

SCIENCE AND TECHNOLOGY

Semiconductor Fab: The Unfinished Agenda

In Context : Semiconductor fabrication represents the ultimate frontier of human tech advancement.

About Semiconductors:

What are Semiconductors?

- ✓ Semiconductors are the thumbnail-sized building blocks of almost every modern electronic device from smartphones to connected devices in the Internet of Things (IoT).
- ✓ They help give computational power to devices.

Components:

- ✓ The basic component of a semiconductor chip is a sliver of silicon, which is etched with billions of microscopic transistors and projected to specific minerals and gases, forming patterns to control the flow of current while following different computational instructions.

Semiconductor nodes and uses:

- ✓ The **most-advanced** semiconductor technology nodes available today are the **3 nanometre (nm) and the 5nm** ones.
 - Semiconductors having **higher nanometre value** are applied in **automobiles, consumer electronics** and so on.
 - Those with **lower values** are used in devices such as **smartphones and laptops**.

Semiconductor fabs: Semiconductor fabrication plant is a factory for semiconductor device fabrication.

Semiconductor Industry

• **The global semiconductor industry:**

- ✓ The global semiconductor industry is currently valued at **\$500-\$600 billion** and caters to the global electronics industry currently valued at **about \$3 trillion**.
- ✓ The chip-making industry is a highly-concentrated one, with the big players being **Taiwan, South Korea and the U.S.** among others.
 - 90% of 5 nm (nanometre) chips are mass-produced in Taiwan, by the Taiwan Semiconductor Manufacturing Company (TSMC).
- ✓ **Issue of the global chip shortage:**
 - **U.S.-China tensions over Taiwan**, and the **supply chain blockages owing to the Russia-Ukraine conflict** have led major economies to enter the chip-making sector with a renewed push.

• **India's semiconductor sector:**

- ✓ The country's electronics and semiconductor products manufacturing sector has witnessed a quantum growth in the last almost a decade.
- **Import & manufacturing:**
- ✓ In 2014 some 92% of the mobile devices sold in the country were imported while in 2022 some 97% of mobile devices were manufactured in the country.

Potential

- In 2014, the country's electronics ecosystem that comprises manufacturing, designing, innovation and production pegged \$10 billion, and in 2022 it grew to \$75 billion and expected to cross \$300 billion by 2025-26.
- **FDI in the sector:** Electronics and semiconductor sector captured 66% of the FDI that came to India in the last three years.
- **Sector specific production:** The electronic devices industry is segmented as Mobile Phones (24%), Consumer Electronics (22%), Strategic Electronics (12%), Computer Hardware (7%), LEDs (2%) and Industrial Electronics (34%) comprising Auto, Medical and other industrial electronic products.
- **Demand:** Technology transitions such as the rollout of 5G networks and IoT are driving the accelerated adoption of electronics products.
- Initiatives such as 'Digital India' and 'Smart City' projects have raised the demand for IoT in the electronics devices market and will undoubtedly usher in a new era for electronic products.

Challenges

- **Setting Up of Semiconductor fabs:**
- ✓ Semiconductor fabrication represents the ultimate frontier of human tech advancement. But the progress of miniaturisation is accompanied by higher complexity and costs.
- ✓ Investment in a semiconductor fab is one of the riskiest. Billions of dollars need to be recovered before the technology becomes obsolete.
- **Challenges of chip manufacturing:**
- ✓ Developing an ecosystem for chip manufacturing in a greenfield location is a major challenge.
- ✓ Hundreds of chemicals and gases are required for chip fabrication, people need to be trained, and abundant clean water be made available. But above all is the art of chip-making.
- ✓ Despite the best of equipment, poor quality and low yields can make fabs fail.
- **Need for an advanced technology:**
- ✓ There are other issues, such as whether to set up a logic/processor, memory or analog fab.

- ✓ Electronic equipment and its functionalities are characterised by their logic chips, which are therefore strategically important and generate the highest profit.
- ✓ The most advanced set of technologies is needed to manufacture them.
- **China's monopoly in the sector:**
- ✓ Elaborating on the opportunities for India currently, he said electronics and semiconductor products today was a \$1.5 trillion industry with China solely accounting for almost 75% of it and having enjoyed a monopoly in the sector for over two decades now.

Lessons from China & way ahead

- India's strategy has been to set up a new logic fab. China, which acquired loss-making fabs and then set up its own logic fab, provides lesson.
- **Acquiring existing fabs has many advantages:** They are reasonably priced, have stabilised technology, a supply chain ecosystem, an established product line, and market.
- ✓ They will enable India to build the fab ecosystem and train human resources.
- ✓ Much lower subsidies would be required, and the funds saved could be used for advanced R&D in fab technologies which will help build state-of-the-art fab in next few years.
- **Another strategy could be setting up ATMPs:** Tessolve, now acquired by Tatas, had set up an ATMP in 2013-14. This ATMP is successfully packaging chips upto 7 nm feature size. China has over 100 ATMPs.
- ✓ China started on the fab journey about 20 years ago. As the Chinese saying goes, the best time to plant a tree was 20 years ago, but the second best time is now.

ENVIRONMENT

Carbon Offsetting

IN CONTEXT: Delta Air Lines in 2020 marketed itself as the “world’s first carbon-neutral airline”, but recently California-based Mayanna Berrin filed a lawsuit against Delta arguing that the airlines’ assertions were bogus, misleading and false.

What does the lawsuit say?

- ✓ The lawsuit accuses Delta of misleading customers with its sustainability pledges.
- ✓ Criticism includes, “inaccurate accounting” of projects where reductions would have occurred regardless of carbon market involvement; failure to immediately offset emissions; relying on impermanent solutions such as building projects (like forests) that may be destroyed by natural hazards.

Carbon Offsetting

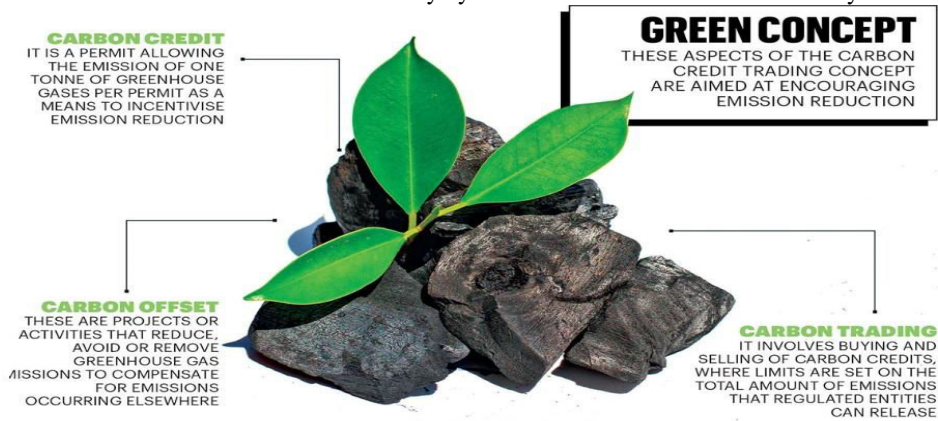
- ✓ It's a slew of ways companies adopt to reduce or remove carbon emissions from the environment. Activities like planting trees, shifting to cleaner fuel and funding carbon capture techniques in theory balance out a company's carbon emissions.
- ✓ For example – company A could offset its unavoidable emissions by purchasing carbon credits from company B that is in the business of, or uses, renewable energy. Company B in exchange would set up a new solar plant or a new wind farm or carry out reforestation initiatives. In this case, B benefits from clean energy and A from its reduced carbon footprint.

Carbon Insetting

- ✓ It focuses on doing more good rather than doing less bad within a value chain.
- ✓ It is the implementation of nature-based solutions such as reforestation, agroforestry, renewable energy and regenerative agriculture.

Greenwashing

- ✓ Greenwashing is the act of making false or misleading statements about the environmental benefits of a product or practice.
- ✓ It can be a way for companies to continue or expand their polluting as well as related harmful behaviors, all while gaming the system or profiting off well-intentioned, sustainably minded consumers.
- ✓ The term was coined back in 1986 in an essay by environmentalist and then student Jay Westerveld.



Carbon Markets

- ✓ It is a mitigation strategy which is becoming popular with several countries to meet their nationally determined contributions (NDCs).
- ✓ Article 6 of the Paris Agreement provides for the use of international carbon markets by countries to fulfill their NDCs.

Carbon Credit: A carbon credit is a kind of tradable permit that, per United Nations standards, equals one tonne of carbon dioxide removed, reduced, or sequestered from the atmosphere.

Carbon allowances or caps: Caps are determined by countries or governments according to their emission reduction targets.

Criticism against Carbon Offsetting:

- ✓ It is criticised for appealing to climate consciousness without real effort or impact. Greenpeace describes it as paying lip service to climate action.
- ✓ One line of scrutiny is about the efficacy of offsets in general — growing evidence shows reforestation as a climate adaptation programme is ineffective and misleading. They failed to sequester the carbon in the first place, or the gains made were quickly reversed or inflated.
- ✓ Another concern hints at the moral problem of greenwashing, where big polluters continue to use fossil fuels and opt for a cheaper route to cutting emissions by way of offsets, all while middle- and low-income nations struggle with climate realities.
- ✓ Experts also argue it lulls people into thinking they are contributing to the environment. One 2015 working paper found that global CO2 emissions would have been 600 million tonnes lower if countries had cut pollution at the source instead of buying offsets.
- ✓ Offset programs work only when they remove or reduce carbon emissions that wouldn't have been eliminated otherwise, what is called "additionality".
- ✓ Paying to conserve rainforests that no one was planning to cut, doesn't amount to offsetting carbon emissions. Proving additionality is a structural challenge, for it is hard to track the genuine progress of activities on the ground.
- ✓ Factors such as double-counting and additionality have the potential to reverse the impact of carbon markets from positive to negative. Ex. Company A pays company B for the offset project and both entities count the emissions reduced in their respective books – this is known as double counting. Similarly, company A pays company C for reforestation initiatives that were slated to happen anyway – this would be considered additionality.

Initiatives Taken:

❖ **Global**

I. Clean Development Mechanism:

- ✓ The CDM allows emission-reduction projects in developing countries to earn certified emission reduction (CER) credits, each equivalent to one tonne of CO2.
- ✓ These CERs can be traded and sold, and used by industrialized countries to meet a part of their emission reduction targets under the Kyoto Protocol.
- ✓ The CDM is the main source of income for the UNFCCC Adaptation Fund, which is financed by a 2% levy on CERs issued by the CDM.

II. CORSIA:

- ✓ Carbon Offsetting and Reduction Scheme for International Aviation, is the first global market-based measure to reduce emissions from international aviation, minimizing market distortion, while respecting the special circumstances and respective capabilities of ICAO Member States.

❖ **Indian**

- I.** PAT (Perform, Achieve and Trade), a market-based scheme, has already prevented CO2 emissions of up to 92 million tonnes during its 1st and 2nd cycles.
- II.** Indian Carbon Market (ICM): with an objective to decarbonise the Indian economy by pricing GHG emissions through trading of carbon credit certificates and in compliance with Article 6.2 of the Paris Agreement.
- III.** Carbon Credit Trading Scheme that is expected to be notified in June 2023 with Carbon Credit Certificates under it are expected to be available for trading by 2025.

What is needed?

- ✓ There is an urgent need for companies and countries alike to identify high integrity projects that adhere to robust climate methodologies.
- ✓ While an important tool, carbon offsetting can't be considered a substitute for direct emissions reductions. Airlines should focus on decarbonising commercial aviation, with the help of sustainable aviation fuel (SAF), hydrogen, and full-electric propulsion techniques rather than making false claims.

PRELIM FACTS

1. TITAN:

IN CONTEXT: A tourist submersible (Titan) went missing with five people on board during a dive to explore the wreck of the Titanic.

What are submersibles?

- ✓ Submersibles are small, limited range watercrafts designed for a set mission, that are built with characteristics that allow them to operate in a specific environment
- ✓ While some submersibles are remotely-operated—essentially manually controlled or programmed robots—these usually operate unmanned.

How are submersibles safely retrieved?

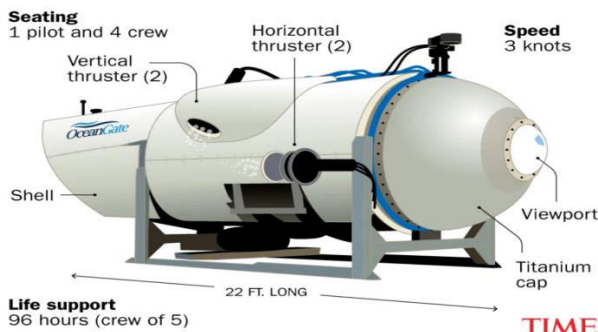
- ✓ Submersibles always operate in conjunction with a mother ship. They are typically launched on a raft or platform which is placed into water and ultimately descends down via four electric thrusters which help it to reach speeds of 3 knots.
- ✓ When it returns to the surface, it must be loaded back onto the surface platform.

Submersible vs Submarine:

- ✓ A submersible is smaller than a submarine.
- ✓ A submersible has very limited power reserves so it needs a mother ship that can launch it and recover it. In comparison, a submarine has enough power to leave port and come back to port under its own power.
- ✓ Submarines can propel themselves forward through the water using propellers or jets that shoot out water. These can be powered by diesel engines, or even nuclear reactors, and do not need a support ship to launch.
- ✓ Unlike submarines, submersibles also have a viewport and external cameras to view the outside space surrounding the vessel.

The Titan submersible

Built by OceanGate, the Titan is designed to take 5 people to ocean depths of up to 13,123 ft.— almost 2 1/2 miles underwater



Titan: Tourist submersible

- ✓ The Titan was made of titanium and carbon fibre.
- ✓ It was designed to transport five people to depths of around 4,000m in order to reach the Titanic shipwreck.
- ✓ It weighs around 10,432 kilograms and can also take on speeds of about 3 knots, or 5.5 kilometres per hour.

2. Chashma-V nuclear Plant

IN CONTEXT: Recently, China inked an agreement with Pakistan to set up a 1,200-megawatt nuclear power plant at Chashma in the Mianwali district of Punjab.

About the project

- ✓ Under this project, Pakistan is getting an investment of \$4.8 billion from China which “sends the message that Pakistan is a place where Chinese companies and investors continue to show their trust and faith”.
- ✓ Pakistan's Chashma power plants are considered a key in the production of cheap nuclear power.
- ✓ The nuclear power plant agreement signing as a token of increasing economic cooperation between Pakistan and China.

3. DAKSHTA

IN CONTEXT: A new online course ‘DAKSHTA’ (Development of Attitude, Knowledge, Skill for Holistic Transformation in Administration) for young professionals, is now live on the iGOT Karmayogi platform.

About iGOT (Integrated Government Online Training) Karmayogi platform:

- ✓ It is a comprehensive portal to guide government officials in their capacity-building journey.
- ✓ The portal combines six functional hubs for online learning, competency management, career management, discussions, events and networking.
- ✓ It is tailored for young professionals and consultants engaged in government.
- ✓ Karmayogi Bharat, a government-owned, not-for-profit special purpose vehicle, has been established by the Department of Personnel and Training (DoPT).
- ✓ Its primary responsibility is to own, manage, maintain, and improve the iGOT Karmayogi platform

ANSWER WRITING

Q. To what extent Dalit Movements of post-independent India has empowered the Dalits? Explain various constitutional, legal and policy measures taken by the government to empower them.

Introduction: Dalit mobilization at all India level had started prior to independence with the efforts of Ambedkar, it gained momentum with mobilization efforts of Post Independent Indian organisations like Republic Party of India (RPI), Dalit Panther, Bahujan Samaj Party (BSP) etc.

Dalit Movements of post-independent India has empowered the Dalits as:

- ✓ **Constitutional protection:** Article 17 of Indian Constitution denounces an act of untouchability. All India scheduled caste Federation (AISCF), ILP and similar organisations had played a crucial role to protect dalits from untouchability.
- ✓ **Legal protection:** The Protection of Civil Rights Act 1955, the SCs & STs (prevention of atrocities) Act 1989 etc. acts were enacted to protect Dalits from Social discrimination, to protect their civil rights.
- ✓ **To mobilize and strengthen the voice of Dalits:** Political organisations like RIP, Dalit Panther, etc. have been successful in mobilizing the Dalits and to act it as a pressure group for achieving their interests.
- ✓ **Political Representation:** Success of political parties -Republican Party of India (RPI), Bahujan Samaj Party (BSP), and many more – have given an important position to Dalits in Indian politics.

- ✓ Economic Interests: The agricultural labour unions set up by different parties and non governmental organisations that have taken up agricultural labour issues such as wage demands, demands for employment guarantee schemes, right to work etc.

Limitations of Dalit Movement:

- ✓ Lack of unity among different Dalit organisations.
- ✓ Till present day Dalits have to suffer from Social discrimination like untouchability, honour killings, etc.
- ✓ Despite constitutional and legal protection the Dalits lack policy and civil rights due to casteism.
- ✓ Dalit Movements got a little success in economic empowerment of the Dalits.
- ✓ Most of the impact of the Dalit Movements was confined to the rural areas.

However, it is worth noting that the Dalit Movement has been instilling the self- confidence in Dalits. The Movement has enabled Dalits to articulate their interests in more organized and coherent ways.

Constitutional mechanism:

- ✓ Article 17 abolishes Untouchability.
- ✓ Article 46 requires the State ‘to promote with special care the educational and economic interests of the weaker sections of the people, and, in particular, of the Scheduled Castes and the Scheduled Tribes, and to protect them from social injustice and all forms of exploitation.
- ✓ Article 335 provides that the claims of the members of the Scheduled Castes and the Scheduled Tribes shall be taken into consideration, consistently with the maintenance of efficiency of administration, in the making of appointments to services and posts in connection with the affairs of the Union or of a State.
- ✓ Article 15(4) refers to the special provisions for their advancement.
- ✓ Article 16(4A) speaks of “reservation in matters of promotion to any class or classes of posts in the services under the State in favour of SCs/STs, which are not adequately represented in the services under the State”.
- ✓ Article 338 provides for a National Commission for the Scheduled Castes and Scheduled Tribes with duties to investigate and monitor all matters relating to safeguards provided for them, to inquire into specific complaints and to participate and advise on the planning process of their socio-economic development etc.

Legal:

- ✓ The Protection of Civil Rights Act, 1955: In pursuance of Article 17 of the Constitution of India, the Untouchability (Offences) Act, 1955 was enacted .Subsequently, it was amended and renamed in the year 1976 as the “Protection of Civil Rights Act, 1955”. Rules under this Act, viz “The Protection of Civil Rights Rules, 1977” were notified in 1977. The Act extends to the whole of India and provides punishment for the practice of untouchability. It is implemented by the respective State Governments and Union Territory Administrations. Assistance is provided to States/ UTs for implementation of Protection of Civil Rights Act, 1955.
- ✓ Scheduled Castes and Scheduled Tribes (Prevention of Atrocities) Act, 1989: Assistance is provided to States/ UTs for implementation of Scheduled Castes and Scheduled Tribes (Prevention of Atrocities) Act, 1989. Financial assistance is provided to the States/ UTs for implementation of these Acts, by way of relief to atrocity victims, incentive for inter-caste marriages, awareness generation, setting up of exclusive Special courts, etc.
- ✓ Scheduled Castes and the Scheduled Tribes (Prevention of Atrocities) Amendment Act, 2015.
- ✓ The ‘Prohibition of Employment as Manual Scavengers and their Rehabilitation Act, 2013’ (MS Act, 2013): Eradication of dry latrines and manual scavenging and rehabilitation of manual scavengers in alternative occupation has been an area of high priority for the Government.

Policy measures:

- ✓ Pre-Matric Scholarships: The objective of the pre-matric Scheme is to support the parents of SC children for educating their wards, so that the incidence of drop outs at this stage is minimized.
- ✓ Post Matric Scholarship for Scheduled Caste Students (PMS-SC): The Scheme is the single largest intervention by Government of India for educational empowerment of scheduled caste students. This is a centrally sponsored scheme. 100% central assistance is released to State Governments/ UTs for expenditure incurred by them under the scheme over and above their respective committed liability.
- ✓ National Scheduled Castes Finance and Development Corporation (NSFDC): Set up under the Ministry, to finance income generating activities of Scheduled Caste beneficiaries living below double the poverty line limits (presently Rs 98,000/- per annum for rural areas and Rs 1,20,000/- per annum for urban areas). NSFDC assists the target group by way of refinancing loans, skill training, Entrepreneurship Development Programmes and providing marketing support through State Channelizing Agencies, RRBs, Public Sector Bank and Other Institutions.
- ✓ Credit Enhancement Guarantee Scheme for Scheduled Castes: The objective of this Scheme is to provide credit guarantee facility to Young and start-up entrepreneurs, belonging to Scheduled Castes, who aspire to be part of neo middle class category, with an objective to encourage entrepreneurship in the lower strata of the Society resulting in job creation besides creating confidence in Scheduled Castes.

Conclusion: Though various policies and programmes are undertaken by the government for the betterment of the dalits from time to time yet, there are so many instances that prove that these are only halfway successful. Even though the economic, educational and political conditions of those sections have met some equilibrium with the mainstream Caste, yet, gaining social equilibrium is still too far to achieve. Government policies and programs can do nothing until and unless the people are mentally and socially prepared to accept the Dalits just the way they are.

People of other castes must accept them as fellow beings with the same flesh and blood; then only can we find a humane society with peace and harmony to live in.

MCQs

- Considered the following statement:
 - Full form of 'DAKSHTA' is Development of Attitude, Knowledge, Skill for Holistic Transformation in Administration
 - It is for young professionals, on Karmayogi Platform.
 - Aims to equip young professionals and consultants in government with the necessary competencies to effectively discharge their duties and responsibilities.

Which of the following statement is/are correct?

 - Only 1
 - 2 and 3
 - 1 and 3
 - All of the above
- Considered the following statement regarding Chashma-V Plant:
 - It will be set up by china at Chashma in the Mianwali district of Punjab in India.
 - It will be a nuclear power plant.

Which of the following statement is/are correct?

 - Only 1
 - Only 2**
 - Both 1 and 2
 - None
- Recently, A tourist submersible (Titan) went missing considered the following statement:
 - The Titan was made of titanium and carbon fibre.
 - It was designed to transport five people to depths of around 4,000m in order to reach the Titanic shipwreck.

Which of the following statement is/are correct?

 - Only 1
 - Only 2
 - Both 1 and 2**
 - None
- Champions of the Earth award, that recognizes outstanding environment leaders from the public and private sectors was established by
 - International union for conservation of nature (IUCN)
 - Food and Agriculture Organization (FAO)
 - Intergovernmental Panel on Climate Change (IPCC)
 - United Nation Environment Programme (UNEP)**
- Considered the following statement:
 - The kalasa- Banduri project was divert water from Mahadayi River.
 - Mahadayi River originates in the Bhimgad Wildlife Sanctuary.

Which of the following statement is/are correct?

 - Only 1
 - Only 2
 - Both 1 and 2**
 - None
- Considered the following statement regarding Alligator Gar Fish:
 - Found in Kashmir's Dal lakes.
 - IUCN status is the least concerned.
 - Live in freshwaters.

How many pair of statement is/are correct?

 - Only 1
 - Only 2
 - Only 3**
 - None
- Considered the following statement regarding United Nations High Commissioner for Refugees (UNHCR) Report.
 - The number of refugees globally stood at 35.3 Million by the end of 2022.
 - Most of the refugees comes from Afghanistan, Syria and India .

Which of the following statement is/are correct?

 - Only 1
 - Only 2
 - Both 1 and 2**
 - None
- Recently, Panchayat- Level- Medicine scheme was lunched to make essential medicines available in remote area. Belong to which state?
 - Jharkhand**
 - Andhra Pradesh
 - Odisha
 - Madhya Pradesh
- Considered the following statement:
 - ISC "DHRUV" is indigenously built a simulators.
 - The simulators provide real-time experience on navigation.
 - It is recently inaugurated by defence minister Nirmala Sitaram.

How many pairs of statement is/are correct?

 - Only 1
 - Only 2**
 - Only 3
 - None
- Recently, Odisha demand official status for tribal languages. Considered the following statement regarding Saora tribe.
 - Saoras are belong to Particular Vulnerable Tribal Groups (PVTGs).
 - They are mainly live in Gajapati, Rayagada and Bargarh districts of Odisha.

Which of the following statement is/are correct?

 - Only 1
 - Only 2
 - Both 1 and 2**
 - None