



## Producing a Perfect Semiconductor Chip

### Why in news?

Many businesses are taking steps to untangle their supply chains and forging closer relationships with chip firms to secure supplies in the long term.

### What are semiconductors?

- A semiconductor is a material product usually comprised of silicon, which conducts electricity more than an insulator, such as glass, but less than a pure conductor, such as copper or aluminum.
- Success in the semiconductor industry depends on creating smaller, faster, and cheaper products.
- The bulk of semiconductor manufacturing and supply capability concentrated in a handful of countries including Taiwan, South Korea, U.S., Japan and China.
- **Properties**
  - Serves as an insulator at zero Kelvin
  - Functions as a conductor as the temperature increases.
  - Can be doped to make the semiconductor devices ideal for energy conversion, switches, and amplifiers There are fewer power losses.
  - Have higher resistivity than conductors but a lower resistivity than insulators
  - As the temperature increases, the resistance of semiconductor materials decreases, and vice versa.

### Why is semiconductor so significant?

- All modern-era digital devices, as well as future innovations, rely on the semiconductor sector.
- These discrete elements drive almost all upcoming technologies, including AI, cloud computing, quantum computing, enhanced wireless networks, blockchain applications, etc.
- Semiconductors also have their application in bitcoin mining, 5G, IoT, self-driving vehicles, drones, robots, gaming, and wearables.

### What are the roadblocks for India?

- **Huge initial investment**- Multi billions of dollars are needed to set up a manufacturing unit.
- **Water constraints**- A single chip requires hundreds of litres of pure water, which may be difficult to come by in sufficient amounts in our topography.
- **Electric supply**- One of the most important components of semiconductor manufacturing is a consistent and stable electrical supply.
- Even a brief outage or power spike may take hours or days to recover from.

- **Technology-** The process starts with a common material, like sand, and finishes with advanced circuitry made up of many transistors, such as a microprocessor.
- To develop a semiconductor chip, manufacturing companies must go through several different designing and manufacturing phases and procedures like silicon plant, water fabrication, test and assembly.

*The Centre has sanctioned the Production-Linked Incentive (PLI) and Design Linked Incentive (DLI) schemes to encourage the manufacturing of various semiconductor goods within India.*

## What are the factors that can increase the pace of semiconductor production?

- **Infrastructure-** Infrastructure must incorporate capacity planning, logistics, and manufacturing outsourcing in addition to production and quality control.
- Proper supply chain, government support and funding are key factors required for manufacturing semiconductors.
- **Power semiconductors-** Power semiconductors have a different structure than ordinary semiconductors, which allows them to withstand high voltages and big currents without damage.
- They are essential for the efficient and sustainable use of energy because they can transfer energy across vast distances with low losses.
- **Clean Energy India-** With a large number of countries racing to build sustainable alternatives to curb fossil fuel emissions, wind energy and solar PV installations have recorded unparalleled growth.
- Power semiconductor manufacturers believe that Gallium Nitride (GaN) and Silicon Carbide (SiC) based devices hold the key as it provides scalable power conversion and storage solutions.
- **Water-** According to the International Technology Roadmap for Semiconductors (ITRS), device fabs utilise 7 liters/cm<sup>2</sup> of UPW per wafer out.
- The conversion of raw water to water of ultrahigh purity is a significant and costly activity for all semiconductor fabs.
- **Policy-** Because the semiconductor value chain is interrelated and linked with several industries, governments must develop policies that address all the crucial characteristics in the long run.
- Government policies should focus on assuring and securing access to foreign technology suppliers through trade and foreign policy to ensure a global level of collaboration.

*For developing a sustainable semiconductors and display ecosystem, an independent India Semiconductor Mission (ISM) will be set up.*

## Reference

1. <https://www.thehindubusinessline.com/opinion/how-can-india-produce-a-perfect-semiconductor-chip/article65249022.ece>



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