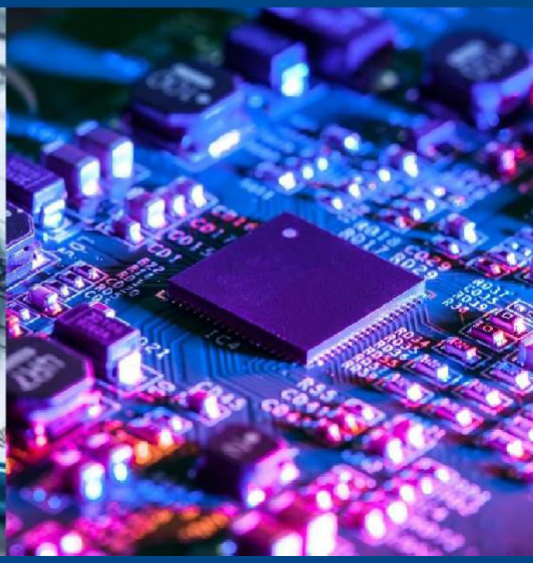
ISSN: 2582-7219





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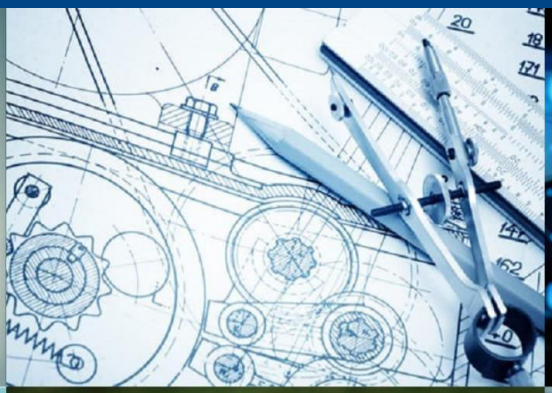

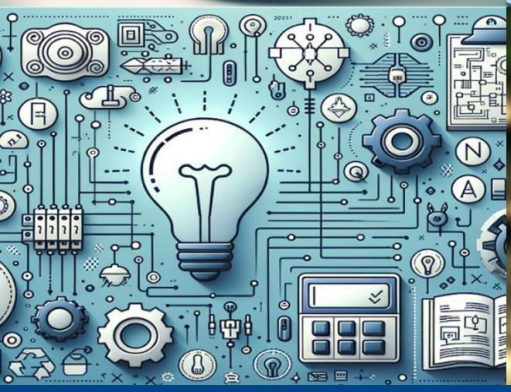

Impact Factor: 8.206

Volume 8, Issue 8, August 2025

© 2025 IJMRSET | Volume 8, Issue 8, August 2025| DOI:10.15680/IJMRSET.2025.0808024

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Growing Semiconductor Industry in India

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ABSTRACT: India's semiconductor industry is poised for significant growth as the country aims to reduce its dependency on imports by establishing a robust domestic semiconductor manufacturing ecosystem. Despite lagging behind nations like Taiwan, Japan, Korea, China, and the United States, India is making strides with government initiatives such as the SemiconIndia Program, the Production Linked Incentive (PLI) Scheme, and the Design Linked Incentive (DLI) Scheme. These Programme, alongside India's growing tech community, skilled workforce, and favourable policies, position the country to become a key player in the global semiconductor market. This shift also reflects a broader global trend to diversify the semiconductor supply chain away from China, with India emerging as a valuable hub for innovation and production. Semiconductors are critical to modern technology, and India's growing efforts are crucial for supporting the nation's technological and economic development.

I. INTRODUCTION

The rapid growth of the semiconductor industry is expected to have a transformative impact on India's economy and technological landscape. Semiconductors, being the foundation of modern digital devices and industries, are crucial for the country's shift towards technological self-reliance. Currently, India relies heavily on imports of semiconductors from countries like Taiwan, the U.S., and China, but the government's strategic focus on building a domestic semiconductor manufacturing ecosystem aims to significantly reduce this dependency. This could result in billions of dollars saved in foreign exchange, enhancing India's trade balance and economy. Several initiatives, including the SemiconIndia Programme, Production Linked Incentive (PLI) Scheme, and Design Linked Incentive (DLI) Scheme, are geared towards promoting local manufacturing and innovation in the semiconductor sector. These efforts align with India's Atmanirbhar Bharat (Self-Reliant India) and make in India programs, with a vision to enhance the country's capabilities in high-tech industries.

The semiconductor industry's growth will not only reduce import dependency but also lead to the creation of millions of skilled jobs, ranging from engineers and technicians to production workers and researchers. The industry will drive innovation in critical sectors such as telecommunications, automotive, and healthcare, where semiconductors play a key role in the development of technologies like 5G, AI, electric vehicles, and smart cities. The defence sector will also benefit from a robust domestic supply of semiconductors, enhancing national security and reducing reliance on foreign technologies. Additionally, the semiconductor boom will support India's Digital India initiative, accelerating the development of digital infrastructure and promoting the adoption of smart technologies. Globally, the semiconductor industry is shifting towards diversification due to supply chain disruptions and geopolitical tensions, positioning India as a promising hub for semiconductor manufacturing. With rising demand and government support, India is set to capture a significant share of the global semiconductor market, projected to reach $1 trillion by 2030.

II. PAST-PRESENT-FUTURE OF SEMICONDUCTOR INDUSTRY

India's semiconductor industry has its roots in the early post-independence era, shaped by the broader need to industrialize after nearly two centuries of deindustrialization under British rule. In the 1960s, Indian companies like Bharat Electronics Ltd. (BEL) began producing germanium semiconductors, marking the country's first steps into the industry. However, much of this early production was limited to the defence sector, and broader industrialization was

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slow. It wasn't until the 1980s, under Prime Minister Rajiv Gandhi's supervision, that the semiconductor industry saw a significant boost. The policies of the Gandhi Family, including relaxed licensing, lowered import duties on electronics, and foreign investment invitations, accelerated the growth of India's electronics and semiconductor sectors. The establishment of Semiconductor Complex Ltd. (SCL) in 1984 and the creation of a polysilicon facility by Metkem Silicon Ltd. in collaboration with BEL further strengthened India's position in the global semiconductor supply chain. Despite these efforts, India largely focused on producing older-generation chips while importing cutting-edge semiconductors from companies like Intel and Motorola.

India's semiconductor industry is undergoing rapid expansion, supported by various government initiatives aimed at fostering domestic manufacturing and reducing import reliance. Key programs like the SemiconIndia Programme and the Production Linked Incentive (PLI) Scheme are designed to attract global tech giants to invest in India's growing semiconductor ecosystem. The country is actively building infrastructure for fabrication units, or fabs, and strengthening its research and development capabilities. India's strategic focus is on diversifying the global semiconductor supply chain, which has faced disruptions due to geopolitical tensions and the COVID-19 pandemic. With an increasing demand for electronics, 5G technology, and electric vehicles, India is positioning itself as a future leader in semiconductor manufacturing. Major investments from international companies and a push for self-reliance under Atmanirbhar Bharat have made India a competitive destination for chip production, design, and innovation. While challenges like lack of existing infrastructure remain, India's strong talent pool and policy support are creating a conducive environment for growth.

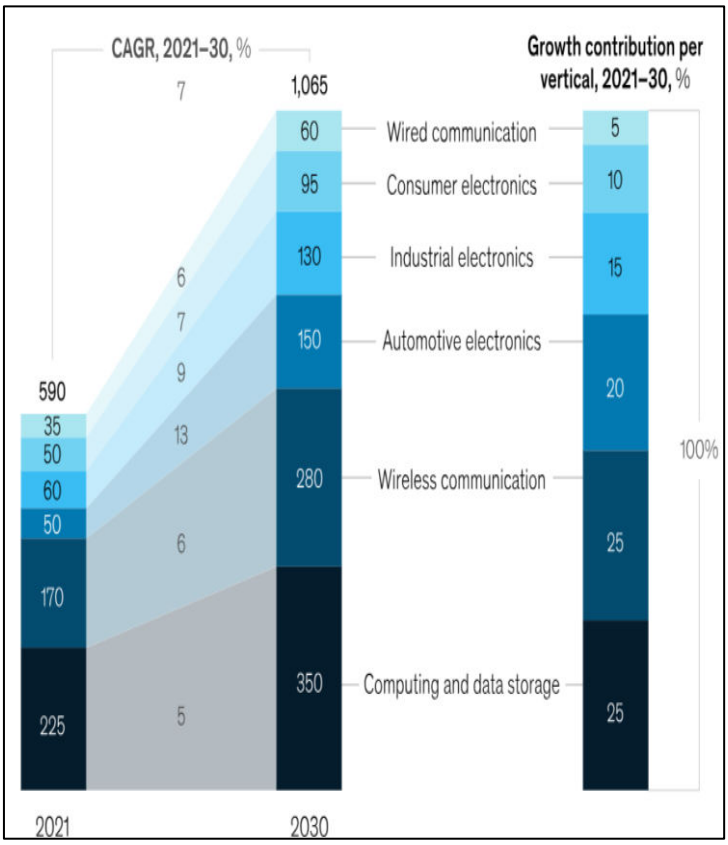

Fig.1: Global Semiconductor market value by vertical, indicative

India's future in the semiconductor industry looks promising, with a strategic focus on integrating cutting-edge technologies like AI, IoT, 5G, and quantum computing into chip manufacturing. The country is moving towards building advanced fabrication units capable of producing chips using sub-7nm processes, critical for modern electronics. Government initiatives such as SemiconIndia and the Production Linked Incentive (PLI) Scheme are driving this transformation, attracting both domestic and foreign investment. As India aims to reduce its dependence on

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imports, its expanding R&D in nanoelectronics and MEMS is vital. By fostering innovation in emerging technologies, India is preparing to be a significant player in the global semiconductor market, addressing challenges like supply chain disruptions and positioning itself as a self-sustaining tech powerhouse in the next decade. This move aligns with the country's broader vision of Atmanirbhar Bharat, promoting self-reliance and boosting the economy by becoming a global hub for high-tech industries.

SEMICONDUCTOR INDUSTRY & THEIR IMPACT ON INDIA:

The semiconductor industry is crucial for India's economic and technological growth. The government's initiatives, such as the $10 billion Production-Linked Incentive (PLI) scheme, aim to boost domestic semiconductor production and attract global players. This will strengthen India's position in the global supply chain, reduce dependence on imports, and drive advancements in industries like automotive, telecommunications, renewable energy, and consumer electronics. The ripple effect of this growth will enhance innovation, improve efficiency, and solidify India's role in the global tech landscape.

MANUFACTURING COMPANY IN INDIA:

India is home to several semiconductor manufacturing companies, with major players including SemIndia, which aims to establish a robust semiconductor ecosystem in the country by setting up state-of-the-art fabrication facilities. Micron Technology and GlobalFoundries have also made significant investments in India, focusing on research and development, as well as the production of advanced semiconductor components. These companies are crucial in advancing India's capabilities in semiconductor technology, contributing to both local innovation and global supply chain resilience.

Fig. 2:Leading Companies in Semiconductor Manufacturing

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SEMICONDUCTOR MANUFACTURING: INDIA vs CHINA:

India and China are both key players in the global semiconductor race, but their approaches differ significantly. China has long been a manufacturing giant, with advanced infrastructure, massive investments, and dominance in the semiconductor supply chain. India, on the other hand, is still developing its semiconductor manufacturing capabilities, focusing on government incentives like the PLI scheme to attract investments and build a domestic ecosystem. While China currently leads in production scale, India is rapidly positioning itself as a future player through policy-driven growth and strategic partnerships.

SEMICONDUCTOR POLICY &APPROVAL IN INDIA:

India's semiconductor policies gained momentum in the 1980s, when the government attempted to emulate successful strategies from countries like China, Taiwan, and Korea. However, the lack of an ecosystem hindered progress. In recent years, the government launched significant programs like the Production Linked Incentive (PLI) and Design Linked Incentive (DLI) schemes to attract global players and boost local manufacturing. The SemiconIndia Programme was also introduced, focusing on building a comprehensive semiconductor ecosystem, skill development, and research collaborations to make India a global leader.

INDIA'S STRATEGIC ROLE IN THE GLOBAL SEMICONDUCTOR SUPPLY CHAIN: LEVERAGING DESIGN EXPERTISE AND INTERNATIONAL COLLABORATION:

In the semiconductor supply chain, India often leverages its global connections for technology transfer and manufacturing. Indian engineers acquire design expertise and information from countries like the U.S., particularly in chip design. Meanwhile, much of the raw materials and product components are sourced from China. Finally, these components are assembled and manufactured in India. This system enables India to play a significant role in the global semiconductor ecosystem, leveraging its engineering talent while relying on international collaboration for full-scale production.

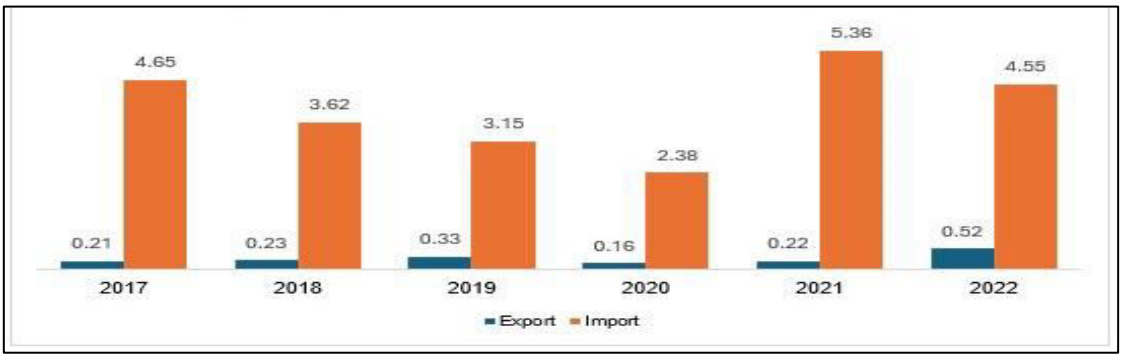

Fig.3: Export/Import of semiconductor devices

ECONOMIC OF INDIA DUE TO SEMICONDUCTOR:

The semiconductor industry has a profound impact on India's economy. As the country becomes a key player in the global semiconductor supply chain, it drives significant economic growth by attracting substantial foreign investment, creating high-tech jobs, and fostering innovation. The establishment of semiconductor manufacturing and design facilities bolsters local industries, enhances technological capabilities, and promotes the development of ancillary sectors such as electronics and telecommunications. Additionally, India's growing semiconductor sector helps reduce import dependency, strengthens trade balances, and positions the country as a critical hub in the global technology ecosystem, ultimately contributing to a more diversified and resilient economy.

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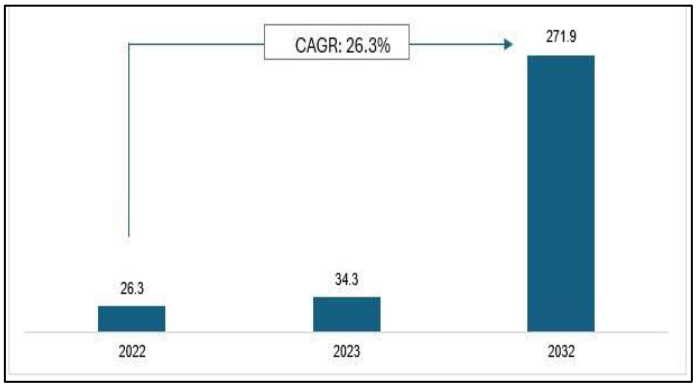

Fig. 4: India Semiconductor Market

GROWTH AND FUTURE OF THE SEMICONDUCTOR INDUSTRY IN INDIA:

India's semiconductor industry is on the rise due to global supply chain diversification away from China. Initiatives like the Indian Semiconductor Mission (ISM) and significant investments in fabs and chip design are propelling India forward. Key trends include a focus on smaller process nodes, AI/ML hardware, edge computing, and IoT solutions. India's talent pool and strategic investments in infrastructure, such as advanced fabs and testing facilities, position it as a major player. Security, sustainability, and supply chain resilience remain critical challenges.

LATEST TRENDS AND NEWS IN THE GLOBAL SEMICONDUCTOR INDUSTRY:

The global semiconductor industry is currently evolving with significant trends. Key advancements include smaller process nodes (e.g., 3nm and beyond), increasing demand for AI-driven hardware, and the rapid expansion of 5G networks. Moreover, edge computing and IoT devices are fuelling the need for high-performance, low-power chips. Supply chain disruptions, particularly during the COVID-19 pandemic, have also accelerated efforts to localize manufacturing. India's semiconductor sector is catching up, with collaborations and strategic partnerships with nations like the U.S. and Taiwan gaining momentum.

CHALLENGES AND SOLUTIONS: ECONOMICS, INDUSTRIAL DEBT AND STRATEGIC PARTNERSHIP:

India's semiconductor industry faces several challenges, including high capital costs, a lack of advanced manufacturing infrastructure, and dependency on global supply chains. Industrial debt, limited R&D capabilities, and fierce competition from established semiconductor hubs like China and Taiwan further complicate India's progress.

To overcome these challenges, India must strengthen strategic partnerships with global leaders in chip manufacturing, invest in research and development, and implement favourable policies to attract foreign investment. By fostering collaborations and developing its talent pool, India can enhance its self-reliance and global competitiveness.

III. CONCLUSION

India's semiconductor market is poised for exponential growth, with an expected market size of USD 271.9 billion by 2032, driven by a CAGR of 25.7%. Despite past challenges in building a semiconductor ecosystem, India is now making significant strides through initiatives like the PLI and DLI schemes, as well as strategic partnerships. With a highly skilled workforce and focused government policies, India is positioning itself as a global leader in semiconductor design and manufacturing, ready to meet growing global demands and contribute to technological advancements.

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