Possibility of a Semiconductor Crisis

What is the issue?

Supply of semiconductors, which was affected due to Covid-related disruptions but had started picking up as manufacturing chains normalised, is now being threatened once again by the Ukraine crisis.

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 was there a shortage in semiconductors?

- The beginning of the Covid-19 pandemic and the subsequent lockdowns across the world forced chip-making facilities to shut in countries like Japan, South Korea, China and the US.
- The Russia-Ukraine crisis has distrupted the supply of two key raw materials for the production of semiconductor chips— neon and palladium.
- The period of semiconductor shortage is a function of two variables
    - The existing stockpiles of these raw materials with chip manufacturers
    - The time for which the crisis in Ukraine prevails

Russia supplies over 40 % of world's palladium and Ukraine produces 70 % of neon.

Why are neon and palladium important for chipmaking?

- **Neon**- Neon gas is used in the photolithography process that is the most common method for fabricating integrated circuits.
- But for use of neon gas in the semiconductor industry, the gas has to reach 99.99% purity

levels which make it a rarity.
- **Palladium**- Palladium is used to coat electrodes that help control flow of electricity.
- It is also used in plating of microprocessors and printed circuit boards which is an essential process of chip making.

What are the constraints in semiconductor production?

- A typical semiconductor value chain includes strong research and development followed by design, production, assembly, testing and distribution and logistics network.
- Several supply-side constraints inhibiting its local manufacturing include
    - Inadequate availability of ultra-pure and clean water and clean sand used for growing wafers
    - Uninterrupted quality electricity supplies
    - Controlled pollution free environment, etc.
- Inadequate logistics and absence of proper waste disposal have further exacerbated the poor state of its production.
- Heavy investments into establishing production lines both in terms of capital and gestation period do not encourage private players to venture into it.

What efforts were taken by the government to boost semiconductor production?

- **PLI Scheme**- The Cabinet has recently approved the Production Linked Incentive (PLI) scheme for the semiconductor industry.
- The outlay of Rs.76,000 crore spread over a period of six years for the development of semiconductors and display manufacturing ecosystem aims to boost the semiconductor production.
- This move claims to attract Rs. 1.7 lakh crore private investment in India.
- **India Semiconductor Mission**- For developing a sustainable semiconductors and display ecosystem, an independent "India Semiconductor Mission (ISM)" will be set up.

What is the way forward?

- A global platform such as Quad can come forward to collaborate and put resources in research, technological know-how, access to critical technologies and materials logistics and other market support.
- Cooperation with consortium like ASEAN can further help to address the supply constraints with regard to semiconductor chips.
- Technical collaboration with Vietnam can be promted as it is home to many technical research and academic institutes in the area of microchip design and development.
- Any collaboration with countries such as Bangladesh, Taiwan which are champions of competitive manufacturing, can open doors of opportunities for low-cost manufacturing.

References

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