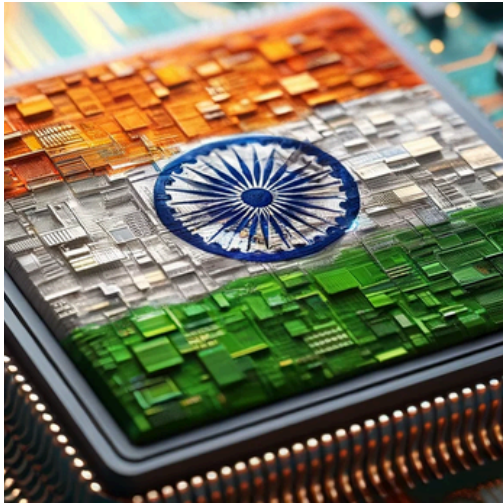


## THE SEMICONDUCTOR REVOLUTION

### SHAPING TECHNOLOGY, EMPOWERING INDIA



#### Introduction to Semiconductors

Semiconductors are materials that exhibit electrical conductivity between that of conductors (like copper) and insulators (like glass). This unique property allows semiconductors to play a critical role in modern electronics, enabling the development of devices such as diodes, transistors, and integrated circuits. Silicon, germanium, and gallium arsenide are some of the most commonly used semiconductor materials, with silicon leading the way in the fabrication of electronic circuits. The electrical properties of semiconductors can be precisely controlled through a process called doping, where small amounts of specific impurities are introduced into their crystal structure.



This process creates regions within the material that either supply free electrons (n-type) or create electron vacancies or "holes" (p-type). The junctions formed between these regions—called p-n junctions—are the foundation of many electronic components.

Semiconductors are the unsung heroes of modern technology, forming the foundation of countless devices that power our daily lives. These tiny components, with sizes measured in nanometres—far smaller than a human hair—enable the seamless operation of smartphones, electric vehicles, satellites, and even space exploration missions. Often referred to as the "brains" of electronics, semiconductors are essential for processing, memory, and connectivity in everything from personal gadgets to supercomputers.

The journey of semiconductors began in the early 19th century, culminating in a breakthrough in 1947 when Bell Labs unveiled the first practical transistor. This invention marked the start of the digital revolution, setting the stage for the creation of today's sophisticated semiconductor chips, which can contain over 50 billion transistors.

Semiconductors have also played a pivotal role in shaping economies and industries worldwide. Taiwan, for example, produces more than 60% of the world's semiconductors, with companies like TSMC leading global manufacturing.

Meanwhile, countries like India are becoming key players in design and innovation, with Indian engineers contributing to chips powering devices like iPhones and Tesla's.

The significance of semiconductors extends beyond Earth, powering space exploration missions like NASA's Mars rover. Their versatility and efficiency have made them indispensable in automotive, consumer electronics, and industrial applications. Despite their small size, semiconductors have a monumental impact on shaping the future of technology and innovation.

## Key Features of Semiconductors

- **Variable Conductivity:** Semiconductors can conduct electricity under specific conditions, such as when exposed to light, heat, or electrical fields. This versatility makes them ideal for sensors and energy conversion devices.
- **Doping-Enhanced Performance:** By introducing small amounts of impurities, the conductivity of semiconductors can be tailored for specific applications, such as amplifying signals or switching currents.
- **Temperature Sensitivity:** Unlike metals, whose conductivity decreases with rising temperatures, semiconductor conductivity increases with heat, making them highly responsive in various applications.
- **Applications in Modern Electronics:** Semiconductors are integral to everyday technology, from solar cells and LEDs to microprocessors and high-frequency communication systems. Gallium arsenide, for example, is widely used in laser diodes and microwave circuits.

- **Quantum Physics Foundation:** The behavior of charge carriers in semiconductors, including electrons and holes, is best explained through quantum mechanics, enabling innovations like transistors and integrated circuits.



## Paving the Path to a Global Hub.

- **Strategic Importance:** Semiconductors are indispensable across key industries like telecommunications, healthcare, automotive, defense, and consumer electronics. With India's rapid digital transformation, the domestic demand for semiconductors is poised to surge significantly.
- **India's Current Landscape:** Design Expertise, India contributes 20% of the world's semiconductor design engineers, with a strong presence in chip design services.
- **Manufacturing Gap:** India imports the majority of its semiconductors, spending over \$24 billion annually.
- **Key Investments and Partnerships:** Vedanta-Foxconn Joint Venture; ₹1.54 lakh crore investment to establish a semiconductor fab in Gujarat.
- **Micron Technology:** \$2.75 billion committed for an assembly, testing, and packaging plant in Gujarat.
- **ISMC and IGSS Ventures:** Proposed fabs in Karnataka and Tamil Nadu to bolster domestic manufacturing.

- **Semicon India Programme:** Launched in 2022 with a ₹76,000 crore allocation to enhance semiconductor manufacturing in India.
- **Offers:** Financial support for semiconductor and display fabs. Incentives for compound semiconductors and ATMP (Assembly, Testing, Marking, and Packaging) units. Funding for R&D and workforce development.
- **Emerging Ecosystem:** India is fostering collaborations with global semiconductor leaders, including the US, Taiwan, and Japan.
- **Efforts are underway to establish a semiconductor-grade silicon supply chain and advanced fabs in the country.**
- **Challenges in Building India's Semiconductor Ecosystem:** High Capital Requirements; Fabs require investments amounting to billions of dollars.
- **Skilled Workforce Shortage:** Manufacturing needs expertise distinct from chip design, necessitating specialized training.
- **Infrastructure Development:** Reliable power and water supply upgrades are crucial for semiconductor fabs.
- **Global Trends and Opportunities:** Geopolitical Shifts; As countries seek to reduce dependency on China, India emerges as a promising alternative for semiconductor manufacturing. Digital Push; Programs like Digital India and 5G rollout are driving demand for advanced semiconductor technologies. Electric Vehicles (EVs); The growing EV market relies on semiconductors for battery management and control systems.
- **Vision for the Future:** By 2030, India aims to establish itself as a global semiconductor hub, promoting local innovation and reducing reliance on imports.

A holistic approach involving policies, public-private partnerships, and skill development initiatives will be pivotal in realizing this vision.

## India's Semiconductor Revolution: Why SEMICON India 2024 Matters

India is making significant strides in the global semiconductor industry, fueled by a strategic combination of government initiatives, industry partnerships, and a skilled workforce. The country's ambition to become a major player in this critical

sector aligns with global trends and increasing domestic demand. SEMICON India 2024 stands at the forefront of this transformation, highlighting the opportunities and challenges shaping India's semiconductor ecosystem.

## A Booming Market with Immense Potential

Forecasts suggest that the Indian semiconductor market will exceed \$55 billion by 2026, driven primarily by three key sectors:

- **Smartphones and Wearables:** Demand for advanced chips to power next-generation devices.
- **Automotive Components:** A growing electric vehicle market requiring sophisticated semiconductor technologies.
- **Computing and Data Storage:** Expanding needs for cloud computing and high-performance data solutions.

By 2030, India's semiconductor ecosystem is projected to reach over \$100 billion, adding 600,000 new jobs and playing a vital role in the global semiconductor market, expected to touch \$1 trillion by then.

## Driving Momentum Through Strategic Investments

India's semiconductor surge has attracted the attention of global industry leaders. Companies like AMD, Applied Materials, Lam Research, and Micron Technology have announced substantial investments to develop India's semiconductor ecosystem.

### Key Initiatives Fueling Growth

India's ambition is supported by robust government incentives and forward-looking policies:

- **\$10 Billion Incentive Scheme:** Designed to attract semiconductor and display manufacturers and foster a domestic ecosystem.
- **Indian Semiconductor Mission:** A comprehensive initiative to expand semiconductor manufacturing and develop supply chain infrastructure.

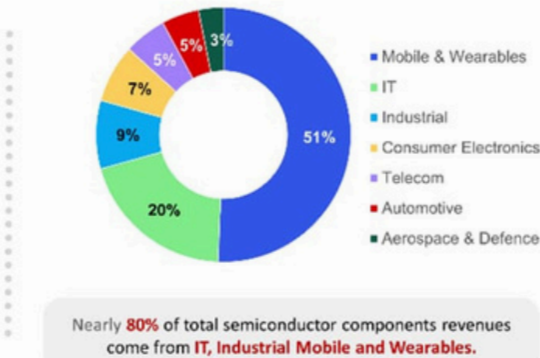


# India Semiconductor Market Dashboard, 2021-2026

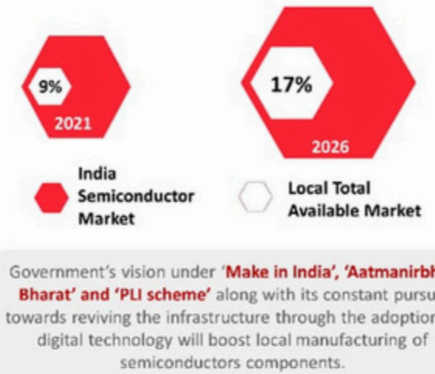
India Semiconductor Market  
Consumption in USD Billion and CAGR  
Growth between 2021-2026



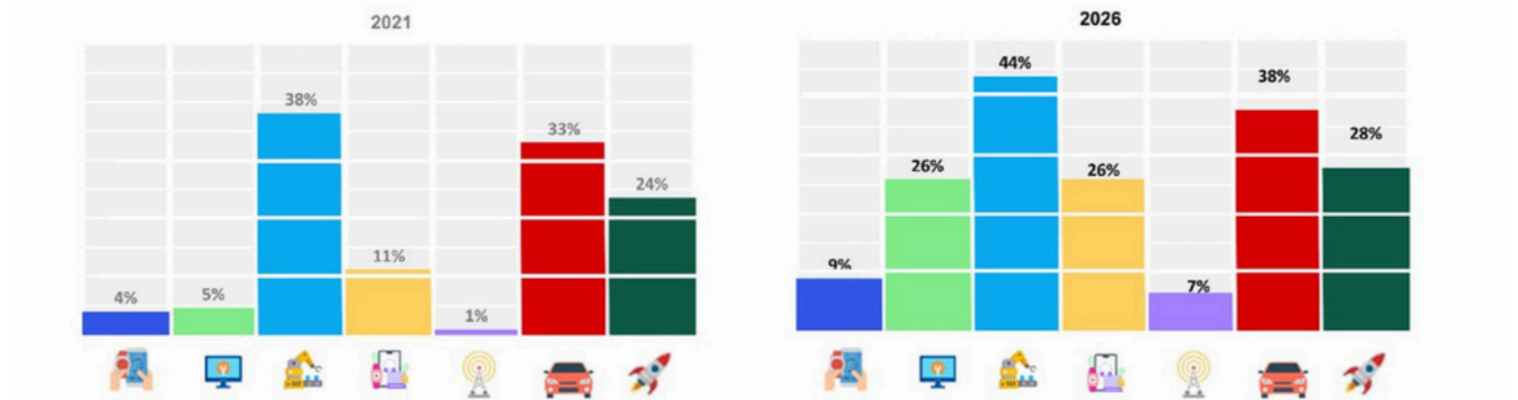
India Semiconductor Market Share by Sector in 2021



India locally Sourced Semiconductor Market Share, 2021 vs 2026



India Locally Sourced Semiconductor Components by Segments, 2021 vs 2026



- Research and Development Focus: Programs like the Semiconductor Research Consortium of India (SRCI) emphasize innovation and technical excellence.

## A Vision for the Future

With initiatives like SEMICON India 2024, India is positioned to emerge as a global leader in the semiconductor sector. Continued focus on public-private partnerships, skill development, and R&D investments will be instrumental in realizing this vision.

As India accelerates its journey, the country not only aims to meet domestic demand but also to become a vital part of the global supply chain, reshaping the technological landscape.

## Semicon India 2024: A Glimpse into the Future of Electronic

Semicon India 2024, held from September 11-13th in Greater Noida, marked a crucial moment for India's semiconductor ambitions.

The three-day event brought together global leaders, industry experts, and policymakers to discuss and shape the future. The event saw participation from over **250** exhibitors and **150** speakers, showcasing breakthrough technologies, discussing emerging trends, and emphasizing collaboration among industry, academia, and government.

Key topics included India's semiconductor manufacturing potential, research and development initiatives, and leveraging geopolitical shifts to position India as a reliable alternative in the global supply chain.

With a focus on public-private partnerships, skill development, and innovation, Semicon India 2024 highlighted the immense opportunities for India to meet growing domestic demand and become a vital part of the **\$1 trillion global semiconductor market by 2030**. This summit marked a significant milestone, solidifying India's role in shaping the future of electronics and advanced technologies.

## Key Highlights

- **Prime Ministerial Inauguration:** Prime Minister Narendra Modi inaugurated the summit, emphasizing the government's strong commitment to building a robust semiconductor ecosystem in India.
- **Global Participation:** The event hosted over 250 exhibitors and 150 speakers from around the world, showcasing cutting-edge technologies and sharing valuable insights into the latest industry trends.
- **Focus on Collaboration:** Semicon India 2024 underscored the importance of collaboration between the industry, academia, and government to foster innovation and tackle the challenges of semiconductor manufacturing.
- **Skill Development:** A central theme of the event was developing a skilled workforce to meet the growing demands of the semiconductor industry, ensuring that India remains competitive in the global market.

As India continues to bridge the gap in production and innovation, the future holds immense opportunities, both domestically and internationally.

With continued collaboration and focus on skill development, India is poised to play a pivotal role in shaping the future of technology.



## Conclusion

India is on the brink of a semiconductor revolution, with significant investments, government support, and a skilled workforce driving the sector's growth. SEMICON India 2024 has highlighted the country's potential to become a global hub for semiconductor design and manufacturing.