



# CURRENT AFFAIRS



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## SEMICONDUCTOR INDUSTRY IN INDIA

*This article covers "Daily Current Affairs" and the topic details "Semiconductor industry in India". The topic "Semiconductor industry in India" has relevance in the Science and Technology section of the UPSC CSE exam.*

### **Relevance:**

#### **For Prelims:**

*Facts about Semiconductors?*

#### **For Mains:**

**GS 3: Science and Technology**

*Facts about the global Semiconductor industry?*

*Reasons for India to Make Chips?*

*Advantages that India has?*

*Challenges Faced By India?*

### **Why in the news:**

US memory-chip maker Micron Technology announced it would set up an outsourced semiconductor assembly and testing plant at Sanand in Gujarat entailing an investment of \$2.75 billion.

### **Facts about Semiconductors?**

- Semiconductors are materials with unique electrical properties.
- They can transmit electricity under certain conditions but not in others.
- Semiconductors are used as the basis for computers and other electronic devices.
- They have the ability to control the flow of electrical current.
- Semiconductors are crucial components in electronic devices such as cars, smartphones, medical equipment, aircraft, and weapons.
- They are produced through a sophisticated process in chip fabrication plants (fabs).
- Semiconductors enable the creation of smaller, faster, and more efficient electronic devices.
- They have revolutionized industries and driven technological innovation.
- Semiconductors play a vital role in modern electronics and technology.

### **Facts about the global Semiconductor industry?**

- The global semiconductor industry is valued at approximately \$500-\$600 billion, serving the global electronics industry valued at around \$3 trillion.
- Semiconductor chips are made from silicon and consist of billions of microscopic transistors. They are designed to control the flow of current and follow specific computational instructions.

- The most advanced semiconductor technology nodes currently available are the 3 nanometre (nm) and 5nm nodes.
- Higher nanometre value semiconductors are used in applications such as automobiles and consumer electronics, while lower nanometre value semiconductors are used in devices like smartphones and laptops.
- Semiconductor fabrication units, or fabs, transform raw materials like silicon into integrated circuits that are incorporated into electronic hardware.
- China has surpassed Taiwan in terms of global sales share from fabs, leading to concerns about its dominance in the semiconductor industry.
- In response to this, the U.S. has enacted the CHIPS Act, providing significant subsidies and investments of over \$280 billion to manufacturers establishing fabs and producing semiconductors within the U.S.
- Additionally, there have been restrictions and sanctions imposed on the Chinese semiconductor industry as part of efforts to safeguard national interests and reduce dependence on foreign supply chains.

### **Reasons for India to Make Chips?**

- **Boosting Electronics Manufacturing:** India aims to promote electronics manufacturing as a strategic sector for its economic growth. By producing chips domestically, India can strengthen its electronics supply chain and reduce dependence on imports, particularly from China. This aligns with the government's vision of enhancing the domestic manufacturing ecosystem and attracting investments.
- **Reducing Import Dependency:** Currently, India heavily relies on imports for semiconductor chips, which can be a significant drain on foreign exchange reserves. By manufacturing chips domestically, India can reduce import dependency, enhance self-reliance, and improve its balance of trade in the electronics sector.
- **Job Creation and Skill Development:** Establishing a robust chip manufacturing industry in India would generate employment opportunities and contribute to skill development. It can create a significant number of high-value jobs, attract talent, and stimulate the growth of a skilled workforce specialized in semiconductor technology.
- **Attracting Investments and Diversification:** As companies worldwide seek to diversify their manufacturing bases away from China, India has an opportunity to position itself as a reliable destination for chip production. By establishing a strong semiconductor industry, India can attract foreign investments, foster technological collaborations, and strengthen its position in the global electronics market.
- **National Security and Strategic Autonomy:** Ensuring domestic chip production is crucial for India's national security and strategic autonomy. Relying on foreign countries for critical components like semiconductors can pose risks in terms of supply chain disruptions, security vulnerabilities, and geopolitical factors. Domestic chip manufacturing enables better control over the entire value chain and enhances India's self-sufficiency in critical technology sectors.

### **Advantages that India has?**

- **Design and Intellectual Labour:** A significant aspect of semiconductor manufacturing involves design and intellectual labour. India has an advantage in this area, as it boasts a substantial number of semiconductor design engineers, many of whom are Indian or of Indian origin. Companies like Intel and NVIDIA have established large facilities in India, which are already equipped with skilled Indian talent working on design challenges. This advantage becomes particularly significant as China faces sanctions and an aging population, potentially diminishing its control over the design aspect.

- **Large Consumer Base:** India has a massive domestic consumption market, being the world's largest populous economy. This offers a significant advantage in terms of semiconductor demand. As India's population continues to grow and the country experiences increasing urbanization and digitization, the demand for electronic devices and components, including semiconductors, is expected to rise. This domestic demand can serve as a strong driving force for the growth of the semiconductor industry in India.
- **Emerging Start-up Ecosystem:** India has witnessed the emergence of a vibrant start-up ecosystem in recent years, particularly in the technology sector. Several start-ups in India are focusing on semiconductor-related technologies, such as chip design, AI, and IoT. This entrepreneurial ecosystem provides opportunities for innovation, collaboration, and the development of indigenous semiconductor solutions, fostering the growth of the industry in the country.
- **Government Initiatives and Policies:** The Indian government has recognized the importance of semiconductor manufacturing and has introduced various initiatives and policies to promote the sector. Programs like "Make in India" and "National Policy on Electronics" aim to create a conducive environment for semiconductor manufacturing, attract investments, and develop the necessary infrastructure and ecosystem for the industry's growth.
- **Skilled Workforce:** India has a large pool of highly skilled engineers and technical professionals. The country's strong educational institutions and technical training programs produce a steady supply of talent that can contribute to the semiconductor industry. Additionally, India's young demographic profile ensures a sustainable supply of skilled labor, which is crucial for the success of the semiconductor manufacturing sector.

### Challenges Faced By India?

- **Costly and Capital Intensive:** Chip production is a highly capital-intensive process. Setting up a semiconductor fabrication facility (fab) requires a significant investment ranging from \$3 to \$7 billion. The high cost involved poses a challenge for attracting adequate investment and creating a competitive manufacturing ecosystem.
- **Lack of Fiscal Support from Government:** The level of fiscal support provided by the government for semiconductor manufacturing is relatively low compared to the massive investments required. Insufficient fiscal incentives and support may hinder the establishment of robust semiconductor manufacturing capacities in the country.
- **Lack of Latest Technology:** While India initially focuses on "lagging-edge" technology nodes to cater to sectors like automotive and appliances, creating global demand may be challenging. Countries like Taiwan already offer cutting-edge chip technologies worldwide, making it difficult for India to compete on the forefront of technology.
- **Water Efficiency:** Chip fabrication requires substantial amounts of ultrapure water on a daily basis. Ensuring a consistent and reliable water supply to semiconductor factories can be challenging, particularly in regions facing drought conditions. The availability of sufficient ultrapure water infrastructure is crucial for sustainable chip manufacturing operations.
- **Supply of Power:** The uninterrupted supply of electricity is vital for semiconductor manufacturing processes. Even slight fluctuations or spikes in power can result in significant financial losses. Ensuring a stable and reliable power supply is essential for the successful operation of semiconductor fabs.
- **Consumer Demand:** To sustain the growth of the semiconductor industry, there is a need to drive up consumer demand for electronic devices and components domestically. The government must work towards creating an environment that encourages consumer demand, ensuring that the industry remains viable without relying solely on taxpayer-funded subsidies.

**Source:**

<https://economictimes.indiatimes.com/tech/technology/government-in-talks-with-multiple-semiconductor-companies-for-major-investments-over-the-next-one-year-ashwini-vaishnaw/articleshow/101225195.cms>

**Q.1 Which of the following statements regarding semiconductors is correct?**

1. Semiconductors are materials that have electrical conductivity between conductors and insulators
2. Semiconductors are materials that only exhibit electrical conductivity in the presence of light.
3. Semiconductors are materials that possess high thermal conductivity and low electrical conductivity.
4. Semiconductors are materials that do not respond to changes in temperature.

**Select the correct option:**

- (a) A only
- (b) B only
- (c) C only
- (d) D only

**Answer: (a)**

**Q.2 Which of the following processes is involved in the manufacturing of semiconductor chips?**

1. Diffusion
2. Etching
3. Lithography
4. Doping

**Select the correct option from the choices given above:**

- (a) 1 and 2
- (b) 2 and 3
- (c) 1, 2, and 4
- (d) 1, 2, 3, and 4

**Answer: (d)**

**Q.3 Analyze the challenges faced by the semiconductor chips industry in India. How can the government and industry stakeholders work together to overcome these challenges and promote indigenous semiconductor chip manufacturing? Discuss with suitable examples.**

**Rishabh**