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/cm2 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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