OUTLOOK FOR INDIA'S SEMICONDUCTOR INDUSTRY

— FOCUSING ON THE POTENTIAL OF DESIGN AND BACK-END PROCESSES —

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SUMMARY

- India's semiconductor industry is experiencing rapid growth in the areas of design and back-end processes such as inspection and packaging. While the government is supporting the development of manufacturing bases, challenges remain in areas like power supply, raw material procurement, human resources, and price competitiveness.
- In addition to back-end processes by US Micron, large-scale investments are underway in front-end semiconductor manufacturing by India's TATA, aiming to transform domestic demand into a base for exports. Meanwhile, participation from Taiwan's TSMC and South Korea's Samsung is not yet anticipated.
- Leveraging India's abundant design talent pool, Western companies are accelerating the establishment of design hubs. Collaboration between Japanese and Indian firms is anticipated in semiconductors, EVs, and automotive AI. When viewed from a long-term perspective, India holds potential as a promising partner for Japanese companies, offering prospects as a semiconductor manufacturing hub.

1. INDIA'S SEMICONDUCTOR INDUSTRY: THE CHALLENGES OF ACHIEVING GROWTH AND SELF-RELIANCE

1-1. Aspiring to shift from import dependence to manufacturing powerhouse

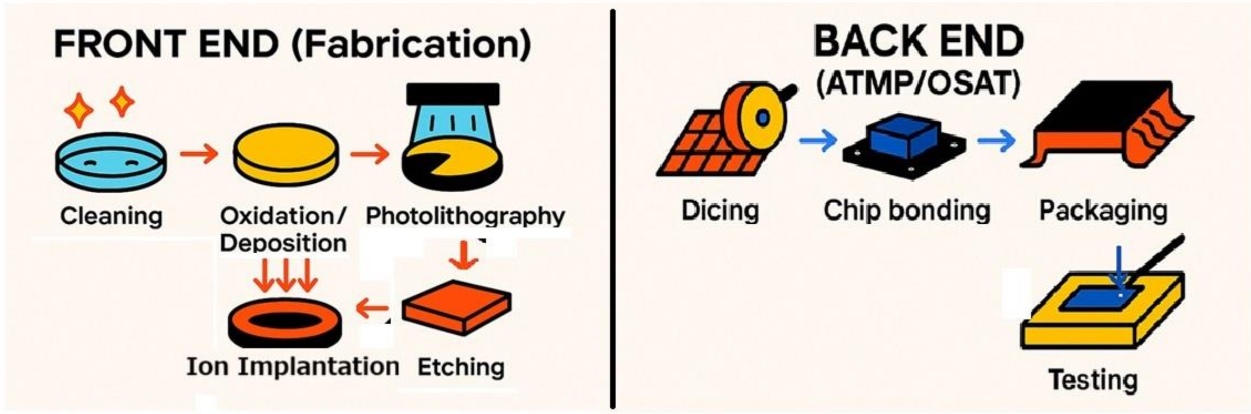
India is now embarking on a full-scale industrial development initiative, positioned as a national strategy, to enhance its presence in the global semiconductor industry. Driven by growing demand related to smartphones, automobiles, computing, and data centers, the country's semiconductor market is projected to expand rapidly in value terms from $38 billion in 2023 to $100 billion by 2030[1]. Furthermore, India's semiconductor industry has few geographical constraints and holds high value as a "strategic asset" when seen from the perspectives of national security and economic independence.

India's semiconductor industry currently relies on imports from China, Taiwan, and South Korea. In strategic sectors such as AI, 5G, and defense, establishing a stable domestic supply chain has become an urgent priority. To reduce reliance on imports, the policy aims to build a comprehensive domestic production system covering the entire process—from front-end fabrication, which begins with circuit design and patterning on silicon wafers,

[1] Press Information Bureau https://www.pib.gov.in/PressNoteDetails.aspx?id=154968&NoteId=154968&ModuleId=3

to back-end assembly, testing, and packaging (ATMP[2]/OSAT[3]), where products are finalized at this stage through encapsulation, assembly, and inspection (Figure 1).

Figure 1: Overview diagram of the entire semiconductor process and back-end process



Source: Compiled by MGSSI using Copilot

The Indian government established the Indian Semiconductor Mission (ISM) in 2021. Through a support package totaling $10 billion, it is promoting the development of a design ecosystem and attracting manufacturing facilities for both front-end and back-end processes. Under the ISM framework, the government has approved subsidy applications for 10 semiconductor manufacturing projects across six states. Four additional projects are pending approval, bringing the total investment to $18.2 billion (Figure 2).

Figure 2: List of 10 semiconductor manufacturing-related projects approved as of end-September 2025 (amounts in hundred million dollars, 1USD ≈88 INR)

SN	Company/project	Segment	Location	Planned investment amount (Hundred Million $)	Central government support (amount/basis)
1	Micron Technology (ATMP)	ATMP/OSAT	Sanand, Gujarat	27.5	Up to 50% of capex $1.375 billion (based on ATMP scheme)
2	Tata-PSMC fab	Silicon CMOS fab	Dholera, Gujarat	103.1	50% (Government commitment with respect to eligible capex. Upper limit guideline: $5.15 billion)
3	TSAT (Tata) Assam	ATMP/OSAT	Jorhat, Assam	30.6	50% (upper limit guideline $1.53 billion)
4	CG Power & Industrial Solutions (OSAT)	ATMP/OSAT	Sanand, Gujarat	8.6	Up to $0.4 billion (concluded Fiscal Support Agreement (FSA) to receive 50% fiscal support on capex)
5	Kaynes Semicon (OSAT)	ATMP/OSAT	Sanand, Gujarat	3.7	50% (upper limit guideline)
6	HCL–Foxconn JV (display driver)	Semiconductor manufacturing (including display driver/OSAT processes)	Jewar, Uttar Pradesh (NOIDA)	4.2	50% (upper limit guideline)
7	SiCSem (SiC compound semiconductor)	Compound (SiC) Fab＋ATMP	Bhubaneswar, Odisha	2.3	50% (upper limit guideline)
8	3D Glass Solutions (3DGS)	Advanced packaging/embedded glass substrates	Bhubaneswar, Odisha	2.2	50% (upper limit guideline)
9	CDIL (Continental Device)	Enhancement of discrete/analog capabilities	Mohali, Punjab	0.1	50% (upper limit guideline)
10	ASIP Technologies (APACT Partnership)	Advanced SiPs (advanced packages)	Andhra Pradesh (Tirupati EMC expected)	5.3	50% (upper limit guideline)

List of semiconductor manufacturing-related projects for which government subsidy applications were submitted as of end-September 2025 (pending)

SN	Company/Project	Segment	Location	Planned investment amount (Hundred Million $)	Latest milestone (announcement date)
1	UST/Kaynes Semicon (new JV)	New OSAT facility	Sanand, Gujarat	3.7	Announcement of JV (September 29, 2025)
2	Suchi Semicon	OSAT	Surat, Gujarat	1.0	Opening of facility (preparing for commercial operations (from January 2025))
3	RRP Electronics (fab plan)	Front-end process (plan)	Navi Mumbai, Maharashtra	13.6	State provides 100 acres of land under Letter of Comfort (September 12, 2025)
4	Cyient Semiconductors/Anora (mass production testing site)	Mass production testing/validation	Bengaluru, Karnataka	Undisclosed	Announcement of new test floor (mid-September 2025)

Source: Compiled by MGSSI based on data from the India Government Press Information Bureau

[2] ATMP: Assembly, Testing, Marking and Packaging (Semiconductor manufacturing back-end processes. The group of processes necessary for chip finalization.)

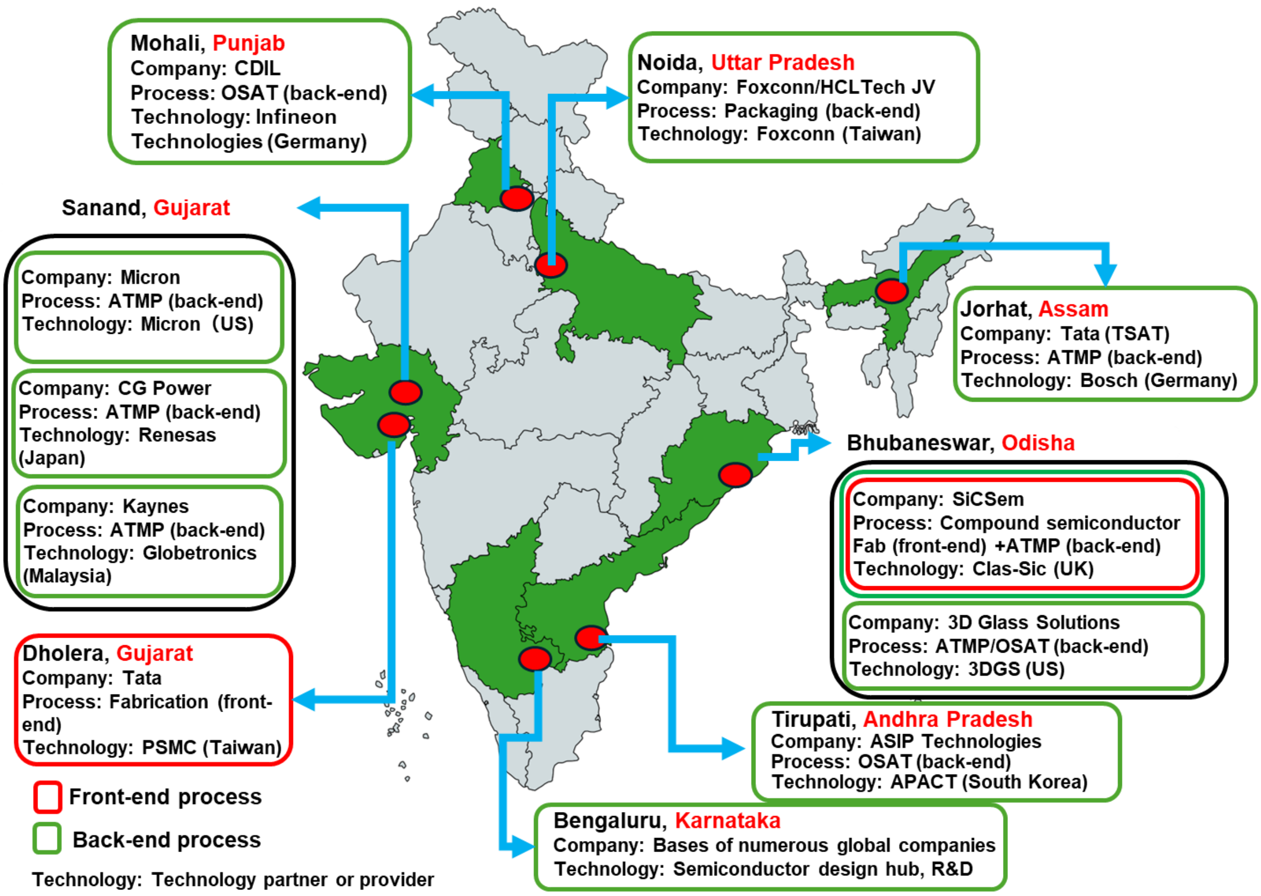
[3] OSAT: Outsourced Semiconductor Assembly and Test (Services provided by external companies specializing in semiconductor back-end processes.)

These initiatives are positioned not merely as industrial policy, but as part of the country's strategy to ensure economic security. Additionally, the government aims to lay the groundwork for India to become a major player in the semiconductor sector in Asia within the next decade.

1-2. Building front-end and back-end ecosystems centered on India's Tata and US-based Micron

India is rapidly promoting the development of its semiconductor industry infrastructure based on a national strategy, covering both front-end and back-end processes. Dholera and Sanand in Gujarat state are emerging as core hubs within this framework (Figure 3). In the area of front-end processes, India's Tata Group is constructing India's first semiconductor front-end factory in Dholera, aiming for mass production to begin in 2027. This project is being developed under a technology partnership with Taiwan's PSMC [4] (Powerchip Semiconductor Manufacturing Corp.), the world's sixth-largest semiconductor foundry by revenue. The total investment amounts to approximately $10 billion, and there are plans to produce 50,000 wafers per month for mature nodes[5] ranging from 28 nm to 120 nm. Additionally, Tata and Tokyo Electron have signed an MOU regarding equipment supply, and equipment manufacturers such as ASML of the Netherlands are currently establishing local support systems.

Figure 3: Semiconductor manufacturing sites/processes and technology partners in India



Source: Compiled by MGSSI based on data from MapChart and the Indian Government Press Information Bureau

Meanwhile, in back-end processes, US-based Micron is building a back-end fabrication plant for DRAM and NAND semiconductor memory products in Sanand. This initiative is positioned as ISM's flagship project. Of the total investment of approximately $2.75 billion, Micron will contribute about $ 826 million, with the remaining funds provided through central and state government subsidy programs. Phase 1 is scheduled for completion

[4] PSMC: Powerchip Semiconductor Manufacturing Corporation Ranked as the third-largest foundry in Taiwan.

[5] Mature node: A semiconductor chip manufactured using relatively older fabrication technology larger than 28 nm in the semiconductor manufacturing process.

in June of 2026, and the plant is expected to lead to the creation of up to 20,000 jobs. At the Sanand hub, in addition to Micron, Indian companies Kaynes Semicon and CG Power have also announced plans to establish large-scale back-end production lines. In some cases, companies can receive government support covering up to 70% of the project cost, derived by combining the 50% support from the central government shown in Figure 2 with an additional 20% support from state governments.

In view of this integration of front-end and back-end processes, Tata has adopted a vertically integrated business strategy. Under this approach, wafers produced at the front-end facility under construction in Dholera, Gujarat, will be completed at the back-end facility being built in Jorhat, Assam. This will create an integrated manufacturing system within India, enabling the company to meet domestic demand in sectors such as automotive, home appliances, and telecommunications, while also supporting a phased expansion into export markets.

1-3. Challenges to becoming a semiconductor manufacturing hub

For India to develop as a semiconductor manufacturing hub, it is crucial to build infrastructure, particularly reliable power and water supply systems, and establish a stable supply chain for raw materials.

Power supply remains a major concern. India's average number of outages per customer (SAIFI[6]) is 2.39, significantly higher than the 0.49 for Malaysia, a leading semiconductor back-end manufacturing hub. The average outage duration in India is also longer at 3.72 hours compared to Malaysia's 0.48 hours, indicating lower reliability. In the Indian states of Gujarat and Assam, in particular, these figures tend to be even worse. Companies operating in Gujarat's Dholera region are attempting to address the issue through measures such as combining renewable energy sources, dedicated transmission lines, and installing diesel generators, but concerns remain about power supply stability.

Water supply is another critical factor. Based on on-site inspections and interviews conducted in the Dholera area, it is expected that the supply system for the large quantities of ultrapure water required for semiconductor manufacturing in the area will be established by the time factories begin operating, thanks to technical support from Japan and other sources.

As for raw materials, India currently depends on imports for most of the materials required for both front-end and back-end semiconductor manufacturing processes. Looking ahead, the country aims to achieve supply chain independence for critical raw materials by the early 2030s by strengthening technological cooperation with foreign companies, including those in Japan, and promoting the phased development of domestic production (see Section 2-2 for details). These efforts will enhance India's resilience to geopolitical risks and support the sustained growth and competitiveness of its domestic semiconductor industry.

2. POTENTIAL FOR COLLABORATION BETWEEN JAPANESE COMPANIES AND INDIA AS A DESIGN HUB

2-1. India's semiconductor design hub attracting global companies

According to a JLL research report, India hosts 1,950 global capability centers (GCCs[7]) that account for 55% of the world's IT and R&D bases and provide employment for over 1.9 million related personnel. The GCC clusters formed in Bengaluru, Hyderabad, Noida, and other locations employ approximately 20%[8] of the world's chip

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[6] System Average Interruption Frequency Index (SAIFI): The average number of power outages experienced by customers over a one-year period. One of the international standards for evaluating power reliability.

[7] GCC: Global Capability Center. Entities established to specialize in handling IT services, engineering, research and development (R&D), and other functions.

[8] https://bastionresearch.in/indias-leap-into-the-semiconductor-future-gradually-getting-ready-one-chip-at-a-time/

design engineers. Companies primarily from the US, along with those from Europe, Taiwan, South Korea, and Japan, are developing SoCs[9] and circuit designs (IP[10]) for AI, automotive, smartphones, and IoT applications.

In the US, Qualcomm is making advancements in technology development and design with a workforce of approximately 17,000 people. AMD plans to double its current labor force of approximately 5,000, to 10,000 related personnel by 2028 (Figure 4). Among European players, the Netherlands' NXP Semiconductors and Germany's Infineon Technologies are strengthening their design capabilities in the automotive and IoT sectors.

Figure 4: Major global companies' semiconductor design-related facilities in India

Company	HQ	Locations of bases in India	Design field	Number of design personnel and researchers currently assigned or scheduled for assignment
AMD	US	Bengaluru	CPUs, GPUs, FPGAs, and SoCs for HPC	Approximately 5,000 →10,000 (by around 2028)
Qualcomm	US	Bengaluru, Hyderabad, Chennai, Noida	5G modems, SoCs, automotive/IoT	Approximately 17,000 (base expansion)
NVIDIA	US	Bengaluru, Hyderabad, Pune	Semiconductor/AI chip design and customization, joint development of AI chips	Approximately 4,000→10,000 (planned)
Micron	US	Hyderabad, Bengaluru	Memory design and verification	Approximately 2,000
Texas Instruments	US	Bengaluru	Analog/DSPs/MCUs	Approximately 2,500
Arm	UK	Bengaluru, Noida	CPUs/IPs, 2 nm design	Approximately 2,000
NXP	Netherlands	Noida, Bengaluru, Hyderabad, Pune	Automotive, IoT, MCUs	Approximately 3,000→6,000 (5-year plan)
Infineon	Germany	Bengaluru (others)	Automotive, power semiconductor R&D	Approximately 2,500→5,000 (by around 2030)
Renesas	Japan	Noida, Bengaluru, Hyderabad, Pune	3 nm process design/automotive System-on-Chip	Approximately 1,000
ROHM	Japan	Bengaluru, Noida, Pune	Power/Analog, LSI design/AE	Approximately 200
Samsung SSIR	South Korea	Bengaluru	Memory, system LSI, foundry-related R&D	Approximately 5,000
MediaTek	Taiwan	Bengaluru, Noida, Mumbai, Delhi	Wireless, connectivity, smartphones, home SoC	Approximately 1,000

Source: Compiled by MGSSI based on various media reports

As for Japanese companies, although they currently utilize less than 5%[11] of the design talent active within India, Renesas Electronics, Sony, and Tokyo Electron are expanding their presence in India, and future developments are anticipated. Moreover, the Indian government has approved 23 chip design projects under the Design Linked Incentive (DLI[12]) scheme to support activities by Indian companies and research institutions in designing new semiconductor chips (Figure 5).

[9] SoC: System on a Chip integrates a CPU, memory, GPU, communication modem, and other components onto a single semiconductor chip (IC)

[10] IP: Intellectual property. Pre-designed, reusable hardware blocks or circuits, such as built-in self-test (BIST) capabilities within the chip, design assets like design-for test (DFT) IP that facilitate testability.

[11] https://kasbusinessconsulting.com/global-capability-centers-indias-tech-leadership/

[12] DLI: Design Linked Incentive. The scheme is an Indian government support program for the semiconductor design sector, aimed at strengthening the domestic design ecosystem and enhancing India's global competitiveness in this field.

Figure 5: Projects approved by the Indian government under the Design Linked Incentive (DLI) scheme (total amount: approximately $113.6million)

SN	Company	Field (project overview)
1	DV2JS Innovation LLP	Image sensors for surveillance/automotive cameras supporting low-light and single-photon detection
2	Vervesemi Microelectronics	Mixed-signal MCUs for motor control and smart energy applications
3	Incise Infotech	Linear LED driver ICs
4	FermionIc Design	8–12GHz hybrid BF 4-channel mux/demux G-P shifter
5	Morphing Machines	REDEFINE architecture-based SoCs, IPs, and accelerators
6	Calligo Technologies	RISC-V + POSIT coprocessor-equipped SoC + accelerator
7	Sensesemi Technologies	SenseSoC-200 (IoT/medical)
8	Saankhya Labs (Tejas subsidiary)	Baseband SoC for 5G base stations
9	Aryabhata Circuits & Research Labs	Advanced tire monitoring Ics
10	BigEndian Semiconductors	Video/audio surveillance SoCs
11	C2i Semiconductors	Digital multi-phase controller ICs for server power supply
12	MBit Wireless	LTE Cat-1 bis & NB-IoT dual-mode BB chip
13	MMRFIC Technology	Ka-band radar beamforming ICs
14	Sophrosyne Technologies	Ultra-low power SoCs for ECG/vital signs monitoring
15	Aheesa Digital Innovations	VEGA-based GPON/FTTx network SoCs
16	Mindgrove Technologies	SoC for edge computing vision applications (Shakti program)
17	InCore Semiconductors	RISC-V multicore (smartphones/edge AI)
18	Netrasemi	High-performance edge-AI SoC (video analysis, vector processing)
19	Netrasemi	64 TOPS ML accelerator based on 12 nm/TSMC process technology
20	Green PMU Semi	Energy harvesting PMUs
21	WiSig Networks	NB-IoT SoCs for terrestrial and satellite applications
22	MosChip Technologies (listed)	Smart energy meter IC “VIDYUT”
23	Multi Nano Sense Technologies	MEMS gas sensor + CMOS AFE SoC

Source: Compiled by MGSSI based on the Indian Government Press Information Bureau

2-2. Japan-India collaboration on semiconductor strategy and potential contributions by Japanese companies

Japan and India established a partnership in July 2023 to strengthen semiconductor supply chains, aiming to build a cooperative framework that leverages their complementary technological strengths in this field. Japanese companies possess global competitiveness in materials technology, manufacturing equipment, automotive semiconductors, and on-site operations. Meanwhile, India is working to establish itself as a global design hub, backed by its abundant design talent and rapidly growing electronics market.

In the Indian market, in particular, where electrification (EV adoption) is advancing, demand for power semiconductors and automotive sensors is surging. By combining Japan's highly reliable technology with India's design capabilities, an integrated approach from design to manufacturing becomes possible. This will not only benefit both countries but also contribute to strengthening supply chains.

Renesas Electronics has already established a 3 nm design center in India to strengthen its automotive SoC development. Sony is leveraging India's technological capabilities for designing image sensors for AI and surveillance applications. Tokyo Electron and SCREEN are establishing equipment supply and technical training bases through collaboration with Indian conglomerates, thereby contributing to human resource development.

In India, with both front-end and back-end sectors in their early stages of development, a phased entry approach is the most realistic option for Japanese companies. The semiconductor industry is supported by an extremely diverse range of raw materials. In the materials sector, Japanese companies possess high technological capabilities and competitiveness in many areas (Figure 6). Going forward, Japanese companies can play a significant role in nurturing India's semiconductor industry. In the short term, material and equipment supply along with quality management support will be effective. In the medium term, the localization of technologies for FC-BGA[13], which allows for miniaturization, high density, and superior heat dissipation properties, and SIP[14], and the strengthening of business continuity plans (BCP[15]) through collaboration with existing bases in Southeast Asia will come into view.

Figure 6: Key materials used in semiconductor front-end and back-end processes and the competitiveness of Japanese companies

Primary materials used in front-end (fabrication) processes

Category	Key materials	Application	Competitiveness of Japanese companies
Advanced substrates	SOI wafers	Low power consumption, 5G, automotive	◎
Photoresists	ArF, KrF, EUV	Microfabrication	◎
CMP slurry	Oxidation and metal polishing agents	Planarization process	◎
High-purity gas	N_2, H_2, Ar, NH_3	Process gases	◎
Specialty gases	WF_6, SiH_4, HBr, CF_4	CVD, etching	◎
Various chemicals	Hydrofluoric acid, hydrogen peroxide	Cleaning processes	◎
Compound substrates	SiC, GaN	EVs, power semiconductors	◎
Silicon substrates	Silicon wafers	Circuit formation substrates	○
Epitaxial materials	SiC epitaxial layers	Power devices	○
Sputtering targets	Cu, Ti, W	Wiring formation	△

Primary materials used in back-end (ATMP/OSAT) processes

Category	Key materials	Application	Competitiveness of Japanese companies
Lead frames	Cu/Fe-Ni alloy	Package base	◎
Molded resin	Epoxy encapsulation materials	IC encapsulation	◎
Bonding wire	Au, Cu, Ag	Electrode bonding	◎
Die attach materials	Solder, silver paste	Chip mounting/bonding	◎
Tape	Dicing tape	Chip protection	◎
Solder balls	Sn, Ag, Cu	BGA applications	◎
EMC materials	Epoxy molding materials	Heat and humidity control	○
Packaging substrates	ABF substrates	High-performance packaging	△

Note: Competitiveness indicators: ◎: strong, ○: medium △, : weak (assessment by the author)
Source: Compiled by MGSSI based on the reports from JEITA Semiconductor and others

As mentioned earlier, the Indian government is also supporting research and development of electronic design automation (EDA) tools and new materials through the DLI. Furthermore, semiconductor research centers are

[13] FC-BGA (Flip Chip-Ball Grid Array: High-density packaging technology for connecting semiconductor chips to substrates.
[14] SIP: Session Initiation Protocol. A signaling protocol that controls the initiation, modification, and termination of calls (sessions) in IP telephony and similar systems.
[15] BCP: Business Continuity Plan. A plan to ensure the continuity and rapid recovery of a company's critical operations without interruption in the event of emergencies such as natural disasters or geopolitical risks.

being established at major educational institutions such as the IITs and IISc[16], and a plan to train 100,000 engineers is also underway. Back-end semiconductor processes have lower automation rates compared to front-end processes, and many steps still require manual labor. Therefore, India's abundant workforce becomes a competitive advantage. Japan-India collaboration in this environment goes beyond mere cost reductions, and becomes a key strategic pillar for advancing technological innovation and strengthening economic ties.

3. OUTLOOK FOR INDIA'S SEMICONDUCTOR INDUSTRY

India's semiconductor industry, as mentioned earlier, faces challenges related to infrastructure stability, particularly in power and water supply, as well as raw material sourcing. Nevertheless, the country is leveraging government support to strengthen its technological capabilities and industrial base. In particular, design and back-end processes offer significant growth potential and the opportunity to play a complementary role in the global supply chain. By capitalizing on rising demand in the EV, AI, and telecommunications sectors and fostering collaboration with Japan, the US, and Europe, India is expected to establish itself as a strategic manufacturing hub. Building a self-reliant supply system will require phased investment, international cooperation, and human resource development, demanding a long-term perspective of at least 10 years. Through these initiatives, India has the potential to grow into a key manufacturing hub for the global semiconductor industry.

[16] IIT/IISc: Indian Institutes of Technology (India's leading science and engineering universities) / Indian Institute of Science (India's premier graduate school for science).