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Semicon India 2021 and Beyond: A Strategic Policy Analysis for Defence and Space Technology Leadership

Pradeep Kumar[1,2*], *Amrita Nighojkar*[2], *and Bandi Ram*[1]

[1]Research Centre Imarat, DRDO, Hyderabad, India
[2]Defence Institute of Advanced Technology, Pune, India

Abstract. The semiconductor industry has emerged as backbone of the global digital economy and enabler of modern defence and space technologies, where secure and high-performance chips are vital. As India strives toward a $5 trillion economy with strategic autonomy and defence-space export driven growth, semiconductors have been placed at the core of national priorities through the Semicon India Programme launched in 2021. This paper presents a strategic policy analysis of India's semiconductor trajectory, highlighting the design and implementation of Semicon India 2021 and its interlinkages with the defence and space sectors. It examines key programme components such as schemes for establishing semiconductor fabrication units (fabs), Assembly, Testing, Marking and Packaging (ATMP)/Outsourced Semiconductor Assembly and Test (OSAT) facilities, and mechanism for design-linked incentives, to assess their capacity to bridge technology gaps faced by ISRO, DRDO, and DPSUs. Building on this evaluation, the paper proposes a roadmap for steering India towards global leader in key sectors- semiconductor, defence, and space technology by 2035.

1 Introduction

Semiconductors have become backbone of the global digital economy and enabler of emerging technologies in domains such as defence, space, telecommunication, autonomous vehicles, quantum and artificial intelligence. The global semiconductor market was around USD 574 billion in the year 2022 and is projected to be USD 1 trillion by the year 2030 [1]. The global semiconductor industry forecast by PwC for different end market is shown in figure 1. The global semiconductor foundries have seen growth of over 41% in the last five years [2]. As shown in figure 2, the semiconductor supply chains are highly concentrated, with Taiwan-based TSMC holding a 61.7% market share, while South Korea dominates the memory sector [2]. This concentration creates vulnerabilities from natural disasters to geopolitical tensions. Nations that control semiconductor technology gain not only economic benefits but also strategic leverage.

*Corresponding author: nighojkar.amrita@gmail.com

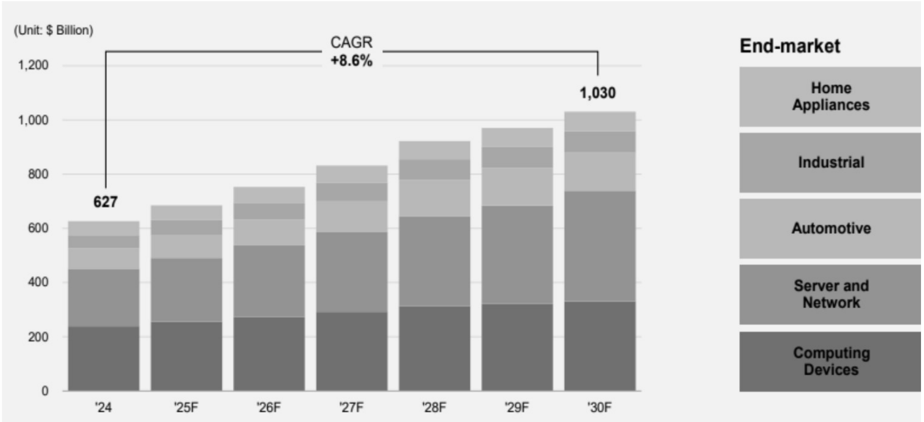

Fig. 1. The global semiconductor industry forecast by PwC

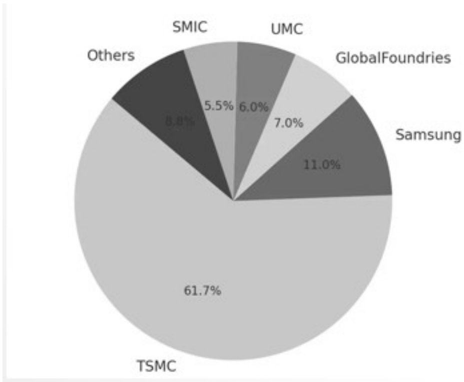

Fig. 2. Market share of semiconductor foundries (Q1 2024). Source: https://wireunwired.com.

Presently, India imports 95% semiconductor chips from China, Taiwan, South Korea and Singapore [3]. This heavy dependence on imports creates several risks and makes the country vulnerable to global supply chain disruptions, exemplified by the chip shortage during the COVID-19 pandemic. Export restrictions on advanced chips have become tools for strategic competition. This situation impacts ISRO's satellite missions, and DRDO's missile and aircraft systems, as well as national security. It also stifles innovation and increases economic strain. At the same time, India's ambition of becoming a Digital India and achieving a USD 5 trillion GDP depends on technology-intensive manufacturing and exports [37]. To address these challenges, India is focusing on building a self-reliant semiconductor ecosystem and in 2021, launched the India Semiconductor Mission (ISM), a significant policy initiative with a budget of USD 10 billion.

This paper examines the strategic framework of Semicon India (2021) and how it fits with India's ambition in defence and space technology. The aim here is to illustrate how semiconductor policy can be integrated with national security needs, allowing economic growth and strategic autonomy move forward together. More specifically, the study attempts to outline the linkages between Semicon India (2021) and the requirements of defence and space, also proposing policy recommendations that could help India become a major player in semiconductor-enabled defence and space by 2035. The structure of the paper is as follows: Section 2 traces the evolution of semiconductor policy in India; Section 3 reviews the schemes under Semicon India (2021); Section 4 analyzes its linkages with defence and space; Section 5 identifies the key risks and challenges; and Section 6 lays out a roadmap up to 2035 with policy recommendations in Section 7. In conclusion, the paper argues that chip sovereignty will depend not only on financial incentives, but also on sustained coordination, institutional learning and the creation of a robust ecosystem. Its four aims are: (i) to examine India's semiconductor policy evolution (1976–2021); (ii) to analyze the design and intent of Semicon India 2021; (iii) to assess the requirements of key sectors like defence and space; and (iv) to outline a strategic plan (2025–2035) with concrete policy recommendations.

2 Policy Evolution: From SCL to Semicon India 2021

2.1 Early Phase (1960-2004): Strategic but Limited

In the 1960s, a handful of Indian companies were producing semiconductors; during this period, Fairchild Semiconductors, a pioneer in integrated circuit (IC) technology, considered India as a possible location for its first Asia unit. Also, during this time, Bharat Electronics Ltd. (BEL) acquired germanium and silicon technology to produce semiconductor devices. BEL, along with Hindustan Aeronautics Ltd. (HAL), remains a major player in the Indian semiconductor space but caters only to the defence sector. Continental Device India Ltd (CDIL) started manufacturing silicon semiconductor chips and devices [4, 5]. In May 1976, the cabinet approved the formation of Semiconductor Complex Limited (SCL) to drive India's ambitions to manufacture semiconductors. Under leadership of electronics and semiconductor industry veteran, Dr M.J. Zarabi – founder Chairman and Managing Director, SCL facility started production in 1984. The dream was shattered by a fire in 1989 and it was renovated in 1997 [6]. India's semiconductor policy evolution phases are illustrated in figure 3.

Fig. 3. Policy Evolution phases.

2.2 Incentive-Based Phase (2004–2014): Missed Opportunities

In late 2005, SemIndia- a public-private partnership consortium (centre, a state government and private equity) was formed with the goal of building a semiconductor fabrication plant in India at investment of about USD 1.82 billion, with technology and support from AMD. On February 16, 2006, SemIndia and government of united Andhra Pradesh approved setting up of Fab City- a semiconductor ecosystem in Hyderabad. In April 2006, Flextronics Inc and Base Oxygen Corporation (BOC) signed an MOU with SemIndia. The project aimed to establish assembly, test, marking and packaging (ATMP) facility in first phase and a fabrication (Fab) plant in the second phase [7]. But the project did not progress well, as the global financial crisis reduced investment appetite, regulatory approvals were delayed, investor confidence weakened and lack of comprehensive semiconductor policy. Consequently, most of the 1,200 acre site was never developed and the state government eventually withdrew the promised incentives [8, 9]. In 2013-14, under Modified Special Incentive Package Scheme (M-SIPS), the center government issued Letters of Intent (LOIs) to two consortium—HSMC and Jaiprakash Associates Ltd. In 2016, due to financial issues, Jaiprakash Associates withdrew its proposal. In 2019, HSMC's permission was cancelled due to lack of visibility [4].

2.3 Ecosystem Building (2014–2020): Early Integration

The Government of India undertook a series of initiatives during this period to strengthen the electronics and semiconductor ecosystem. The "Make in India" campaign (2014) intended to attract global manufacturers and enhance domestic industrial capacity, whereas "Digital India" (2015) generated significant demand for electronic goods and emphasized the importance of building domestic manufacturing capability [10]. In 2016, the Electronics Development Fund (EDF) was launched to promote R&D and Innovation in the key technology sectors like Electronics, Nanoelectronics and IT [11]. The policy initiative led to formulation of National Policy on Electronics (NPE 2019), which set the goal of USD 342 billion in electronics manufacturing by 2025 [12]. In 2020, the government launched two key schemes to enhance electronics and semiconductor manufacturing. The Production Linked Incentive (PLI) scheme encouraged investment in cutting edge technologies and helped large-scale electronics production to stay competitive internationally. As well as, the Scheme for Promotion of Manufacturing of Electronic Components and Semiconductors (SPECS) extended 25% incentive on capital for making electronic components, semiconductor and display fabs, and sub-assemblies [13]. These initiatives accelerated local electronics assembly, but without domestic semiconductor fabs, the country continued to depend on imported chips.

2.4 Strategic Transformation (2021): Security-Centric Approach

The global semiconductor chips shortage during COVID-19 pandemic, combined with the growing needs of India's defence and space programmes, led to a significant change in the country's semiconductor policy. In December 2021, the Government of India approved the Semicon India Programme with an incentive of USD 10 billion, creating a robust domestic supply chain for semiconductors and advanced displays through India Semiconductor Mission (ISM), a dedicated agency under MeitY [14, 15]. There has been a fundamental shift in the strategic landscape, wherein semiconductors are no longer viewed merely as commercial entities but are now classified as critical national security infrastructure. To become a trusted semiconductor hub, the government has been organizing annual Semicon India Summits since 2022. This flagship initiative brings together global chipmakers, investors, and policymakers. In the Semicon India 2025 Summit, over 350 companies from 48 countries participated which shows India's rising role in the global chip ecosystem. "Vikram", the country's first fully indigenous 32-bit processor, developed by ISRO's VSSC and fabricated at SCL, was also unveiled in this summit [16, 17]. The deployment of the "Vikram" processor in space missions, defence systems and strategic electronics – underscores a shift towards technological self-reliance and bridges the gap between hardware indigenization and the national security. The major semiconductors policy milestones are summarized in Table 1 below:

Table 1. Major Semiconductor Policy Milestones in India

Year	Policy/ Schemes/initiatives	Key features
1960s	BEL, HAL and CDIL	Acquired germanium and silicon technology for producing semiconductor devices
1976	SCL formation	SCL was approved to manufacture semiconductors at Mohali, Punjab
1984	SCL production	SCL facility started production
1989	SCL fire accident	Destroyed facilities; India lost momentum in fab capability.
2006	SemIndia	First incentive-based scheme to attract semiconductor investments
2013	Modified SIPS (M-SIPS)	Further push by Government by issuing LOIs to two consortiums
2014	Make in India	To attract global manufacturers and boost domestic industrial capacity
2015	Digital India	Created large-scale demand for electronic products and highlighted the importance of building local capability
2016	Electronics Development Fund (EDF)	Funding to promote R&D and Innovation in technology sectors
2019	National Policy on Electronics (NPE 2019)	Comprehensive electronics manufacturing policy
2020	Scheme for Promotion of Manufacturing of Electronic Components & Semiconductors (SPECS)	Offered 25% incentive on capital expenditure for making electronic components, semiconductor and display fabs
2021	Indian Semiconductor Mission (ISM)	USD 10 billion outlay to build a domestic semiconductor and display ecosystem
2025	The Semicon India 2025 Summit	Unveiling of “Vikram”, the country’s first fully indigenous 32-bit processor developed by ISRO’s VSSC and fabricated at SCL

3 Semicon India 2021: Vision and Schemes

The Semicon India Programme (2021) is the country’s first comprehensive semiconductor policy, linking economic growth, national security, and global partnerships. It is built on four main pillars [18] as shown in figure 4.

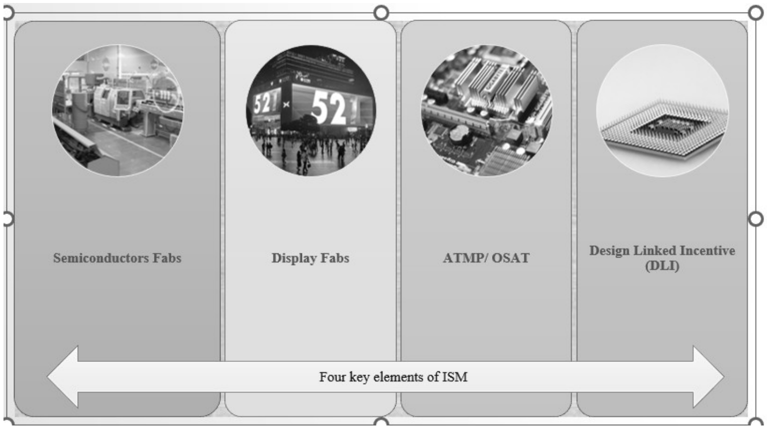

Fig. 4. Four main pillars of Semicon India 2021.

3.1 Semiconductors Fabs

The scheme offers financial support to companies setting up semiconductor wafer fabs in India to attract large-scale investment. The approved incentives include: up to 50% of the project cost for fabs of 28 nm or below, up to 40% for fabs between 28–45 nm, and up to 30% for fabs between 45–65 nm. It aims to establish at least two greenfield fabs.

3.2 Display Fabs

The scheme provides financial support to companies for setting up TFT LCD or AMOLED display fabrication units in India. It offers up to 50% of the project cost, with a maximum support of USD 1.60 billion per fab to reduce dependence on imports of LCD/OLED panels.

3.3 Compound Semiconductors, Silicon Photonics, Sensors and Assembly, Testing, Marking and Packaging (ATMP) / OSAT

30% of capital expenditure is provided as financial support to companies setting up compound semiconductor, silicon photonics, sensor (including MEMS) fabs, or ATMP/OSAT facilities in India. Support for GaN and SiC fabs is especially important for high-power and radiation-hardened applications in defence and space sectors.

3.4 Design Linked Incentive (DLI):

The scheme supports India’s chip design ecosystem by providing financial incentives and design infrastructure for ICs, Chipsets, SoCs, Systems, IP Cores and related designs. It offers product design incentive of up to 50% of eligible costs (capped at USD 2 million per application) and a deployment incentive of 6% to 4% of net sales over five years (capped at USD 4 million per application). The scheme particularly supports fabless startups, academic initiatives and defence-specific chip design projects, including processors and SoCs.

The proposed Dholera fab at Gujarat, a joint venture between Tata Electronics and PSMC Taiwan, shows a paradigm shift in India’s semiconductor journey. Similarly, the Micron’s ATMP facility at Sanand, Gujarat will enhance critical packaging capacity. It will also attract other supply chain partners such as substrate makers and testing companies. All these projects, represent India’s first tangible progress in addressing critical gaps in the semiconductor value chain [19, 20]. The approved units are summarized in Table 2 below:

Table 2. Approved Semiconductor Projects and Current Status [21, 22, 23, 24]

Year	Project	Company	Investment (USD)	Output Capacity	Status
June 2023	ATMP[1] fabrication plant, Sanand, Gujarat	Micron Technology	3 billion	Memory, storage assembly & test facility- 0.5 to 4 million units/ day	Ongoing
Feb 2024	Semiconductor fab, Dholera, Gujarat	Tata Electronics with Powerchip Semiconductor, Taiwan	12 billion	50,000 wafers/ month	Ongoing
Feb 2024	ATMP[1], Morigaon, Assam	Tata Semiconductor	3.5 billion	48 million chips/ day	Ongoing
Feb 2024	ATMP[1] unit, Sanand, Gujarat	CG Power, Renesas Electronics, Japan and Stars Microelectronics, Thailand	1 billion	15 million chips/ day	Pilot facility operational
Sept 2024	Semiconductor unit Sanand, Gujarat	Kaynes Semicon Pvt Ltd	434 million	6.3 million chips/ day	Pilot facility operational
May 2025	Semiconductor unit Jewar, UP.	HCL-Foxconn JV	487 million	20,000 wafers/ month	Ongoing
Aug 2025	Compound semiconductor fab, Bhubaneshwar.	SiCSem Pvt Ltd in collaboration with Clas-SiC Wafer Fab Ltd., UK	272 million	60 thousand wafers/ annum, ATMP capacity: 96 million units/ annum	Recently approved
Aug 2025	Semiconductor manufacturing facility Mohali, Punjab.	Continental Device India Private Limited (CDIL)	16 million	158.38 million units/ annum	Recently approved
Aug 2025	Advanced semiconductor packaging Bhubaneshwar.	3D Glass Solutions Inc.	256 million	Per annum: - Substrates: 69,600, Assembled units:50 million, 3DHI modules: 13,200	Recently approved
Aug 2025	Semiconductor manufacturing unit, AP.	Advanced System and APACT Co. Ltd, South Korea	62 million	8 million units/ month	Recently approved

[1]**ATMP:** Assembly, Testing, Marking and Packaging

4 Strategic Linkages to Defence and Space

The global space economy is projected to grow from USD 600 billion in 2024 to USD 1.8 trillion by 2035 [25]. In a press briefing on 20 June 2024, Dr. Jitendra Singh, Union Minister of State said, "The share of India in the global space economy by 2030 is going to rise 4 times in comparison to 2021. In 2021, the Indian space industry contributed 2% to global share. This is expected to rise to 8% by 2030 and further to 15% by the year 2047". On the defence side, India reported record USD 16.7 billion in defence production and exports reaching USD 2.78 billion in FY 2023-24 and has set ambitious goals for USD 40 billion in defence production and USD 6.6 billion in exports by 2029 [26]. These ambitions underline the need for secure and high-performance semiconductors, which are indispensable for space and defence electronics. At present, however, India imports nearly 90–95% of its semiconductors [3], creating risks for both cost and supply security.

The Semicon India Programme (2021) was designed to strengthen supply chain sovereignty by promoting fabs, ATMP/OSAT facilities and design ecosystem [14]. It aims for self-reliance in defence avionic, radar, electronic warfare, satellite constellations and secure networks by nurturing development of compound semiconductors such as Gallium Nitride (GaN), Silicon Carbide (SiC) and Silicon Photonics. It also focuses on Advanced Packaging Technologies, System-on-Chip (SoC) architectures and System-of-Systems integration [18]. These technologies also act as building blocks for emerging technologies like Artificial Intelligence (AI), Quantum Communication and Quantum Sensing which will shape the next generation of warfare and space exploration. By including these advancements in the roadmap, India aims to reduce foreign imports and firmly establish itself as a global leader in the defense-space semiconductor market.

Table 3. Emerging Semiconductor Technologies for Defence and Space[2]

Semiconductor Technologies	Defence/ Space applications
Compound semiconductors: GaN, SiC and Silicon Photonics, MEMS	High-power radars, electronic warfare, satellite payloads, secure communications, radiation-hardened systems
Advanced packaging: 3D Heterogeneous Integration, glass interposers and silicon bridges	Miniaturized avionics, thermal management for space electronics, secure & reliable mission-critical systems
System-on-Chip (SoC)	Integrated processors for satellites, UAVs, missile guidance and AI-enabled defence platforms
System-of-Systems Integration	Satellite constellations, network-centric warfare, secure command and control systems
AI-Optimized Chips	Autonomous navigation, target recognition, real-time battlefield analytics, deep-space exploration
Quantum-Ready Chips	Quantum communication, secure cryptography, quantum sensing for defence and space missions

[2]Source: PIB (2021), MeitY/ISM policy documents, and DRDO/ISRO reports

4.1 ISRO and Space Applications

Indian Space Research Organisation (ISRO) requires radiation-hardened semiconductor chips for launch vehicles, satellites, payloads and communication systems. These chips must function reliably in harsh environmental conditions like extreme temperatures and high radiation. The launch of “Vikram” is a major breakthrough and emphasizes the linkage between semiconductor policy and India’s space missions.

4.2 DRDO and Defence Public Sector Units (DPSUs)

Defence Research and Development Organisation (DRDO) requires semiconductor chips for missile avionics, radars, drones, robotics, secure communication, and electronic warfare. The indigenous development of NavIC chips, silicon photonics, MEMS sensors, high-performance detectors, cryogenic coolers, laser diodes and photo detectors has been launched [27]. The policy measures such as the Design Linked Incentive (DLI) scheme for startups and design houses working on defence-grade semiconductors acts as catalysts for indigenous development. Through the Semicon India Programme, availability of trusted, domestic semiconductor chips, will facilitate DPSUs to achieve self-reliance and defence export goals.

4.3 Policy Implications for Strategic Autonomy

The chips produced in untrusted fabs abroad can lead to significant vulnerabilities in strategic systems like defence and space. The alignment of semiconductor policy with defence and space requirements created a strategic shift in India’s industrial planning. Through DLI and Semicon India initiatives, India is laying the foundation for strategic autonomy in critical technologies by promoting advanced secure fabs, compound semiconductor units, ATMP/OSAT facilities, indigenous design and dual-use technology ecosystems. Consistent implementation of these schemes and policies will reduce import dependence, and India will emerge as a trusted and dependable global stakeholder. India’s semiconductor ecosystem is shown in figure 5.

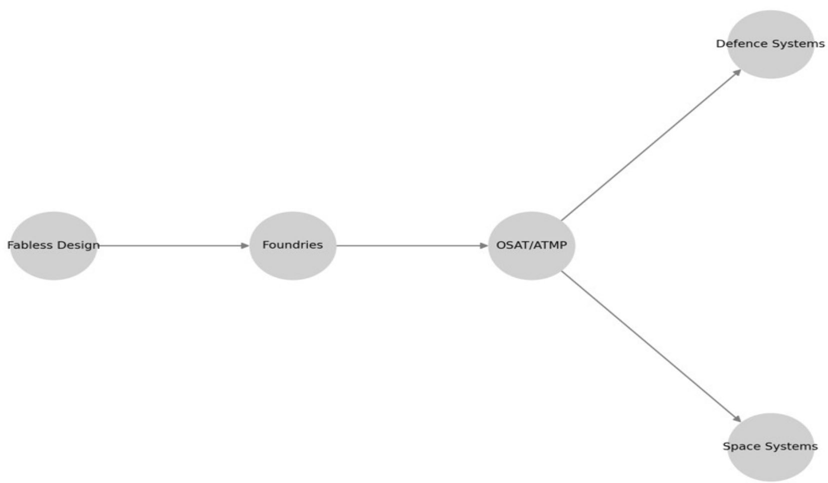

Fig. 5. India’s semiconductor ecosystem map.

5 Challenges and Risks

India's semiconductor aspiration faces multiple challenges like financial constraints, talent shortage, technological dependencies, institutional complexity and Indian federal system. Although, the Semicon India Programme shows a great potential, but its success will depend on sustained investment, policy coordination and building up the whole ecosystem ability.

5.1 Capital Intensity

The establishment of Semiconductor foundries are highly capital-intensive. A single good facility can cost between USD 10–20 billion, and sometimes even more for the advanced ones [28]. India faces difficulty in mobilizing such massive investments, especially, when the countries like United States and European Union are offering a lot of incentives and China, gives subsidies equivalent to nearly 5% of its GDP [29]. Furthermore, the governments overspend on Capex but fail to address the high Opex (operational) costs, make a fab uncompetitive in long-term.

5.2 Talent Shortage

In India, a significant number of engineers graduate annually, yet there is a shortfall of trained process, fabrication and VLSI design engineers for semiconductor industries. In 2022, Deloitte reported, "By 2030, the global semiconductor industry would need a million skilled workers or more than 100,000 annually". To meet the projected requirements, India must scale up technical training through institutions of national importance like IISc, IITs, NITs, IIITs, IISERs and central/state universities.

5.3 Low R&D Spending

The Science & Technology Minister of Government of India, Dr Jitendra Singh stated in the Rajya Sabha that, "Country's expenditure on R&D remained 0.6% - 0.7% of GDP and it is relatively much lower than other countries spending like China (2.4%), USA (3.5%) and Israel (5.4%)". If India does not spend a significant amount on R&D from both public and private companies then India will keep dependent on imported technologies.

5.4 Policy Coordination

In India, the multiple agencies like Ministry of Electronics & Information Technology (MeitY) for policy formulation & implementation, Ministry of Defence (MoD) for strategic procurement, Department of Space (DoS) for space requirements, Ministry of Commerce for trade facilitation and state governments for land, road, electricity & water etc. are involved for establishment of industrial ecosystem. Due to involvement of multiple agencies, there is a risk of overlap and delays in implementation. India can move faster in semiconductor manufacturing by synchronized efforts and streamlined governance.

5.5 Environmental Responsibility

Ecological integrity is another major concern for development of semiconductor chips. The semiconductor foundries are water and electricity intensive. A semiconductor fab requires ultrapure water around 10 million liters per day [30] and hundreds of megawatts stable power [31]. India already faces water scarcity in Gujarat, where semiconductor foundries are proposed. At the same time, disposal of chemical waste adds further apprehension. Thus, the development of semiconductor ecosystem may create local opposition and ecological strain unless the environmental issues are addressed through recycling and renewable energy integration.

5.6 Strategic Risk

The global semiconductor industry is susceptible to geopolitical risks like wars, tensions, pandemics, export controls and technology restrictions. The supply chain disruptions directly affect availability of critical semiconductor chips and components. India must navigate these geopolitical hurdles to strengthen supply chain, and safeguard strategic electronics ecosystem [32]. Beyond structural challenges, the semiconductor ecosystem framework is also impacted by a set of fundamental trade-offs, which influence strategic choices and long-term outcomes. First, the establishment of advanced fabs requires a substantial financial commitment and a long gestation period, potentially constraining investments in complementary areas such as design, packaging, and skill development [28, 41]. Second, the global integration enhances technological progress but creates a risky dependence on a few key manufacturing hubs. This risk is intensified by rapid tech cycles, which can make new facilities obsolete before a nation achieves strategic independence [41]. Third, the trade-off between defense-grade reliability and fast-paced commercial chip cycles drives a hybrid approach: merging stable, trusted technologies with strategic commercial innovations [40]. Finally, there is a policy trade-off between short-term incentive-driven outcomes and long-term capability building, where an excessive focus on immediate investment attraction may not translate into sustainable ecosystem development without parallel emphasis on institutional coordination and capability accumulation [42]. In the Indian context where resource constraints, technological gaps, and strategic imperatives intersect, these trade-offs are critical for designing a phased and adaptive semiconductor strategy.

6 Phased Roadmap (2025-2035)

To mitigate the challenges and risks like high capital intensity, talent shortage, fragmented governance, and environmental pressures etc., India must adopt phased approach sequencing priorities across the short-term, medium-term, and long-term goals. To ensure sustainable growth, the defence and space needs shall be embedded in the policy framework. A structured roadmap with strong policy interventions can gradually reduce import dependence, strengthen national security, and fulfill India's ambitions to become a trusted global hub for strategic semiconductor technologies [14, 33, 40].

6.1 Short Term (2025-2027)

The current top priority is to make at least one silicon fab and ATMP facility operational. It will enhance investors' confidence. India also needs to set up a Trusted Foundry Certification Framework, modeled on line but distinct from the U.S. Department of Defense system. This framework will ensure that chips meet India's security requirements. Concurrently, it is also essential to set up a National Radiation-Hardened Test Centre in collaboration with ISRO and DRDO. This test center will be important for qualifying chips used in satellites and missile systems [33, 34].

6.2 Medium Term (2028-2031)

During this phase, India must establish compound semiconductor such as GaN and SiC foundries which are crucial for defence and space sectors. To ensure reliability in mission-critical applications, a framework for lot-level traceability of semiconductor chips to be implemented. At the same time, procurement guarantees from ISRO, DRDO and DPSUs will reduce the risks for investors and will encourage more participation from industry players [14, 33].

6.3 LongTerm (2032-2035)

The main goal is to enhance the net export (export more than import) of trusted defence & space grade semiconductor chips and electronics systems. To achieve this, India requires indigenous capability in Electronic Design Automation (EDA) tools. It will reduce dependency on U.S. firms and enhance security. For major global aerospace and military market share, the indigenous semiconductor chips should meet Quality Microelectronics List (QML)-equivalent standards [33, 35].

7 Policy Recommendation (2025-2035)

India can achieve defence and space technology leadership by implementing a staged policy framework with synchronized action plan. The top most requirement is to establish and certify, trusted foundries. To meet defence and space-grade semiconductor chips requirements, radiation-hardened testing and qualification facilities to be established. At the same time, the government should provide procurement guarantees from ISRO, DRDO and DPSUs to create anchor demand for domestic manufacturers which will encourage more participation from industry players. To foster innovation in advanced materials, fabrication processes and design automation, the R&D spending to be enhanced up to 2% of GDP by 2030. Moreover, India should pursue mutual recognition of standards to enable the global acceptance of defence/space-grade chips. A dedicated Defence and Space Semiconductor Mission to be created within the India Semiconductor Mission (ISM) to achieve economic and strategic objectives. In total, all these interventions will provide the institutional, financial and technological foundation essential for India to emerge as a trusted global hub for strategic semiconductors for defence and space technologies [14, 28, 33].

8 Conclusion

The Semicon India -2021 shows a paradigm shift in India's technology policy. Earlier efforts treated semiconductors as part of the broader electronics sector, but this programme recognises chips as the backbone of sovereignty, security, and resilience in a volatile global environment [14, 36]. It is therefore not just an economic initiative but also a strategic programme, directly linked to India's defence and space ambitions. Semiconductors are crucial for space and defence systems; it is essential to make trusted and radiation-hardened chips [28, 33, 38, 39]. The incorporation of defence and space requirements into semiconductor roadmap, will lead India toward technological sovereignty.

However, the data suggests that realizing these objectives depends on mitigation of significant structural risks and inherent uncertainties. Key challenges include the capital requirements, human resources, long development cycle, vulnerable supply chain due to shifting of geopolitical landscapes, institutional coordination and the gaps between stated strategy and operational reality. Moreover, rapid sector evolution makes it difficult for emerging participants to secure the long-term viability of their initial infrastructure [41].

India can build the base for an indigenous and secure semiconductor supply chain by effectively implementing the phased roadmap with trusted foundry certification and rad-hard test infrastructure. It will enable India to become a net exporter of trusted defence/space -grade chips and global leader of advanced electronic systems by 2035. This outcome would not only help India to achieve a USD 5 trillion economy, but also strengthen its strategic role [37]. Success will depend on positioning and consistent implementation of policy framework with national security requirements, raising R&D spending and ensuring defence- space as major demand drivers.

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