
SEMICON INDIA 2.0

Semiconductor Value Chain, Policy Framework & Industry Outlook

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Key Takeaways from SEMICON India 2026 Conclave

We attended SEMICON India 2026 on September 18, 2026, which highlighted the government's focus on moving beyond standalone fabs and OSAT facilities to develop a complete "silicon-to-systems" semiconductor ecosystem. The government's ISM 2.0 policy framework, with an outlay of ₹1,270bn, aims to strengthen the entire value chain, including chip design and IP, semiconductor manufacturing, equipment and materials, advanced packaging, R&D and skilled manpower. This broader ecosystem approach is supported by strong domestic demand, with India's electronics market expected to reach **US\$240bn by 2031**, driving semiconductor demand of **US\$110–120bn** and implying **14–16% CAGR** over the next five years. Globally, the semiconductor market is expected to grow at around **8% CAGR** and reach **~US\$1,600bn** over a similar period, with the government targeting a **10–15% share of the global semiconductor market for India over the next 10 years**. The conclave brought together leading global players such as AMD, Intel, Applied Materials, KLA, Lam Research, ASML, Micron, SanDisk, Siemens and Synopsys, alongside Indian companies including Kaynes, MosChip, L&T Semiconductor Technologies, HCLTech, Infosys, Wipro and Tech Mahindra, highlighting the growing participation of Indian companies across the wider semiconductor value chain.

What is semiconductor?

A semiconductor is a material that can conduct electricity under controlled conditions, making it useful for managing and processing electronic signals. Silicon is the most commonly used semiconductor material and serves as the foundation of modern electronics. Semiconductors are used to manufacture chips, transistors, memory devices, and sensors that power smartphones, computers, automobiles, industrial equipment, and data centres. Because they enable electronic devices to process, store, and transmit information, semiconductors are often considered the building blocks of the digital economy.

Semiconductor manufacturing Process:

- 1. Start with quartz / silica** - The journey begins with silica-rich raw material, commonly quartz. The silica is processed at very high temperature to produce metallurgical-grade silicon. This is then purified through several chemical steps until it reaches the extremely high purity required for semiconductor manufacturing.
- 2. Grow a silicon crystal ingot** - The ultra-pure silicon is melted. A tiny seed crystal is dipped into the molten silicon and slowly pulled upward while rotating. As the silicon solidifies, it forms one large single-crystal cylinder called an ingot. This is the Czochralski process commonly used for semiconductor wafers.
- 3. Slice the ingot into wafers** - The ingot is cut using precision saws into thin circular disks. These are called silicon wafers. SUMCO describes its wafer slices as roughly 1 mm thick before subsequent processing. Salami → thousands of round slices

4. Flatten, polish and clean the wafer - The freshly sliced wafer isn't perfect. It goes through processes such as Lapping, Chemical etching, Polishing, Cleaning, Inspection. The objective is an extremely flat, smooth and clean surface. Make the wafer as perfectly flat and clean as possible.

5. Prepare the wafer for circuit manufacturing - Now the wafer enters the FAB. From here, the process becomes highly repetitive. The following steps are not done only once. They are repeated many times to build the chip layer by layer.

5A. Coating with Photoresist - A light-sensitive liquid chemical called photoresist is spread evenly across the polished wafer surface. This chemical layer is designed to change its structure whenever light strikes it.

6. Photolithography (Printing the Circuit Map) - A stencil called a mask, which contains the blueprint design of billions of microscopic transistors, is positioned over the wafer. High-powered Extreme Ultraviolet (EUV) light is shone through the mask, which melts the exposed photoresist chemical layer on the wafer below.

7. Etching (Acid Washing) - A chemical acid wash is applied to dissolve and wash away the light-melted photoresist areas. This leaves behind the precise, bare outline of the circuit layout etched directly into the silicon.

8. Doping (Creating Smart Micro-Switches) - Because pure silicon does not naturally conduct electricity well, engineers shower the exposed silicon areas with gases and ions:

- Adding Phosphorus creates an N-type region with extra free electrons.
- Adding Boron creates a P-type region with missing electrons, called "holes".

Combining these regions forms microscopic switches called transistors that can turn electrical current ON (1) or OFF (0).

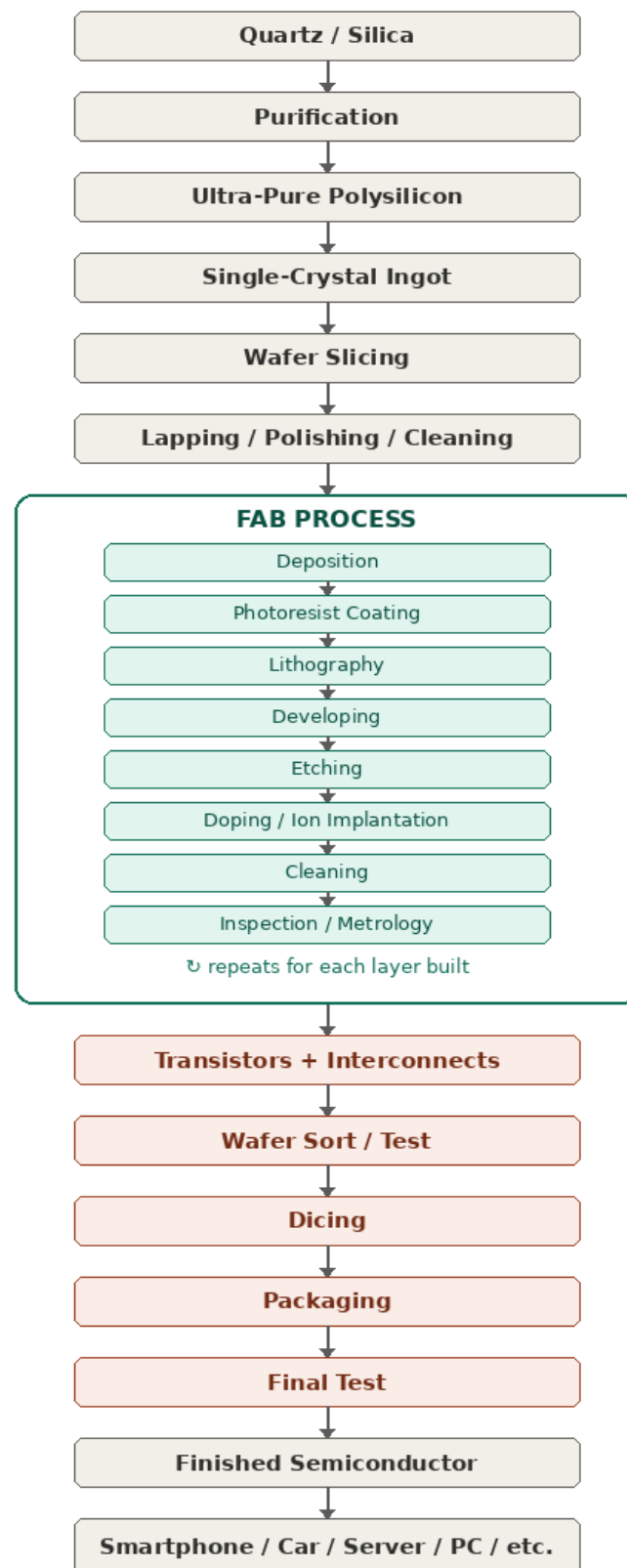
9. Layering Metal Interconnects - To connect all these billions of micro-switches together, microscopic layers of copper and other metals are deposited over the circuits. This process of coating, printing, etching, and metal deposition is repeated over 100 times to construct a multi-story network of microscopic highways on top of the wafer.

10. Wafer Dicing (Cutting Individual Chips) - Once all circuit layers are complete, a single wafer contains hundreds or thousands of identical individual chips. The wafer is cut (diced) using precision saws to separate each individual chip die.

11. Packaging - Each individual silicon chip is mounted into a protective package with external electrical connections. Packaging protects the fragile silicon from physical damage and heat while allowing it to connect to circuit boards in devices.

12. Testing - Before being sent out, every packaged chip goes through automated testing equipment to verify electrical performance and catch any defects. Once verified, the finished chips are distributed to manufacturers to power smartphones, computers, cars, and servers.

Exhibit 1:
Semiconductor
manufacturing
process



Semiconductor Value Chain:

The semiconductor industry is not a single straight line; it is a large, interconnected value chain where specialized companies operate at distinct layers. Here is the complete semiconductor value chain from design to end product, including the key global and Indian companies participating at each level:

1. Chip Design, EDA Software & IP (The Blueprint)

Before physical manufacturing begins, engineers create architectural blueprints for chips containing billions of microscopic transistors.

- **Chip Designers (Fabless):** Companies that design chip architectures but outsource manufacturing to external factories.
 - **Global Leaders:** NVIDIA, AMD, Qualcomm, Broadcom, MediaTek, Apple.
 - **Indian Players:** Vervesemi Microelectronics, Aheesa Digital Innovation, L&T Semiconductor Technologies.
- **EDA Software (Design Tools):** Specialized engineering software used to design, simulate, place components, and verify circuit layouts.
 - **Global Leaders:** Cadence, Synopsys, Siemens EDA.
- **Semiconductor IP:** Pre-designed circuit building blocks (like CPU cores or memory controllers) licensed to chip designers.
 - **Global Leaders:** Arm, Synopsys, Cadence.

2. Raw Materials, Silicon Wafers & Specialty Chemicals (The Ingredients)

This stage provides the ultra-pure raw materials and chemicals needed to build microscopic circuits.

- **Silicon Wafers:** Transforming ultra-pure silicon into single-crystal ingots, which are sliced into mirror-polished round disks.
 - **Global Leaders:** Shin-Etsu Chemical, SUMCO, GlobalWafers, Siltronic.
 - **Specialty Chemicals & Photoresists:** Light-sensitive liquid coatings, polishing slurries, and ultra-pure acids.
 - **Global Leaders:** Merck, JSR, Fujifilm, Tokyo Ohka Kogyo (TOK), Entegris, Resonac.
 - **Industrial & Specialty Gases:** Ultra-high-purity gases required throughout the chemical fabrication process.
 - **Global & Indian Leaders:** Linde, Air Liquide, Air Products, Air Water, INOX Air Products (India).
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3. Manufacturing Equipment ("Picks & Shovels")

A chip factory (Fab) relies on highly specialized machinery to process wafers at the atomic scale.

- **Lithography (Printing):** Machines that project circuit patterns onto wafers using Extreme Ultraviolet (EUV) or Deep Ultraviolet (DUV) light.
 - **Global Leader: ASML.**
- **Deposition, Etch & Cleaning:** Equipment used to deposit ultra-thin material layers, carve circuit patterns, and wash away chemical residue.
 - **Global Leaders: Applied Materials, Lam Research, Tokyo Electron (TEL), ASM International.**
- **Inspection & Metrology (Quality Control):** High-precision inspection tools and sensors that scan wafers for microscopic alignment errors or contamination.
 - **Global Leaders: KLA Corporation, Hitachi High-Tech, Onto Innovation, HORIBA, Bruker, Sensofar.**

4. Wafer Fabrication / Foundries (The FAB)

The physical manufacturing plant where raw silicon wafers are processed layer-by-layer through over 100 chemical cycles to build active transistors.

- **Foundries & IDMs:**
 - **Pure-Play Foundries: TSMC, GlobalFoundries** (manufacturing chips designed by third parties).
 - **Integrated Device Manufacturers (IDMs):** Companies like **Samsung, Intel, Micron, Infineon** that both design and manufacture chips.
 - **Indian Fab Players: Tata Electronics** (building a 300 mm wafer fab in Dholera with PSMC) and **CDIL** (operating integrated wafer fabrication).

5. Packaging, Testing & OSAT/ATMP (Back-End Assembly)

Completed wafers are cut into individual silicon dies, placed into protective packages, and tested for electrical performance.

- **Packaging & Testing Equipment:** Machinery that bonds silicon dies into packages and runs automated electrical quality checks.
 - **Packaging Machines: BESI, ASMPT, Kulicke & Soffa.**
 - **Testing Equipment: Advantest, Teradyne.**
- **OSAT / ATMP Providers:** Outsourced Semiconductor Assembly and Test companies that package and verify chips.

- **Global Leaders:** ASE, Amkor, JCET.
- **Indian OSAT/ATMP Players:** Tata Electronics, Micron India, CG Semi, Kaynes Semicon, Sahasra, Suchi Semicon.

6. Factory Infrastructure & Utilities (Supporting Ecosystem)

Fabs require surrounding industrial infrastructure to manage air purity, power, and high-precision fluid delivery.

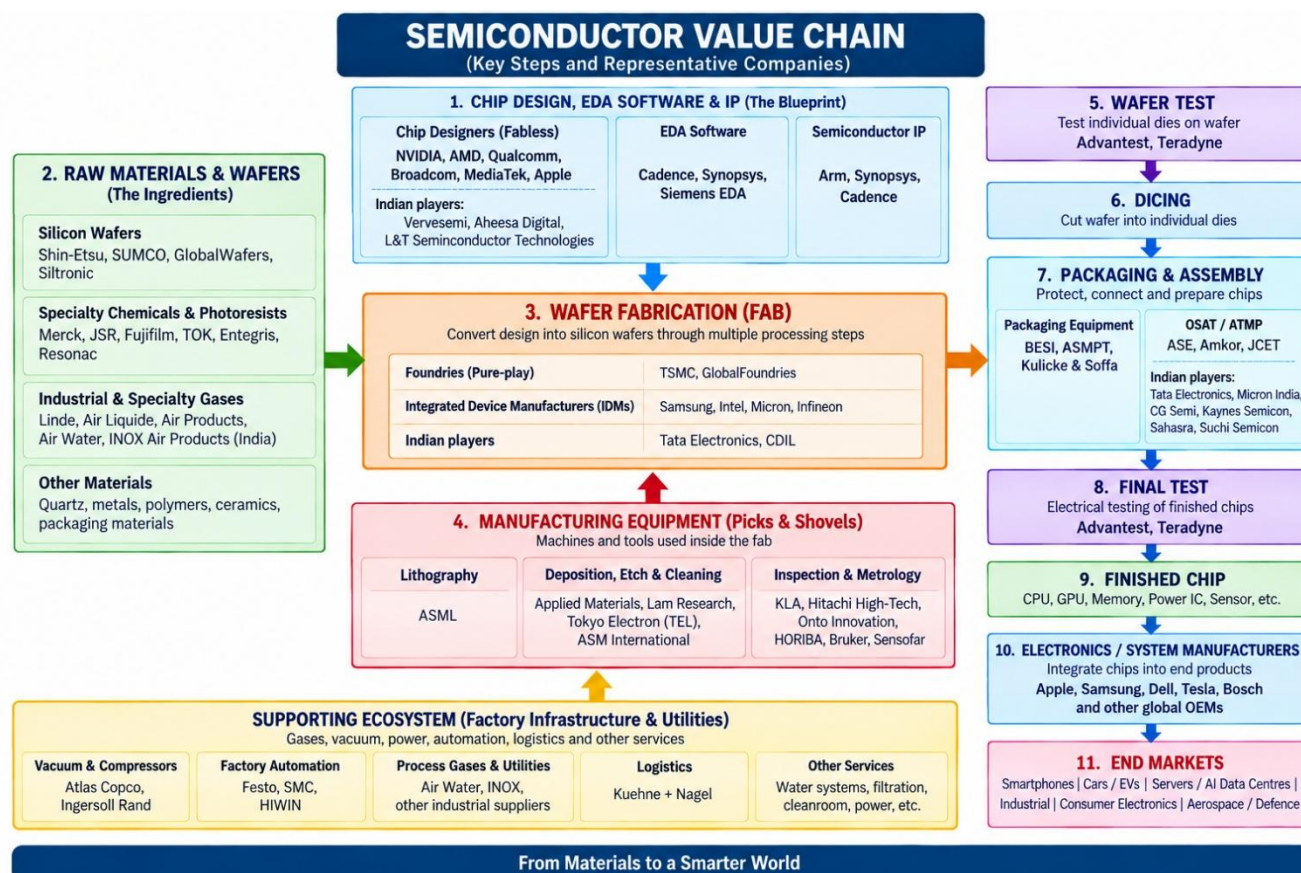
- **Vacuum & Compressors:** Atlas Copco, Ingersoll Rand.
- **Factory Automation:** Festo, SMC, HIWIN.
- **Logistics & Transport:** Kuehne + Nagel.

7. Electronics System Manufacturers & End Markets

Packaged chips are supplied to system manufacturers and integrated into final consumer and industrial applications.

- **End Markets:** Smartphones (**Apple, Samsung**), Automotive/EVs, AI Data Centers/Servers, Industrial Robotics, and Consumer Electronics.
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Exhibit 2: Semiconductor Value Chain



INDUSTRY OPPORTUNITY

Global semiconductor market to reach US\$1.6tn by 2031

As per McKinsey estimates, the global semiconductor market is expected to grow at ~8% CAGR to US\$1.6tn over the next five years, led by computing, data storage and wireless applications. India aims to capture ~10–15% of the global market over the next decade, supported by initiatives such as ISM 1.0, ISM 2.0, Electronics Components Manufacturing Scheme (ECMS) and PLI, along with state-level incentives to attract investments and build a domestic semiconductor ecosystem.

Indian semiconductor market to grow at 14–16% CAGR to US\$120bn by 2031

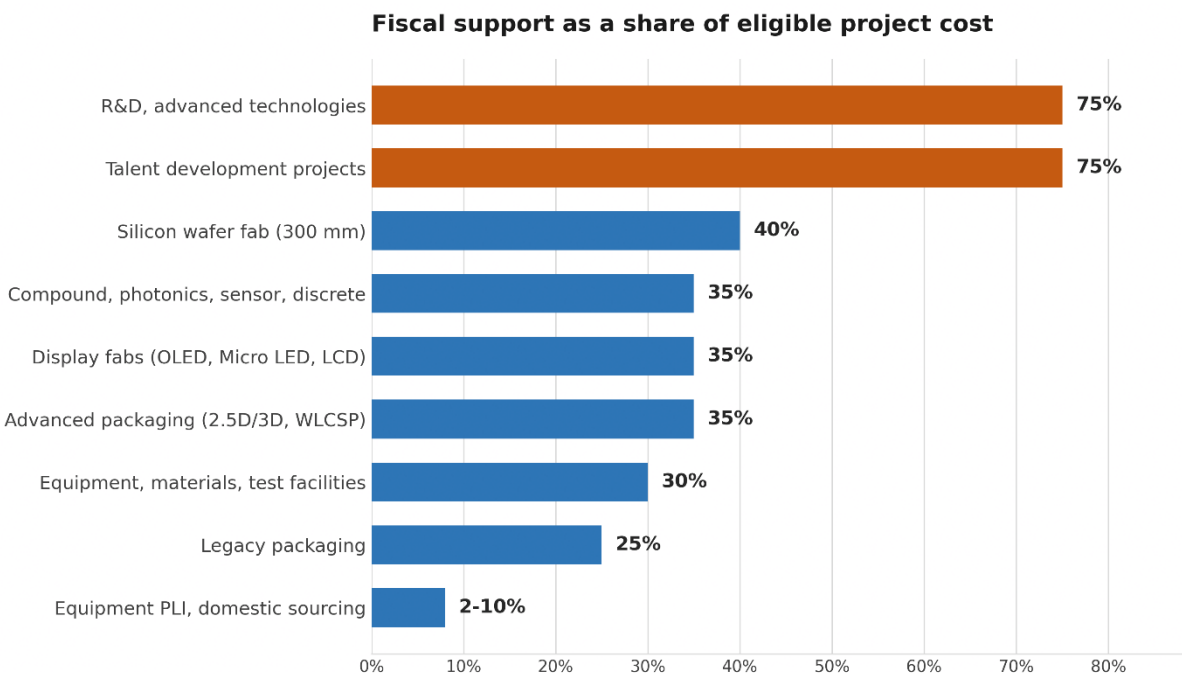
India's semiconductor market is expected to grow from around US\$60bn currently to US\$110–120bn by 2031, implying 14–16% CAGR, significantly ahead of global growth. Growth is expected to be driven by automotive, industrial and IT hardware, while government support for fabs, Assembly, Testing, Marking and Packaging (ATMP) units, display manufacturing and chip design startups is helping build domestic capabilities across the value chain.

POLICY & GOVERNMENT INITIATIVES

ISM 2.0 to focus on building a complete semiconductor ecosystem

ISM 2.0 aims to develop an integrated semiconductor ecosystem spanning chip design, manufacturing, equipment and materials, advanced packaging, R&D and talent development. Approved by the Union Cabinet in July 2026, the programme carries a total outlay of ₹1,270bn and is structured around six key pillars: Design, Machines & Materials, Fabs, ATMP/OSAT, Research & Development, and Talent Development.

Exhibit 3: Government fiscal support to Semicon projects



Source: Semicon India 2026, Government, YES Sec

INDIA'S POSITION IN THE VALUE CHAIN

Current State of the Indian Semiconductor Industry

India’s semiconductor strategy is moving from individual project development toward building a broader, integrated semiconductor ecosystem covering design, manufacturing, packaging, equipment, materials, R&D and talent. This direction has become more visible with the transition from Semicon India Programme 1.0 to Semicon 2.0. Semicon 2.0, approved in July 2026 with an outlay of ₹1,27,500 crore, is structured around six pillars: Design; Machines & Materials; Fabs; ATMP/OSAT; R&D; and Talent Development.

Progress from policy to production

Under Semicon 1.0, 12 semiconductor manufacturing projects have been approved across six states, involving investment commitments of more than ₹1.64 lakh crore. The projects include silicon and compound-semiconductor fabs, display-related manufacturing and packaging facilities. By September 18, 2026, five units had started commercial production, marking the transition from project approvals to actual manufacturing activity in India.

Key projects include:

- **Tata Electronics + PSMC:** A 300mm semiconductor fab in Dholera, Gujarat, with planned capacity of 50,000 wafer starts per month. Tata states that the fab is designed for 28nm–110nm analog and logic applications.
- **Tata Semiconductor Assembly & Test (TSAT):** A large semiconductor packaging facility in Morigaon, Assam, with planned capacity of 48 million units per day.
- **Micron:** An ATMP facility in **Sanand, Gujarat**, focused on assembly and testing of DRAM and NAND products. Commercial production began in 2026.
- **CG Semi:** An OSAT facility in **Sanand, Gujarat**, developed with Renesas and Stars Microelectronics; commercial production commenced in July 2026.
- **Keynes Semicon:** An OSAT facility in Sanand with planned capacity of more than six million chips per day; the project has moved into production.
- **SiCSem:** Developing an integrated silicon-carbide semiconductor manufacturing ecosystem, including wafer, fab and ATMP capabilities.
- **CDIL:** An established Indian semiconductor manufacturer with discrete-device manufacturing capabilities; its Mohali commercial production line was inaugurated during SEMICON India 2026.
- **Suchi Semicon:** An OSAT facility in Surat covering wafer probing, assembly, packaging and testing; its commercial production line was also inaugurated during SEMICON India 2026.
- **HCL-Foxconn JV:** Developing a semiconductor facility near Jewar, Uttar Pradesh, focused on display-driver ICs.
- **Crystal Matrix:** Developing a GaN-based compound-semiconductor and Mini/Micro-LED ecosystem at Dholera.

Indian Semiconductor Value Chain & Key Companies

Exhibit 4: Government fiscal support to Semicon projects

Value Chain	What It Involves	Key Indian / India-based Companies
A. Chip Design & IP	Designing semiconductor architectures, chips and proprietary IP	• L&T Semiconductor Technologies • MosChip Technologies • Vervesemi Microelectronics • Aheesa Digital Innovation
B. Semiconductor Engineering & Design Services	VLSI, verification, embedded systems, product engineering and R&D support	• Tata Elxsi • L&T Technology Services (LTTS) • HCLTech • Infosys • Wipro • Tech Mahindra
C. Materials, Chemicals, Gases & Filtration	Critical materials, specialty chemicals, gases and contamination-control products used in semiconductor manufacturing	• INOX Air Products • Air Water India • Nagase • Dyna Filters
D. Wafer Fabrication / Semiconductor Fabs	Processing silicon wafers and building semiconductor devices	• Tata Electronics • SiCSem • CDIL • Crystal Matrix • SCL Mohali
E. Packaging, Assembly & Testing (OSAT / ATMP)	Wafer probing, dicing, assembly, packaging and semiconductor testing	• Tata Semiconductor Assembly & Test • Micron India • CG Semi • Kaynes Semicon • Suchi Semicon • Sahasra Semiconductors
F. Equipment, Factory Infrastructure & Automation	Equipment and systems required to operate fabs and packaging facilities	• Applied Materials India • Lam Research India • ASML India • Tokyo Electron India • KLA • Atlas Copco • Ingersoll Rand • Festo • SMC • HIWIN
G. EMS & System Integration	Manufacturing and integration of electronic products using semiconductor components	• Dixon Technologies • Syrma SGS • Amber Enterprises • Avalon Technologies

India's Position Across the Semiconductor Value Chain

India is building capabilities across the semiconductor value chain, with its strongest positions currently in **chip design, engineering talent and downstream electronics demand**. At the same time, **wafer fabrication, advanced equipment, semiconductor-grade materials and specialised manufacturing capabilities** remain areas where the domestic ecosystem is still developing. The government's **Semicon 2.0** framework is aimed at addressing these gaps by supporting the broader "silicon-to-systems" ecosystem across design, machines and materials, fabs, advanced packaging, R&D and talent.

1. Areas of Strength

A. Chip Design & Engineering Talent

India has built a significant semiconductor design base, supported by a large engineering workforce and the presence of global semiconductor R&D centres. India accounts for nearly 20% of the global semiconductor chip-design workforce and hosts about 7% of the world's semiconductor-domain GCCs.

Under the Chips to Startup programme, around 70,000 design engineers have been trained over the past four years, while EDA tools have been made available across 400+ engineering colleges and 105 startups/MSMEs. More than 300 chip designs have been developed through the wider design ecosystem, with several already moving toward fabrication and testing.

Key participants include L&T Semiconductor Technologies, MosChip Technologies, Vervesemi, along with engineering and R&D companies such as Tata Elxsi, LTTs, HCLTech, Infosys, Wipro and Tech Mahindra.

B. Packaging & OSAT / ATMP

India's strongest area of new physical semiconductor manufacturing has so far been assembly, packaging and testing. As of September 2026, five semiconductor manufacturing units had commenced commercial production, including Micron, Kaynes Semicon, CG Semi, CDIL and Suchi Semicon.

The government's next phase also places greater emphasis on advanced packaging, including technologies that can improve performance and integrate multiple semiconductor dies. This provides India with an opportunity to develop manufacturing and packaging capabilities while gradually building deeper semiconductor process expertise.

C. Large Domestic Electronics Market

India's semiconductor demand is supported by the rapid expansion of the electronics industry. Deloitte estimates India's semiconductor market at around US\$45–50bn in FY25, increasing to approximately US\$120bn by 2030 and US\$300bn by 2035, driven by electronics manufacturing, automotive electrification, AI and data-centre demand.

The presence of a large electronics manufacturing base, including companies such as Dixon Technologies, Amber Enterprises and Syrma SGS, provides a growing downstream market for semiconductors manufactured and packaged in India.

2. Key Gaps in the Value Chain

A. Semiconductor Manufacturing Equipment

India remains heavily dependent on global suppliers for advanced semiconductor manufacturing equipment. Core areas such as lithography, deposition, etching, inspection and metrology are dominated by companies including ASML, Applied Materials, Lam Research, Tokyo Electron and KLA.

Building domestic capabilities in semiconductor equipment is therefore an important focus of Semicon 2.0, which specifically includes machines and materials as one of its six pillars. At SEMICON

India 2026, global equipment companies also announced plans to expand their Indian footprint. Applied Materials announced a US\$5bn investment over the next decade, while Lam Research announced approximately ₹10,000 crore for a silicon-component manufacturing and vertical ingot-processing facility in India.

B. Semiconductor Materials, Chemicals & Gases

Advanced semiconductor manufacturing requires extremely high-purity silicon wafers, photoresists, process chemicals, specialty gases and other materials. India's domestic supply base in several of these categories is still developing, creating dependence on global suppliers.

This has now become an explicit policy focus. Under Semicon 2.0, the government intends to incentivise companies involved in the manufacturing of semiconductor materials, chemicals and gases, while industry leaders have highlighted the need for greater localisation of ultra-pure materials and certified domestic suppliers.

Relevant global companies include Merck, JSR, Fujifilm, Entegris, Resonac, Air Liquide and Linde, while INOX Air Products and Air Water India participate in the Indian market.

C. Wafer Fabrication & Process Know-how

India's commercial wafer-fabrication ecosystem is still at an early stage compared with established semiconductor manufacturing hubs such as Taiwan, South Korea and the US. The country's first major commercial silicon fab being developed by Tata Electronics and PSMC in Dholera is scheduled for commissioning in 2028, while the initial Indian manufacturing roadmap is focused on 28nm–110nm nodes.

The challenge is not limited to capital expenditure. A competitive fab also requires process know-how, high yields, equipment integration, specialised suppliers and long-term customer relationships.

D. Fab-specific Talent & Infrastructure

India has a relatively strong pool of semiconductor design engineers, but the manufacturing ecosystem requires additional skills in cleanroom operations, fab construction, equipment maintenance, process engineering and precision manufacturing.

The government has therefore expanded its talent focus beyond chip design toward cleanroom, fab and precision-manufacturing skills under Semicon 2.0. The programme also aims to deepen training and industry participation in these areas.

Semiconductor fabs additionally require highly reliable power, ultra-pure water, cleanroom systems, gases, vacuum and specialised logistics, increasing the infrastructure requirements for successful commercial operations.

E. Moving from Design Services to Product & IP Ownership

India's semiconductor presence has historically been weighted toward engineering and design services for global companies. The next stage is expected to involve greater development and ownership of Indian-designed chips, semiconductor IP and complete products.

This transition is explicitly reflected in Semicon 2.0, which aims to deepen India's position in chip and system design and semiconductor IP, while the government has also highlighted the move from design services towards a broader “Product Nation” model.

Analyst View

- **Shift from Capacity Creation to Ecosystem Development:** India's semiconductor strategy is evolving from building standalone fabs and OSAT facilities to developing a broader "Silicon-to-Systems" ecosystem spanning design, manufacturing, packaging, materials, equipment, and end-product development.
- **Strong Policy Support:** The Government's Semicon 2.0 (ISM 2.0) programme, with an outlay of ₹1.27 lakh crore, aims to strengthen six key pillars: chip design, materials & equipment, fabs, ATMP/OSAT, R&D, and talent development.
- **Robust Demand Outlook:** India's semiconductor market is expected to grow from US\$50-55 billion in FY25 to US\$110-120 billion by 2031, implying a 14-16% CAGR, significantly higher than the projected global industry growth rate.
- **Global Supply Chain Realignment:** Investments by global semiconductor leaders such as Micron, Applied Materials, Lam Research, PSMC, Renesas, and Stars Microelectronics are helping accelerate the development of India's domestic semiconductor ecosystem.
- **Design-Led Competitive Advantage:** India remains one of the world's largest semiconductor design hubs, accounting for approximately 20% of the global chip-design talent pool, providing a strong foundation for future IP and product development.
- **Packaging Emerging as a Key Opportunity:** Advanced packaging and OSAT/ATMP operations represent a relatively lower-capex entry point into semiconductor manufacturing and are likely to witness faster commercialization than wafer fabrication.
- **Pragmatic Manufacturing Strategy:** India's initial focus on 28nm–110nm mature-node technologies aligns with domestic demand from automotive, industrial, power electronics, telecom, and defence applications.
- **Significant Import Dependence Remains:** The country continues to rely heavily on imports for semiconductor equipment, silicon wafers, specialty chemicals, and advanced manufacturing materials, highlighting opportunities for future localization.
- **Broad Investment Opportunity Across the Value Chain:** Potential beneficiaries extend beyond chip manufacturers to include design services, engineering R&D, EMS players, industrial gas suppliers, precision engineering companies, and semiconductor packaging firms.
- **Long-Term Opportunity:** While fabs are highly capital intensive and have long gestation periods, higher returns may emerge from businesses focused on chip design, IP creation, advanced packaging, engineering services, and semiconductor-related manufacturing ecosystems.