India Semiconductor Mission

Boosting India’s Semiconductor and Display Ecosystem
SEMICONDUCTORS are the true champions of the technology world, powering everything from toys to cellphones to vehicles, from behind the scenes. They have fostered breakthrough technologies in recent years, like artificial intelligence and machine learning completely changing the way we live and work.

Semiconductors have become the backbone and a prerequisite for any endeavour in emerging technologies. With the introduction of IoT (Internet of Things) and 5G technology in India, semiconductor chip consumption is expected to climb to about $100 billion by 2025, up from $24 billion currently. The current geopolitical situation places a premium on the security of essential information infrastructure, which is why reliable semiconductor and display sources are critical.

With the majority of semiconductor manufacturing and supply capacity concentrated in a few countries, including Taiwan, South Korea, Japan, US, and more recently China, governments around the world have realized that treating chip manufacturing as a strategic imperative is in their national interest. However, semiconductor shortages during the pandemic, as well as new geopolitical realities in semiconductor supply chains, intensify the need for reliable and trusted semiconductor sources.

Thus, the opportunity is huge and India also must capture this moment by creating an entire semiconductor and display ecosystem that can deliver innovative products.

India Semiconductor Mission (ISM)
The India Semiconductor Mission (ISM), which has been set up as a dedicated institution for the ‘Semicon India Programme’, is a new business unit inside the Digital India Corporation. ISM has been created with the goal of developing a long-term strategy for developing sustainable semiconductor and display manufacturing facilities, as well as a semiconductor design eco-system in the country. This mission aims to serve as a focal point for the comprehensive, coherent, efficient, and smooth deployment of the programme in consultation with government ministries, departments, industries, and academia.

Through the ISM, two silicon wafer fabs, two display fabs, as well as fabs for compound semiconductors, photonics, and sensors will be supported. Upstream activities such as Outsourced Semiconductor Assembly and Test (OSAT), Assembly, Testing, Marking, and Packaging (ATMP), and chip design will also be promoted through this mission. There are also attempts to catalyse business and academia to build an 85,000-strong talent pool of qualified semiconductor specialists at all skill levels, from technicians to researchers, which the industry requires.

With a Rs 76,000-crore incentive package through ISM, India has finally taken a giant step toward bringing semiconductor and display fab manufacturing to the country, at a time when supply shortages of the critical component have hit industrial production across the automotive, electronics, and other technology-led sectors. It is never too late for India to consider becoming a semiconductor manufacturing destination, given the country’s long-term semiconductor demands and potential to establish a worldwide electronics manufacturing base. The required investment may be in the billions of dollars, yet the benefits significantly surpass the costs.

While India has earlier attempted to increase semiconductor production, this is the first time a scheme has been approved to increase semiconductor production, which is an essential component of modern technology products. Previous attempts to persuade firms to invest in India had failed miserably, but the government believes that the presence of a robust home market, as well as appropriate incentives and enablers, will succeed this time.

Towards Self Reliance
The objectives of ISM are also in line with the government’s vision of an Atmanirbhar Bharat (Self-Reliant India). Semiconductor consumption in India is growing at a 15% annual rate and currently, India imports all of its requirements. With the fast acceptance of digital items such as smartphones, laptops, electronic gadgets, and IoT devices, as well as new-age cars and trucks, foreign exchange outflows have reached alarming levels.

India has been striving to attract chip manufacturers, but expensive capital requirements, lack of infrastructure, and prior knowledge have proven to be obstacles in the past, which will now be mitigated to a large extent by ISM. The plan to enhance semiconductor production will bring in significant investments and create huge employment, in addition to reducing the country’s reliance on imports. The significance of ISM can also be seen in the fact that an investment of over Rs 1.70 lakh crore is expected to be made through ISM in the next four years.

Innovation Key to Success
Substantial R&D is widely recognised as a crucial component in supporting, pioneering, and leading many thrusts in the semiconductor ecosystem. Every country with a large semiconductor sector has made significant investments in semiconductor R&D centres, which act as a bridge between academia and industry.

From the early 1970s 10 µm technology to today’s 7 nm devices, the industry has developed, with industry
leaders aiming to build incredibly small chips: 5 nm, 3 nm, and even smaller. ARM, Qualcomm, Intel, Cadence, and Texas Instruments are among the worldwide semiconductor corporations that have created design and software development infrastructure in India, assisting in the development of a critical mass of chip development expertise. That talent should be put to work supporting entrepreneurs with chip design and the creation of a fabless semiconductor ecosystem.

Government-funded academic institutions and local technical entrepreneurs should now lead the R&D effort in supporting indigenous manufacturing. India must increase investment in advanced semiconductor R&D, in addition, to aggressively investing in manufacturing and production capabilities, to fuel the next generation of innovation and leadership in this essential industry.

As chips become smaller and more competitive, semiconductor businesses will require a new strategy that takes into account everything from fab size to supply-chain challenges. Some of these challenges are:

- **High Investments**: Semiconductors and display production is a highly complex and technology-intensive industry that requires major and sustained inputs due to large capital investments, high risk, long gestation & payback periods, and rapid technological developments. Even on a small scale, a semiconductor fabrication facility can cost multiples of a billion dollars to set up, lagging behind the latest technology by a generation or two.

- **Lack of Fab Capacities**: India has a good chip design talent pool, but it has never developed chip manufacturing capabilities. ISRO and DRDO both have their own fab foundries; however, they are primarily for their own needs and are not as advanced as the most advanced in the world.

- **Lack of Skilled Workforce**: When it comes to India becoming a prominent player in semiconductor chip manufacturing, there is clearly a shortage of skill. Semiconductor manufacturing is a complex and research-intensive sector, defined by rapid changes in technology that require a significant set of skills.

**Way Forward**

There are some key areas and sectors that India needs to focus on for successful outcomes of the India Semiconductor Mission:

- **Future chip production should not be a one-trick pony, but rather a multi-tiered ecosystem that includes design, fabrication, packaging, and testing. In this industry, India must also improve research and development to maximize self-sufficiency.**

- **Given the long gestation periods and rapid technological changes, India must out-strategize on design and functionality, as the final product will be available only three to four years after work begins, by which time the current chip shortage will have been resolved and technology will have advanced even further.**

- **The raw materials utilised in the semiconductor manufacturing process, particularly gases and ultra-pure chemicals, require substantial R&D. As circuits get smaller, more novel materials are needed to make semiconductors. Thus, materials utilised to build microchips must be discovered, developed, and formulated.**

- **For cutting-edge R&D, there should be a collaboration with various R&D centres such as IMEC (Interuniversity Microelectronics Centre), GlobalFoundry, AMD (Advanced Micro Devices), VDEC (VLSI Design and Education Center), Intel, Qualcomm, Samsung, ST Microelectronics, etc.**

- **Establish government-funded centres for the production of electronic-grade silicon and monocrystalline wafers.**

- **To bridge the technology gap, there is a need to set up an R&D Foundry that would enable the development of Process Design Kits (PDK) for the next generation of devices (below 28 nm and up to 1 nm). This may be strengthened by collaborating with the major R&D Fabs.**

- **As part of the policy framework of ISM, it is essential that the products manufactured by Indian foundries be preferred over the imported ones. For ensuring profitability, the viability gap funding may be provided.**

**Realising the Dream**

With significant fiscal incentives and non-fiscal benefits, India’s semiconductor dream is likely to come true, contributing significantly to the country’s goal of a $1 trillion digital economy and $5 trillion GDP by 2025, as well as having a multiplier effect on allied sectors like electronics, telecom, automotive, railways, and electrical products. Semiconductors are like building blocks of electronics or oil for the energy or automobile sector. It is imperative that we produce them locally to become Aatmanirbhar to some extent and also feel safer from the cyber or digital security perspective. Hence, having an indigenous semiconductor foundry or fab is the need of time.

The ISM will undoubtedly boost semiconductor and display manufacturing, which is a wise move that will benefit India, particularly at a time when the world is experiencing a semiconductor shortage. As the ISM enters its implementation phase, the government needs to be both supportive and vigilant to ensure that companies stick to their commitments and pledges to make India’s semiconductor journey a success.