are importing a substantial volume of semiconductors from abroad to satisfy our increasingly demanding requirements. Our semiconductor industry significantly trails that of Taiwan, Japan, South Korea, China, and the United States. Diverse governmental initiatives, including the Semiconindia Programme, the Production Linked Incentive (PLI) Scheme, and the Design Linked Incentive (DLI) Scheme, aim to establish India as a global hub for semiconductor design, manufacture, and technical innovation.

Keyword: Digital India, Semiconductors, PLI Scheme, DLI Scheme, Equipment.

INTRODUCTION

Materials that possess conductivity levels intermediate between conductors and insulators are referred to as semiconductors. They may consist of pure chemicals such as silicon or germanium, or they may be mixes like gallium arsenide or cadmium selenide. Semiconductors are integral to numerous widely utilised digital items, such as mobile phones, digital cameras, televisions, washing machines, refrigerators, and LED lights, hence constituting the backbone of the economy. Contemporary automobiles, household devices, essential medical apparatus, and similar items all incorporate semiconductor chips. Investigating the demand for semiconductors in diverse critical machinery Governments worldwide are increasing their investments in semiconductor technology. Various countries have enacted multiple legislations pertinent to CHIPS manufacture to promote and sustain indigenous semiconductor manufacturing and research. India has implemented numerous plans and programs to commercialise and enhance semiconductor industry output, hence reinforcing the initiative of "Digital India."

Today, the production of nearly all digital products, from automobiles to computers, encountered challenges due to supply constraints, highlighting the critical role of semiconductor-based chips in the efficient functioning of both the global and Indian economies. Numerous industrial delays and shutdowns have resulted from the surge in demand for smart devices, vehicles, and other chip-enhanced items. Customer reports of prolonged delays for various semiconductor-based devices have resulted in a global revenue decrease of hundreds of billions of dollars. It is essential to acknowledge that, although constituting a minor fraction of the global GDP, semiconductors drive products and processes valued in the trillions of dollars. The increasing demand, coupled with digital revolution and the pandemic, has further amplified the need for semiconductors. In 2020 and 2021, the demand for processors for gadgets and data centres surged. The global semiconductor market is projected to attain $1 trillion in revenue by 2030.



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LITERATURE REVIEW

Himanshu Kushwaha and Anil Sethi, Assistant Professor in the Department of Electronics at Keshav Mahavidyalaya, University of Delhi, India, in their study "Future of Semiconductor Fabrication (FAB) Industries in India - Opportunities and Challenges (2017)," asserted that India's demand for electronic products incorporating semiconductor devices will reach several billion dollars in the coming years. Numerous enterprises are currently involved in design; yet, they lack on-site manufacturing capabilities. The design projects under their management increasingly rely on foreign wafer fabrication facilities, and semiconductor manufacturing in India will only expand with a robust, growth-oriented semiconductor policy and a well-maintained ecosystem established by the central government to attract foreign entities to set up wafer fabrication and research and development units in India.

Pranay Kotasthane and Arjun Gargeyas (2022), in their paper "Harnessing Trade Policy to Build India's Semiconductor Industry," examine the significance of trade and knowledge transfer in advancing India's semiconductor sector. The technology transfer agreement with the United States became the foundation of Taiwan's semiconductor sector. Taiwan's liberal trade policies in the 1960s facilitated the expansion of state-funded foundries such as United Microelectronics Corporation (UMC) and Taiwan Semiconductor Manufacturing Company (TSMC), since Taiwanese engineers acquired technological expertise through the agreement. Taiwan ascended to superpower status in the semiconductor sector due to a gradual increase in private investment and enhanced access to foundry resources and equipment. India and other burgeoning semiconductor nations can achieve significant advancements by emulating Taiwan's semiconductor industry in commerce and technology transfer.

In his 2021 research article, "Is India Going to Be a Major Hub of Semiconductor Chip Manufacturing?", Prof. Mamidala Jagadesh Kumar examines India's potential to emerge as a significant centre for semiconductor chip production. India have the capability to produce semiconductor chips, fulfilling the demand for chip manufacturing and contributing to the development of solar cells. Challenges include energy requirements, water accessibility, electronics-grade silicon, chip design expertise, and collaboration between industry and academia. The article argues that India has the potential to emerge as a worldwide hub for semiconductor chip manufacturing, attributed to favourable government regulations, increasing domestic demand, burgeoning entrepreneurship, and a substantial pool of competent local designers.

OBJECTIVES OF THE STUDY

- To identify and assess the problems that the Indian semiconductor sector.
- To investigate possibilities for Indian semiconductor businesses to access international markets and improve export capacities.
- To understand the basic concept of semiconductor industry for development in Indian economy.
- To learn about Government initiatives for promoting Semiconductor industry in India.

RESEARCH METHODOLOGY

The paper relies exclusively on the accessible secondary data. Data is sourced from diverse publications of central and state governments, foreign governments, international organisations and their subsidiaries, prior research papers, articles, magazines, and credible websites, as well as publicly accessible published data.

Indian Semiconductors Industry:

The contemporary information age relies on semiconductor chips. Semiconductors enable electrical equipment to perform calculations and handle tasks that enhance our lives. They constitute essential infrastructures that influence India's security, including military equipment, supercomputers, banking systems, power transmission, and communication. Our economy is significantly reliant on the semiconductor industry. Semiconductors are increasingly in demand. Consequently, India's position in the global technological industry would enhance. Furthermore, it will bolster economic growth, create employment

opportunities, and establish India as a significant player in the global economy. India allocates $24 billion annually for imports and relies on them. The demand is anticipated to attain $110 billion by 2030. It is projected that during the next decade, it will emerge as a global hub for semiconductor technology.

Plans by the Indian Government for the Semiconductor Industry:

The Indian government aims to establish itself as a global leader in chip manufacturing. India is positioned as one of the leading purchasers of semiconductor products globally. However, the nation's domestic semiconductor production capabilities remain nascent. The trade deficit is substantial, as imports constitute the majority of India's semiconductor consumption. The Indian government has initiated multiple projects to bolster the semiconductor sector, recognising the necessity to diminish reliance on imports and promote indigenous production.

Several important government programs include:

Initiated in 2014, the Make in India campaign seeks to enhance manufacturing in India and position the country as a worldwide manufacturing leader. Several initiatives have been implemented to promote semiconductor production, including the Production-Linked Incentive (PLI) program for the electronics sector. The program is a significant initiative offering a $1.7 billion incentive package to companies establishing semiconductor manufacturing plants in India. This new legislation will not only assist semiconductor firms but will also create indirect and professional employment opportunities.

The government has introduced Design Link Incentives (DLI) to bolster the sector, in addition to existing initiatives like Chip to Startup (C2S) and the Electronic Components and Semiconductor Promotion Scheme. The government's 'Semiconindia Programme' promotes enterprises to enhance their investments in the semiconductor sector to mitigate the global chip shortage.

The Ministry of Electronics and Information Technology has introduced the Design Linked Incentive (DLI) Scheme to mitigate the disadvantages faced by the domestic semiconductor design industry, aiming to enhance its position in the value chain and fortify the semiconductor chip design ecosystem in the nation. Design Linked Incentive (DLI) Program: The initiative seeks to provide financial incentives and infrastructure support throughout the various phases of development and deployment of semiconductor designs for Integrated Circuits (ICs), chipsets, System on Chips (SoCs), systems, and IP cores, as well as semiconductor-related designs over a span of five years.

Objectives of DLI Scheme

- Nurturing and facilitating the growth of the domestic companies, startups and MSMEs.
- Achieving significant indigenization in semiconductor content and IPs involved in the electronic products deployed in the country, thereby facilitating import substitution and value addition in electronics sector.
- Strengthening and facilitating access to semiconductor design infrastructure for the startups and MSMEs.

The Production Linked Incentive (PLI) Scheme offers financial benefits to semiconductor manufacturers that opt to produce in India. This program allows qualifying firms to receive a portion of their increased sales as an incentive.

Last year, firms such as Taiwan's Foxconn and Vedanta were attracted to the production-linked incentive program, which offered assurances of multi-billion dollar investments for the creation of semiconductor manufacturing facilities, utilised in a wide array of products from autos to mobile phones.

The government has established Electronics manufacture Clusters (EMCs) nationwide to facilitate semiconductor manufacture. These clusters provide infrastructure, shared facilities, and a conducive atmosphere for enterprises in the semiconductor sector.

Challenges within the Indian semiconductor industry:

A significant challenge is India's ability to compete with established semiconductor production centres regarding cost efficiency and access to advanced technologies.

Infrastructure challenges and cost rivalry render international semiconductor manufacturers apprehensive about operating in India.

The Indian semiconductor business has a significant challenge due to inadequate state-of-the-art infrastructure. Contemporary semiconductor manufacturing plants are costly and occasionally eschewed by private entities due to the significant risk associated. To surmount this obstacle, governments must proactively champion investment in the semiconductor sector, both nationally and globally, by offering grants, financial incentives, and infrastructural support.

Semiconductor manufacturing facilities, referred to as "fabs," require substantial space, continuous power, and an abundant water supply. India's infrastructure is still under development concerning reliable water and power sources. Moreover, the positioning of airports and customs facilities is crucial for the import and export of vital components. In India, the customs clearance process may be protracted, and challenges arise from the inadequate infrastructure surrounding potential manufacturing sites.

The semiconductor and display manufacturing sector is a complex and technologically sophisticated domain that requires significant and ongoing investments due to huge capital expenditures, elevated risk, prolonged payback and gestation periods, and rapid technological improvements. The anticipated level of government support is insignificant when one evaluates the substantial investments typically required to establish production capacity throughout the many sub-sectors of the semiconductor industry.

Moreover, swift technological advancements are a hallmark of the semiconductor industry. Remaining at the forefront of innovation necessitates continual learning and adaptability.

Possibilities for Indian semiconductor businesses to access international markets and improve export capacities:

The World Semiconductor Trade Statistics (WSTS) organisation reports that India accounts for 0.5% of global semiconductor sales and 1% of total semiconductor trade. India has emerged as a significant participant in the semiconductor trade and sales. The United Nations Comtrade database indicates that, following a consistent annual decline in integrated circuit imports between $1.5 billion and $2 billion from 2014 to 2017, India's IC imports surged by 218% to $8 billion in 2018. India's integrated circuit imports rose to $12 billion in 2021.

India is set to emerge as a global leader in the semiconductor sector, with demand projected to exceed $80 billion by 2026 and $110 billion by 2030. The Indian electronics and semiconductors industry is seeing rapid expansion, with a compound annual growth rate (CAGR) of 25% projected through 2028, driven by increasing demand for compact electronics, the proliferation of the Internet of Things, and the launch of innovative consumer products. The objective of the Indian government is to establish a robust ecosystem for semiconductor manufacturing.

As production advances and design functions solidify, the semiconductor industry is projected to create a demand for 1.2 million employment in the country, including various professions such as engineers, operators, and technicians, necessitating a skilled talent pool.

CONCLUSION

The India Semiconductor Market Size is projected to attain USD 271.9 billion by 2032, growing at a CAGR of 25.7% from 2022 to 2032, in response to semiconductor demands. The Indian government has concentrated on several initiatives, including the Production Linked Incentive (PLI) Scheme, Design Linked Incentive (DLI) Scheme, and the Semiconindia Programme, necessitating the effective execution of semiconductor sector programs. In the 1980s, the Indian government sought to create a national leader in semiconductor manufacturing by replicating the techniques of China, Taiwan, Malaysia, Korea, and Singapore. However, we are unsuccessful in establishing a robust environment for the semiconductor business. In 2024, India has emerged as a prominent superpower, with its engineers comprising approximately 20% of the global semiconductor design workforce. The nation possesses sufficient resources for the semiconductor industry and a robust ambition to

dominate the global semiconductor sector. The government is focussing on partnerships and collaborations with local and international organisations and agencies to enhance cooperative research, commercialisation, and skill development for the Indian semiconductor industry.

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