



Semiconductor Chip Manufacturing Technology

For Prelims: [Semiconductors](#), Centre for Development of Advanced Computing (C-DAC), Critical Information Infrastructures, Industry 4.0, [Production-Linked Incentive \(PLI\)](#)

For Mains: Significance of semiconducting devices in Indian economy, Need for promoting electronics and semiconductor industry, Role of electronics industry in making India self-reliant

[Source: TH](#)

Why in News?

Recently, the **TATA Group** collaborated with **Taiwan's PSMC** to establish a 300 mm (millimetre) **wafer fabrication plant** in Gujarat, with plans to launch its initial 28 nm (nanometer) chip in 2026.

- The **Indian Government** has also recently sanctioned two assembly and test plants in Gujarat and Assam.

What is a Semiconductor Chip?

- **About:**
 - **Semiconductor:** [Semiconductors](#) possess **electrical conductivity** properties **intermediate** between conductors and insulators, which can be modified by introducing **dopants**.
 - **Semiconductor chips, transistors, fabrication technology, and wafers are interdependent components** essential for electronic device **functionality**.
 - Transistors serving as the **building blocks** of semiconductor chips fabricated on wafers using specific technologies, enabling the creation of **complex devices** powering modern technology.
 - **Semiconductor Chips:**
 - It is a tiny electronic device made of semiconductor material (usually silicon or germanium) which serves as the **basic building block** of most electronic circuits.
 - These chips can contain billions of [microscopic switches](#) on a chip smaller than a fingernail.
 - The basic component of a semiconductor chip is a **silicon wafer** etched with tiny transistors that control the flow of electricity according to various computational instructions.
 - It performs various functions, such as **processing data**, storing information, or controlling electronic devices.
 - They are a **critical part** of almost every modern electronic device, including smartphones, computers, and integrated circuits.
 - **Transistor:**
 - [Transistors](#) are fundamental components of semiconductor devices that amplify or switch electronic signals and electrical power.
 - They are the building blocks of modern electronic devices and are used in various

applications, including amplifiers, switches, and digital circuits.

- **Fabrication Technology:**

- **Fabrication technology** refers to the process of creating semiconductor devices like chips and transistors. It involves several key steps, including **wafer preparation**, photolithography, etching, doping, and packaging.

- **Wafer:**

- A wafer (also called a slice or substrate) is a **thin slice of semiconductor** material, such as **crystalline silicon**, used for the fabrication of integrated circuits.
- A **semiconductor chip** is produced by printing an array of chips on a **circular semiconductor wafer**, similar to how postage stamps are printed on a sheet and then cut out individually.
- **Larger wafer sizes** in the industry enable more chips to be printed on a single wafer, **accelerating** and **reducing** the cost of chip production, despite the technical challenges and initial capital expenses involved.

SEMICONDUCTORS

Semiconductors are materials having conductivity between conductors and insulators

EXAMPLES

- **Pure Elements:** Silicon and Germanium
- **Compounds:** Gallium Arsenide and Cadmium selenide

SIGNIFICANCE

- Essential to almost all sectors of the economy - **aerospace, automobiles, communications, clean energy, information technology** and **medical devices** etc.

SEMICONDUCTORS AND INDIA

- **India Imports from:** China, Taiwan, USA and Japan
- **Indian Semiconductor Market:** Expected to reach **USD 55 bn** by **2026**

SCHEMES

- ↳ **Production-Linked Incentive (PLI) scheme**
- ↳ **Design Linked Incentive (DLI) Scheme**
- ↳ **Scheme for Promotion of Manufacturing of Electronic Components and Semi-conductors (SPECES)**

OBJECTIVES

- ↳ Encourage semiconductor and display manufacturing in the country.
- ↳ Nurture >20 domestic companies in semiconductor design
Achieve a turnover of > Rs.1500 crore in next 5 years
- ↳ Manufacture electronics components and semiconductors

INDIA'S SEMICONDUCTOR MISSION (ISM)

VISION

- Build a **vibrant semiconductor and display design and innovation ecosystem**

LAUNCHED

- 2021

NODAL MINISTRY

- Ministry of Electronics and Information Technology (MeitY)

TOTAL FINANCIAL OUTLAY

- Rs 76,000 crore

COMPONENTS

- Scheme for setting up of Semiconductor Fabs
- Scheme for setting up of Display Fabs
- Scheme for setting up of Compound Semiconductors/Silicon Photonics/Sensors (including MEMS) Fabs/ Discrete Semiconductors Fab and Semiconductor ATMP/OSAT
- DLI Scheme

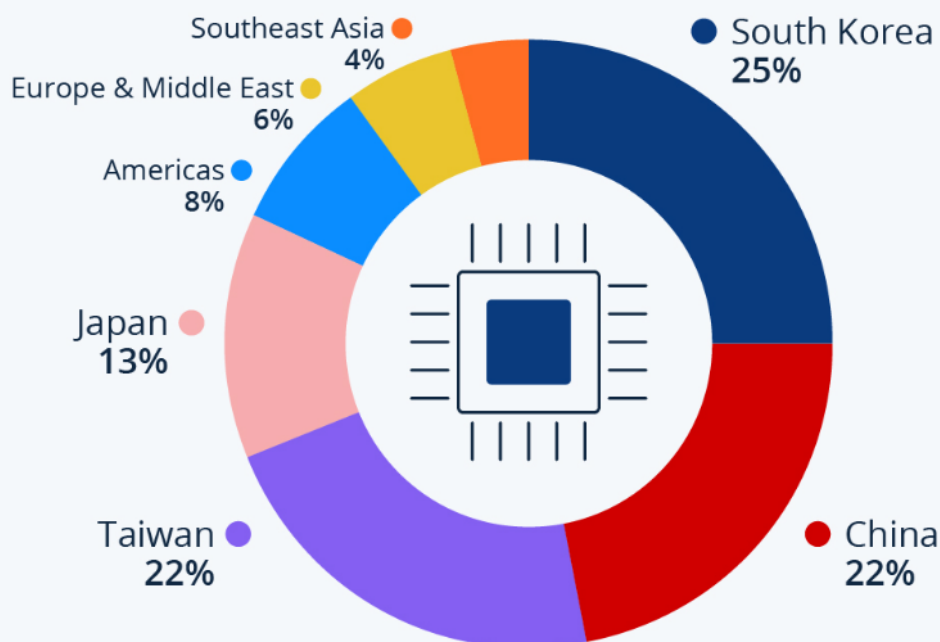


What is the Status of India's Semiconductor Ecosystem?

- India is actively pursuing the development of a **robust semiconductor ecosystem**. With its large market potential, talent pool, and government support. India aims to **reduce dependence on imports** and establish **domestic manufacturing capabilities**.
- India's established chip design industry **since the 1990s** will aid its semiconductor manufacturing efforts, offering opportunities for various professionals beyond electronics and computer engineers.
- **Key Advantages:**
 - **Market Potential:** India's rapidly growing population and burgeoning middle class create a **strong demand** for semiconductor products.
 - India's semiconductor market is projected to reach **\$55 billion by 2026**, reflecting its focus on domestic manufacturing.
 - **Talent Pool:** India emphasises **skill development** and innovation, encouraging domestic chip design skills.

Where Can the Most Chips Be Manufactured?

Distribution of global semiconductor fabricating capacity in 2022, by location*



* 300mm fabs

- **Initiatives Taken by the Government for the Semiconductor Sector:**
 - **Production Linked Incentive scheme (PLI)**
 - **Digital RISC-V (DIR-V) program** for the production of microprocessors.
 - **Modified Special Incentive Package Scheme (M-SIPS) for Semiconductors.**
 - **Chips to Startup (C2S) Programme** to train high-quality engineers.

Drishti Mains Question:

Q. Explore the obstacles, policy suggestions, and potential changes needed to enhance growth in India's semiconductor sector.

UPSC Civil Services Examination, Previous Year Question (PYQ)

Prelims:

Q. Which one of the following laser types is used in a laser printer? (2008)

- (a) Dye laser
- (b) Gas laser
- (c) Semiconductor laser
- (d) Excimer laser

Ans: (c)

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