

## 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 disrupted 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 prompted 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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