APRIL 2026

Expanding India's Role in the International Semiconductor Ecosystem

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A Report of CSIS Renewing American Innovation

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Center for Strategic & International Studies
1616 Rhode Island Avenue, NW
Washington, DC 20036
202-887-0200 | www.csis.org

Acknowledgments

The authors would like to thank Shruti Sharma, program manager and research associate with Renewing American Innovation, for her contributions to this report, as well as Andreas Kuehn, senior fellow at Observer Research Foundation America, and Charles Wessner, senior adviser (non-resident) at CSIS, for their in-depth review and comments on earlier drafts.

This report is made possible by general support to CSIS. No direct sponsorship contributed to this report.

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Why India's Semiconductor Push Matters

Today's semiconductor ecosystem is a complex global network involving research and development (R&D) and investments in education, training, and advanced manufacturing. India is a significant contributor within this ecosystem, particularly in semiconductor design and the supply of high-quality talent in the fields of science, technology, engineering, and mathematics (STEM). Recognizing strong global demand for design capabilities, the Indian government has moved to scale its role in recent years through initiatives that support domestic fabrication, advanced packaging, and precompetitive research. Significant public and private investments—alongside new technology partnerships with Singapore, the United Kingdom, and the United States—are beginning to expand India's semiconductor supply chain resilience.[1] However, India must overcome persistent challenges in infrastructure, regulatory predictability, trade policy, and administrative efficiency to become a globally competitive semiconductor manufacturing hub.

The semiconductor industry lies at the heart of the global digital economy: In 2025, worldwide chip sales hit $791.1 billion, and forecasts suggest this number will reach close to $1 trillion in 2026, in line with massive and still-growing demand in applications such as AI accelerators, datacenters, automobiles, and consumer electronics.[2]

Yet the global supply chain remains highly concentrated.[3] East Asia, led by Taiwan and South Korea, accounts for over 75 percent of semiconductor manufacturing capacity, with Taiwan alone producing more than 60 percent of global foundry revenue and more than 90 percent of leading-edge chips critical for next-generation technologies.[4] This concentration has created vulnerabilities. Geopolitical tensions, armed conflict, natural disasters, or supply disruptions such as pandemic shocks have repeatedly highlighted the fragility of global chip flows and the economic risks associated with overdependence on a narrow set of production hubs.

For the United States and its partners, India's semiconductor ambitions carry strategic implications. Policymakers in Washington, Brussels, Tokyo, and other capitals have pursued reshoring, right-shoring, and diversification initiatives to reduce dependency on East Asian production and build more resilient, trusted technology networks.[5] A more capable Indian semiconductor ecosystem could thus support supply chain diversification while aligning with broader efforts to enhance resilience in the Indo-Pacific and allied industrial bases.

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For India itself, the stakes are both economic and strategic. The market for chips in India alone is projected to reach over $100 billion in revenue by 2030, according to a joint report from the India Electronics and Semiconductor Association and Counterpoint Research.[6] If India can overcome structural constraints in its semiconductor ecosystem, it could then strengthen its electronics industry, create high-skilled jobs, and diminish reliance on imported chips for critical sectors including telecommunications, defense, cloud computing, and AI.[7] On the other hand, inability to address these structural constraints would highlight the limits of policy-led semiconductor strategies in the absence of deep, long-term ecosystem capacity.

Strengthening India's Semiconductor Design and STEM Talent

India's contribution to the semiconductor design sector is poised to increase over the next decade. India boasts approximately 120,000 chip design engineers, accounting for about 20 percent of the world's semiconductor design talent.[8] This pool of skilled professionals has attracted nearly all of the world's top 25 semiconductor design companies, including leading firms AMD, Arm, Infineon, Intel, Nvidia, and Texas Intstument.[9] Many of these firms have long-standing design offices in India and have further plans to expand their R&D operations in the country.

The government is concentrating on improving both the quality and quantity of human resources in the field of semiconductor design and manufacturing. Roughly 600,000 engineers in electronics-related fields graduate in India each year, but less than 1.5 percent have the skills needed for joining the semiconductor workforce.[10] One report projected that India would face a shortfall of 300,000 semiconductor workers by 2027.[11] Two initiatives supporting the goal of producing more and better talent are the Design Linked Incentive (DLI) Scheme and the Chips to Startup (C2S) program.

- **DLI Scheme:** This program supports domestic companies, startups, and micro, small, and medium enterprises (MSMEs) throughout the development and deployment phases of various semiconductor-related designs, such as integrated circuits, chipsets, system-on-chips, and intellectual property (IP) cores, over a five-year period.[12]

- **C2S Program:** This program aims to train 85,000 professional engineers at the bachelor's in technology, master's in technology, and doctorate levels at over 100 institutions across India to strengthen India's very-large-scale integration (VLSI) and embedded systems design sector. There are a total of 15 initiatives under this program, including ones that provide comprehensive education in design, access to online electronic design automation tools and facilities, training offerings, and support for industry-led R&D.[13]

India is also working with partners including the United States on policies that will continue supporting the training of domestic chip designers. In 2023, the United States and India launched an initiative that included "innovation bridges" to facilitate person-to-person exchanges of expertise in advanced technologies.[14] Over a five-year period beginning in 2018, the U.S. National Science Foundation (NSF) invested more than $146 million in collaborative research activities with scientists, engineers, and educators across India.[15]

In August 2022, the NSF announced a $2.8 million investment to encourage collaboration between U.S. university researchers and Indian scientists and engineers by participating in joint projects.[16] The collaboration is also supported by an approximately $430 million, five-year grant from the Indian Ministry of Science and Technology. Research awards from both the U.S. and Indian governments have helped enhance the reputation of the receiving students and faculty and improved their ability to obtain additional funding from the private sector in the future. Scientific collaboration between the two countries has been further reinforced in recent years, including through a U.S.-India implementation arrangement in January 2023 and a new partnership between the NSF and the Indian Anusandhan National Research Foundation in February 2025.[17]

International collaboration is also elevating educational standards in India. India's 2020 National Education Policy included reforms aimed at increasing student exchange opportunities and boosting investment in R&D.[18] Under this policy, India is now developing flexible master's degree programs, promoting partnerships between Indian and foreign universities, and attracting top-notch foreign universities to India. U.S. universities such as the Pennsylvania State University, Rice University, and Purdue University have established partnerships with universities in India to increase research and training opportunities.[19]

U.S. private investment in education and training in India also demonstrates the growing demand for skilled professionals in the semiconductor industry. Semiconductor equipment manufacturer Lam Research has committed to training 60,000 engineers over 10 years through its Semiverse training platform, which features a virtual nanofabrication and process modeling environment.[20] The platform officially launched in the fall of 2025, enrolling 1,961 students from 31 institutions across India, and leading multiple "train the trainers" programs at the Indian Institute of Science in Bengaluru, including a January 2026 training workshop that was attended by professors from 14 institutions. Lam expects 4,000 students to enroll in Semiverse in the fall of 2026.[21]

India also benefited from programs under the U.S. CHIPS and Science Act of 2022. In September 2024, the U.S. State Department announced that it would partner with the India Semiconductor Mission (ISM) to assess India's semiconductor ecosystem—including a focus on talent development and regulatory improvement—as a project of the International Technology Security and Innovation Fund.[22] However, the broader fund's implementation has slowed significantly in recent years.

Emerging R&D and Innovation Capabilities

India is also expanding its domestic R&D capabilities. One of the government's goals is to promote precompetitive R&D and collaborative research in critical areas such as lithography, which demands significant investment and plays a critical role in shaping the semiconductor technology road map.[23]

Recognizing the importance of networks of cooperative research institutions, the government recently announced the launch of the Bharat Semiconductor Research Centre (BSRC), an industry-led, nonprofit semiconductor research center.[24] The BSRC aims to position India as a globally competitive semiconductor research hub by bridging the gap between research and manufacturing. Its mission includes facilitating collaboration among global research centers, academia, industry, and the Indian semiconductor ecosystem. The center will be co-located with the Semi-Conductor Laboratory in Mohali, a suburb of Chandigarh, Punjab, which has a long-standing legacy of leading in semiconductor design, manufacturing, and R&D.[25] According to former Union Minister of State for Skill Development & Entrepreneurship and Electronics & IT Shri Rajeev Chandrasekhar, the BSRC is the first of its kind in the country and aims to become one of the world's leading semiconductor research institutes within the next four to five years.[26] India's Ministry of Electronics and Information Technology (MeitY) also established the Indian Nanoelectronics Users' Programme to support research in compound chips, sensors, and prototyping and startup incubation through the Indian Institute of Science in Bengaluru and various Indian Institutes of Technology.[27]

While the BSRC is a promising step, a key question is whether India can invest to match the scale and sophistication of its more established international counterparts. As global competition in science and technology intensifies, precompetitive research consortia including NY Creates (United States), the National Science and Technology Council (United States), **Imec** (Belgium), CEA-Leti (France), Fraunhofer (Germany), and Rapidus/LSTC (Japan) are rapidly being built up.[28] Establishing an Indian equivalent would require consistent investment, strong governance, and cultivation of deep, long-term partnerships—both domestic and international.

The research areas of the BSRC are still being finalized but will reportedly focus on semiconductor processes, advanced packaging, compound semiconductors, fabless design, and electronic design automation tools.[29] As details on BSRC's size and operations emerge, its role in fostering collaboration and innovation across Indian institutions—including the Semi-Conductor Laboratory in Mohali, Punjab; the Central Electronics Engineering Research Institute in Pilani, Rajasthan; and the Centre for Nano Science and Engineering , the Semiconductor Fabless Accelerator Lab, and the ChipIN Centre in Bengaluru, Karnataka—will become clearer.[30]

In parallel, the October 2025 announcement of an indigenous 7-nanometer (nm) processor led by Indian Institute of Technology Madras under the Shakti program also marks India's entry into advanced-node design, reinforcing a broader strategy to build domestic capabilities and reduce reliance on imported chips.[31]

Building a Market-Oriented Domestic Semiconductor Manufacturing Base

Another key goal of the Indian government is to establish domestic semiconductor manufacturing capabilities. The continued digitization of India's economy and society, aggressive investment by businesses in India, and rising ownership of electronic products by Indians of all income levels are all rapidly driving up domestic demand for semiconductors.[32]

With strong demand projections and many global firms adopting a "China plus one" strategy—where companies diversify supply chains by expanding production into alternative locations alongside China—India's rapidly growing market positions it as both a competitor to China's production lines and an attractive destination for investment. India can be a source for the world's customers to diversify semiconductor supply chains in the future.

Modernization of Semiconductor Complex Limited

Semiconductor manufacturing in India began in earnest in 1984. During the premiership of Indira Gandhi, the state-owned Semiconductor Complex Limited (SCL) was established in Punjab, with an initial investment of $40 million.[33] SCL began operations with technology that was one generation behind U.S. capabilities through a transfer from the U.S. company Microsystems.[34] Additional technology transfers from Rockwell and Hitachi enabled SCL to design and manufacture VLSI technology, mainly for military applications. However, a fire at its production facility in 1989 shut down SCL operations for eight years. The facility was rebuilt and restored in 1997 with a significant a financial investment of ₹332.56 crore (about $50 million).[35]

SCL continued supplying integrated circuit chips for various applications, from missiles to water purifiers, until 2006.[36] In 2006, SCL was taken over by the Space Division of the MeitY and primarily focused on designing, developing, and supplying integrated circuit chips for India's defense and strategic sectors. SCL contributed significantly to the development of India's digital infrastructure but became overly dependent on government orders from the defense and space sectors. Domestic defense and space missions were not enough for SCL to stay globally competitive in advanced semiconductor manufacturing.[37] India's remaining semiconductor facilities, including the Gallium Arsenide Enabling Technology Centre in Hyderabad and the Semiconductor Technology and Applications Research Centre, are operated by the Defense Research and Development Organization and are not commercial semiconductor manufacturing facilities.[38]

The Indian government now plans to modernize and commercialize SCL with a new state-of-the-art manufacturing facility, backed by a government investment of ₹516 crore ($2.75 billion).[39] Under the purview of MeitY, SCL aims to upgrade from its current 180 nm technology to 28 nm and eventually to a 12 nm node in low-volume production, as well as adding capacity for gallium nitride on silicon production.[40] The modernization plan includes scaling SCL and its laboratories based on a market-oriented R&D road map.

Incentive Programs for Attracting Foreign Semiconductor Manufacturers

India also seeks to attract foreign companies to manufacture semiconductors in the country. After some initial stalled efforts in 2007 and 2011, incentives launched in 2021 now appear to be gaining traction.

In 2007, then-Prime Minister Manmohan Singh announced a policy to subsidize a portion of fixed investments and establish special economic zones to attract semiconductor factories, such as those by U.S. firms AMD and Intel, but these efforts did not take off.[41]

In 2011, the government introduced policies to attract both brownfield investment (i.e., to renew or expand production facilities already in operation or acquire these facilities from their current owners) and greenfield investment (i.e., to build production facilities from scratch) to establish two semiconductor wafer fabs in India. The plan was for the first hub to manufacture (1) chips used in mass-produced goods and (2) chips used by fabless design companies, while the second hub would serve as a state-of-the-art semiconductor facility.[42]

Despite initial enthusiasm, the investments failed to materialize. Challenges such as inadequate infrastructure, lack of clarity in implementation guidelines, absence of experienced manufacturing partners, and limited ecosystem readiness deterred serious investor interest. As a result, neither fab project progressed beyond the proposal stage. India remained without a commercial-scale semiconductor fabrication plant for the following decade.

The Narendra Modi government is making efforts to change this. New strategic initiatives include the ISM, the Scheme for Promotion of Manufacturing of Electronic Components and

Semiconductors (SPECS) program, the Electronics Component Manufacturing Scheme (ECMS), and the broader Production Linked Initiative (PLI) scheme.

India Semiconductor Mission

Launched in December 2021, the ISM 1.0 provides subsidies to attract foreign semiconductor manufacturing capacity to India. In 2023, after the first round of proposals fell short of expectations, the government significantly revised its IMS 1.0 strategy: It (1) lowered the technical threshold to 28 nm or above fabrication projects, (2) expanded opportunities for back-end assembly, packaging, and testing facilities, and (3) increased the amount of funding. ISM 1.0 set aside an upwardly revised pool of around $10 billion for project proposals, which covered 50 percent of the cost of approved projects. As of April 2026, the Indian government has accepted 10 proposals: nine for greenfield investment (four in Gujarat, two in Odisha, one in Assam, one in Andra Pradesh, and one in Uttar Pradesh) and one for brownfield investment (in Punjab).

These projects, discussed in further detail below, represent a credible if nascent effort by India to enter key areas of chip manufacturing that would provide a platform for India to pursue broader strategic objectives. The ISM emphasizes a phased approach, starting with the production of older nodes before moving to the most advanced semiconductor technologies. Only two of the accepted projects are for semiconductor fabrication; the other eight awarded projects cover packaging.

- In June 2023, the government approved a $2.75 billion back-end memory facility for assembly, testing, marking, and packaging in Sanand, Gujarat, in partnership with U.S. memory manufacturer Micron.[43] Gujarat's state government is covering around 25 percent of the cost, in addition to the ISM's 50 percent, while Micron will invest the remaining 25 percent (approximately $825 million). Micron's facility opened in late February 2026 and has begun to ramp up packaging production for dynamic random-access memory, "NOT-AND" (logic gate) flash memory, and solid-state drives.[44]
- In February 2024, the Indian government approved an approximately $11 billion proposal by Tata Electronics and Powerchip Semiconductor Manufacturing to construct a 300 mm wafer fabrication facility in Dholera, Gujarat.[45] The facility is under construction and will produce legacy chips in the range of 28 nm–110 nm, with a goal of 50,000 wafers per month once fully operational.
- In February 2024, a joint venture was finalized among CG Power (India), Renseas Electronics (Japan), and Stars Microelectronics (Thailand); the project will establish a back-end facility for packaging industrial, automotive, and power chips in Sanand, Gujarat. The total investment is projected at around $1 billion.[46]
- In February 2024, ISM approved a Tata-owned chip-packaging facility in Jagiroad, Assam, with a projected cost of ₹27,000 crore (around $30 billion).[47] The facility is expected to generate some 27,000 jobs for the region and will offer wire bond, flip chip, and other packaging services. It will be supported through a collaboration with German firm Robert Bosch GmbH, following an MOU signed in July 2025.[48]

- A back-end facility in Sanand, Gujarat, operated by Kaynes Semicon also received ISM support. The facility imports wafers from Singaporean customer Lightspeed Photonics to be packaged, and sources input materials and gases from Japan's Mitsui & Co. Its initial construction cost was projected to reach ₹3,300 crore (around $360 million).[49] In October 2025, the facility shipped its first completed multi-chip modules to Alpha & Omega Semiconductor. The facility is designed to package advanced insulated-gate bipolar transistors as it ramps up to full production. Kaynes Semicon has also signed an MOU for capacity building and talent development with the VLSI Society of India.[50] Relatedly, in June 2025, Kaynes Semicon announced it had purchased power-module-production infrastructure from Fujitisu General Electronics for $13.8 million.[51]
- On May 14, 2025, India's Union Cabinet approved the establishment of a new semiconductor manufacturing facility, expected to be operational in 2028, that will produce display driver integrated circuits using gold bump technology. The facility is a joint venture between HCL and Foxconn, and is located in Jewar. With a planned investment of ₹3,700 crore (approximately $433.6 million), the facility will have an initial capacity of 20,000 wafers per month. The project is supported by leading equipment manufacturers, including U.S.-based Applied Materials and Lam Research, as well as critical gas and chemical suppliers, including multinationals Merck, Linde, Air Liquide, and Inox, strengthening the regional supply chain ecosystem by localizing key inputs and technical services.[52]
- SiCSem, in partnership with Clas-Sic (United Kingdom), received cabinet approval and ISM support in August 2025 for a compound chip fab in Odisha. The project aims to produce silicon carbide chips and will include integrated packaging lines with an initial projected investment of ₹2,000 crore (over $215 million).[53]
- Continental Device India received support in August 2025 to expand and enhance an existing facility in Mohali, Punjab, for power and industrial chips. The facility is unique as the only brownfield project approved under ISM 1.0. The facility is supported by a partnership with German firm Infineon. It already produces solar and electric vehicle chips, and in 2023 it produced India's first domestically manufactured silicon carbide chips. ISM support to expand the facility is roughly ₹117 crore, or about $12 million.[54]
- In August 2025, 3D Glass Solutions Inc. received ISM 1.0 support for an advanced 3D packaging facility in Bhubaneshwar, Odisha, which will include flip chip assembly and advanced glass interposer manufacturing, as well as 3D heterogeneous integration devices. The company's investment is projected at around $200 million.[55]
- Advanced System in Package Technologies, in partnership with South Korean firm APACT, received approval for a ₹480.85 crore ($51 million approximately) project for semiconductor packaging.[56]
- In February 2026, the Modi government announced it would fund an ISM 2.0 through a relatively modest ₹1,000 crore (roughly $100 million) investment, with a specific continued emphasis on supporting research, training, and IP development, while also indigenously producing semiconductor equipment and materials.[57] The budget also included around

8,000 crore (roughly $800 million) for supporting the Modified Programme for Development of Semiconductor and Display Manufacturing Ecosystem in India. Reportedly, the government has considered an ISM 2.0 subsidy fund of up to $20 billion, though the final amount is still being debated.[58] The discussion regarding the future of ISM 2.0 has sparked domestic debate over whether the significant public subsidies involved might be better spent on other pressing national priorities. Regardless, as it stands, the policy articulates the aim to reduce India's reliance on foreign chips and position itself as a global leader in the industry by 2035.

Scheme for Promotion of Manufacturing Electronic Components and Semiconductors

Launched in 2020, SPECS was a foundational step in India's strategy to strengthen its domestic electronics manufacturing base. By offering a 25 percent capital expenditure subsidy on facilities, equipment, and R&D, SPECS helped reduce the cost disadvantage faced by local manufacturers and encouraged early-stage investments in key sectors such as (1) assembly, testing, marking, and packaging, (2) semiconductor components, and (3) specialized sub-assemblies.[59]

As of early 2024, the scheme had approved 32 projects across 10 states, with a cumulative investment of over ₹3,400 crore ($410 million) and expected production output valued at more than ₹18,000 crore ($2.2 billion).[60] These projects are anticipated to generate approximately 5,100 direct jobs and significantly more indirect employment through associated supplier networks. The scheme has played a catalytic role in establishing regional manufacturing clusters by attracting mid-sized firms to the electronics space, contributing to improved ecosystem depth, and signaling long-term policy commitment.[61]

Electronics Component Manufacturing Scheme

Approved by the Union Cabinet in March 2025, ECMS represents a policy evolution that aims to address specific gaps left unaddressed by SPECS.[62] ECMS adopts a performance-linked framework, where incentives are based on revenue and employment generation rather than capital expenditure. This strategic shift is particularly important for segments such as components, sub-assemblies, and capital goods, where barriers to entry are lower but the policy support under earlier schemes was weak or misaligned. ECMS serves as a corrective and complementary measure to SPECS—targeting depth where SPECS focused on breadth. It aligns better with India's current industrial maturity, where the growth in finished goods manufacturing (e.g., mobile phones and IT hardware) has outpaced the development of the upstream component ecosystem. If implemented effectively, it could not only reduce import dependence but also support cluster formation in regions such as Coimbatore, Vadodara, and Pune. The scheme's success will depend on timely execution, transparent allocation of funds across categories, and integration with existing infrastructure and workforce development initiatives.

Production Linked Incentive Scheme

On March 28, 2025, India launched a ₹229.19 crore ($2.68 billion) PLI scheme to localize the manufacturing of passive electronic components (e.g., resistors, capacitors, inductors, and transformers) for the first time under a dedicated incentive framework.[63] The six-year scheme ties incentives to both production and job creation, with projected outcomes of $6.94 billion in investment, $53.33 billion in output, and 91,600 direct jobs.[64] The policy directly addresses a projected $248 billion supply gap, positioning India as a rising contender in global electronics manufacturing.[65]

Incentive Programs for Building an Innovation Ecosystem

India has established various public-private partnership schemes to support its growing semiconductor ecosystem.[66] These schemes, which variously support incubator development, entrepreneurship centers, international patenting, and collaborative research between industry and government, are similar in concept to the United States' Small Business Innovation Research and Small Business Technology Transfer programs.[67]

The Promoting Innovations in Individuals, Startups, and MSMEs scheme and the Startup India Seed Fund Scheme provide seed funding to Indian innovators and startups, respectively.[68] These grants provide funding for proof-of-concept or prototype efforts, helping to translate basic R&D into viable commercial products.

In addition to early-stage support, the Electronics Development Fund supports venture funds, angel funds, and private equity funds specializing in India's electronics sector.[69] The Karnataka state government has also established venture capital funds to invest in early-stage and growth-stage semiconductor startups.[70]

International Cooperation

In parallel with these domestic initiatives, India has also deepened its international technology partnerships to strengthen advanced semiconductor innovation and other emerging technology collaboration.

U.S.-India Technology Cooperation

The U.S.-India Initiative on Critical and Emerging Technology (iCET), launched in May 2022 by President Joe Biden and Prime Minister Modi, has become a central pillar of bilateral cooperation in high-tech sectors, with semiconductors as a core focus.[71] At the second meeting of the iCET in June 2024, both countries reaffirmed their commitment to joint efforts in coproduction, codesign, and R&D across domains including chips, quantum computing, AI, and defense technology.[72]

Under this framework, Bharat Semi, 3rdiTech, and the U.S. Space Force announced plans to establish the Shakti Semiconductor Fab—a multi-material compound semiconductor facility in India that will produce chips using gallium nitride, silicon carbide, and other advanced materials for national security, clean energy, and telecom applications.[73] The project benefits from 50 percent capital subsidies.[74]

In early 2025, following a meeting between President Trump and Prime Minister Modi, the iCET was rebranded as the U.S.-India Transforming the Relationship Utilizing Strategic Technology (TRUST) initiative, expanding its mandate to include new public-private bridges such as INDUS Innovation, while aligning with broader U.S.-India goals of building secure supply chains and advancing a bilateral trade agreement on critical technologies. [75] Crucially, TRUST also directs the two countries' private sectors to develop a U.S.-India Roadmap on Accelerating AI Infrastructure, including cooperation on development and access to compute and processors for AI.[76] As of the first quarter of 2026, this has resulted in announced data center investments of over $65 billion combined from Amazon, Google, and Microsoft, and a corresponding 21-year moratorium on taxes for local datacenters announced in India's latest Union Budget.[77] While the GPUs and core technologies to support these datacenters and hyperscalers will overwhelmingly be imported, the second-order benefits to India's technology ecosystem stand to be significant. At the India AI Impact Summit in February 2026, Prime Minister Modi outlined India's semiconductor goals and connected them to the need for AI computing power to support applications that drive economic growth. Indian officials echoed the importance of partnerships with the United States, and the event included India joining the Trump administration's Pax Silica supply chain initiative.[78]

India-Singapore Technology Cooperation

In September 2024, India and Singapore signed an MOU aimed at deepening cooperation, including on joint efforts to develop semiconductor clusters, cultivate skilled talent in chip design and manufacturing, and facilitate investment by Singaporean firms with global supply chain roles.[79] It also covers broader collaboration in digital public infrastructure, cybersecurity, 5G, supercomputing, quantum computing, and AI.

India-United Kingdom Technology

Launched in July 2024, the India-United Kingdom Technology and Security Initiative (TSI) represents a high-level strategic effort to fuse two advanced technology ecosystems. Anchored by the national security advisers of both countries, the TSI is only the second mechanism of its kind for India, modeled in part on the earlier U.S.-India iCET initiative. The TSI aims to catalyze moonshot projects by investing sustained political and bureaucratic capital, with early commitments including the establishment of observatories and R&D collaboration.[80]

Challenges for Building a Competitive Ecosystem

India is pursuing a variety of initiatives to build a robust domestic semiconductor ecosystem. At the same time, India's central and state governments must refine their regulatory frameworks to enable deeper cooperation and attract significant foreign investment. In its drive to develop a world-leading semiconductor ecosystem, India is competing with other growing players in the industry, including Malaysia, Thailand, and Vietnam, as well as established players such as Ireland, Israel, and Singapore.

The complexity of India's regulatory system varies significantly across states. . . . Streamlining these regulations is essential for fostering a globally competitive ecosystem.

In India, as in the United States, state governments exercise significant control over economic policy and can offer additional financial incentives to U.S. and international companies considering establishing a presence in their home states. For example, Andhra Pradesh, Gujarat, Karnataka, Odisha, Tamil Nadu, and Uttar Pradesh in recent years have all developed special incentive packages to attract investment and address foreign investors' concerns, using a combination of subsidies, tax incentives, and other forms of support.[81] However, the complexity of India's regulatory system varies significantly across states and from special economic zone to special economic zone. Streamlining these regulations is essential for fostering a globally competitive ecosystem. Achieving this objective requires a clear understanding of existing regulations, identifying which can be restructured at the state or federal level, and developing appropriate implementation mechanisms. While recent regulatory reforms are welcome, coordinated and accelerated improvements are still needed. This will remain a key challenge, and a key impediment, for rapid progress in the development of a globally competitive semiconductor ecosystem.

Ease of Doing Business

The overall ease of doing business in India, while significantly improved over the past decade, remains an obstacle to attracting investment. Transparency and predictability in the policy environment are essential conditions for attracting foreign investment. India has historically struggled in this area, including when it comes to semiconductor fabrication, assembly, packaging, and testing.

Policy consistency is also essential for domestic business, and while generally India's environment has seen improvements, more needs to be done here as well. The Modi government's introduction of the "Make in India" initiative, which focuses on streamlining regulations, boosting infrastructure, and promoting digitization, has accelerated reforms. In the view of some analysts, however, the net impact remains mixed.[82] In their view, to achieve a genuine renaissance in manufacturing, the government needs to do more to remove policy roadblocks and level the playing field for both foreign and domestic investors.

Moreover, in recent times, India's government has surprised foreign investors with abrupt, detrimental policy changes. For example, in August 2023, a new licensing requirement for importing laptops, tablets, servers, and computers was implemented without prior notice or stakeholder consultation and took effect immediately.[83] Facing pressure from industry and the U.S. government, the Indian government adjusted the policy and removed the license requirement, instead requiring companies to register the volume and value of imported products in these categories by November 2023.[84] These snap policies undermine investor confidence, as technology firms cannot anticipate regulatory changes or the associated costs.

As another example, India has removed most retroactive taxes at the central government level, but some remain in place at the state level. Differing rules apply for foreign firms investing in India, and limited flexibility in employment practices (specifically hiring and firing) undermines foreign companies' willingness to invest. Establishing new private-sector-owned R&D centers can also be challenging due to inconsistent facility classification and permitting processes.

Meanwhile, despite ongoing reform to regulatory clearances, judicial processes, and land acquisition, India still lags behind other national competitors in these areas, all of which are crucial for attracting semiconductor investment in back-end or legacy node fabrication facilities.[85] Attracting U.S. and foreign semiconductor investment will require addressing issues in three domains—infrastructure, trade policy, and regulations—to improve India's competitiveness. A discussion of each follows.

Basic Infrastructure

While India's strong digital public infrastructure implementation has positioned it well for future economic connectivity, fundamental challenges in physical transportation and power and water infrastructure remain, where reliable and high-quality supply are particularly important for attracting investment and sustaining manufacturing.[86]

Still, progress is being made. New Delhi's push for stronger physical infrastructure is paying dividends, with over 180 new port projects and thousands of miles of new highways constructed in recent years.[87] Yet internal connectivity remains a bottleneck. Shipments generally move faster in China than in India due to last-mile connectivity issues and customs delays, which together render exports less competitive and make moving goods internally inefficient relative to competitors. According to the 2025 National Time Release Study, prepared by India's Central Board of Indirect Taxes and Customs, the government is taking paths to shorten shipping times by improving customs simplification, digitization, and process efficiency.[88]

STABLE POWER

Key concerns also surround supportive infrastructure for electronics and semiconductor manufacturing, particularly with regard to the power supply. Stable electricity supplies are the bedrock of semiconductor fabrication. According to McKinsey, modern fabrication facilities can use up to 100 megawatt-hours per hour; in other words, in one year, a single semiconductor fab uses as much electricity as 500,000 households combined.[89] Yet in India, electricity distribution remains a challenge, in large part due to the structural fragility of state-based discoms, which face political pressure that prevents cost-reflective price setting. This means clusters and firms often must coordinate to build their own power facilities to ensure stable electricity supply.

ADEQUATE WATER

A similar challenge exists with ensuring the immense volumes of clean fresh water needed for semiconductor manufacturing are available.[90] A semiconductor fab will use 10 million gallons of ultrapure water in a typical day of operations.[91] Water shortages abound in India, especially in urban areas.[92] State and central governments may need to partner with industry to construct desalination plants dedicated to providing water for industrial use. The I2U2 (India, Israel, the United Arab Emirates, and the United States) partnership represents a potential opportunity for collaboration in this area.[93]

MATERIALS AVAILABILITY

In semiconductor-specific manufacturing, India faces challenges in sourcing raw and processed materials, including silicon metal and highly purified gases such as hydrogen fluoride and fluoride polyimide.[94] While some domestic suppliers of these products do exist, the products tend to be at lower purity levels than is needed for advanced technology manufacturing. Collaboration with foreign firms will be essential to address shortfalls, strengthen the ecosystem, and provide assurances to future investors in the semiconductor industry. Some firms have reported that indigenous Indian supplier options are of better quality and more diverse than they were on ISM 1.0 launch in 2023, so this an area of high promise.[95]

Trade Policy Constraints

India's trade and tariff policies are not optimized for the fast, low-cost movement of goods.[96] While the Modi government has utilized the spike in attention to trade agreements to negotiate new agreements with the United Kingdom and the European Union, and negotiations with the United States have resulted in a framework for a free trade agreement, trade policy friction abounds.[97] Tariff barriers, imports of used capital equipment, lab requirements, Information Technology Agreement (ITA) endorsement and enforcement, and World Trade Organization (WTO) e-commerce duties moratorium are all areas of concern (discussed in further detail below).

ITA ENFORCEMENT

The ITA is a reciprocal trade agreement that reduces tariff barriers on key inputs for technology manufacturing to zero. While India is a signatory to ITA, the WTO ruled in 2023 that India was violating its ITA commitments in trade with the European Union, Japan, and Taiwan.[98] This lack of enforcement detracts from its appeal for semiconductor industry investors. In addition, India has not signed the ITA2 expansion agreement, which included many specific benefits for semiconductor-related products and materials. In order to attract additional investment in the future, the Modi government should enforce India's commitments to the ITA and sign the ITA2.

HIGH TARIFFS

India still maintains the highest tariff barriers of any G20 country and has an extremely complex tariff regime, which can lead to excessive surcharges. The average tariff on electronics imports to India is 7.5 percent, more than double comparable tariffs in China, Malaysia, or Mexico.[99] This is problematic because Indian electronics manufacturers rely heavily on imported inputs due to a lack of domestic subcomponents. According to a recent Niti Aayog study, local branches of global suppliers price their products about the same as imported ones, including tariffs.[100] This leads to higher costs for part inputs, making them less competitive in global markets. In addition, numerous experts have cited that frequent changes to India's tariff schedules contribute to a sense of unpredictability.[101]

DAMAGING INTERNAL TRADE BARRIERS

Additional specific internal trade policies directly impact India's viability for foreign manufacturing investment. Foreign companies operating capital equipment (e.g., lithography machines or other etching and deposition tools, testing equipment, and servers) face specific challenges in India when attempting to move or import tools from other fabs around the world, because these tools are treated as "secondhand" goods, which is damaging for companies' agility. While some specific project exemptions (Micron) have been facilitated, moving used, foreign-made capital equipment is a key pillar of needed agility that Indian officials will have to reconcile if the country intends to be competitive.

In March 2024, the WTO's customs moratorium on electronic transmissions—which includes chip production software, design, and process data—was extended for another two years, despite significant objections from India.[102] India has been one of the main opponents of progress in this area (along with Indonesia and South Africa), as it has sought to impose tariffs on digital goods and services in a way that would raise costs and custom duties for advanced manufacturers based within India.[103] On April 1, 2026, the moratorium lapsed despite U.S. government advocacy for a permanent extension, opening up the possibility of India (or other WTO members) imposing tariffs on these keystone digital goods and services in chips supply chains.

Administrative Red Tape

India's administrative and regulatory regimes remain a primary obstacle to greater investment. India's customs clearance processes remain sluggish, despite efforts to reduce bureaucracy. Its inefficient judicial system impacts economic dynamism, and corruption remains a concern. Even after significant reforms, progress remains uneven. For example, as some analysts have explained, while the government succeeded in its efforts to build a national single-window system for investment, environmental, and other regulatory clearances, it faced a significant backlog of reviews in its initial rollout, with only 6 percent of clearance requests approved as of early 2023.[104] State-based subsidies (even after they are approved for disbursal) are often delayed. According to the World Bank's Customs Performance Index, as of 2023, India was only slightly above the global average (2.8) for the index, with a score of 3.0 out of 5.0 in customs efficiency.[105]

WEAK IP PROTECTION

India needs to improve its IP protection regime for the benefit of semiconductor design and manufacturing processes, including trade secrets. India remained on the Office of the U.S. Trade Representative's Priority Watch List in 2025 due to broad concerns over weak enforcement of IP protection.[106] While India has undertaken reforms and is working to cooperate with the United States on technical challenges, weak IP protection remains a significant hurdle for semiconductor companies considering bringing their leading-edge technology and expertise to the Indian operating environment.[107]

CUSTOMS REFORM

To streamline customs clearance and reduce turnaround times, India launched e-SANCHIT in 2017 as a pilot under its Single Window Interface for Facilitating Trade initiative.[108] The platform enables businesses to digitally upload all supporting documents required for customs clearance, eliminating the need for physical submissions and reducing processing delays. Building on this digital infrastructure, the Indian Customs Border System aims to fully automate customs clearance by the end of April 2026. While these initiatives represent meaningful progress, the overall process still faces many challenges in execution and consistency, and significant effort will be required to ensure seamless integration across agencies and ports.

According to the 2023 and 2025 National Time Release Studies, import release times for seaport shipping containers, air cargo containers, and inland containers at 15 representative ports across nine states have shown year-over-year improvement since 2017.[109] For example, average import release times for containers at seaports improved from 108 hours in 2021 to 86 hours in 2023. As of 2025, those release times had fallen further to under 80 hours, while inland container checkpoints times had stagnated. Government targets in the Modi administration's National Trade Facilitation Action Plan have not yet been met, with only about 50 percent of shipments clearing seaports and inland container depots in less than 48 hours, and 55 percent clearing air cargo complexes in under 24 hours.[110]

These figures on shipment clearances also lag most countries competing for semiconductor investment, including Malaysia and Vietnam. Moreover, the network of customs facilities and internal checkpoints within India, particularly at state boundaries, adds a level of challenge to moving goods, inputs, and products.

Finally, semiconductor products, components, and equipment are often classified incorrectly or differently depending on which port they enter India through, sometimes due to a lack of product knowledge on the part of customs officials. Companies have also reported a lack of corresponding Harmonized System Codes for equipment imported.[111] Some tools (even refurbished) are more advanced than any previously imported to India, including for evaluation and development boards, contributing to delays and overcharges on customs duties. Better training and resources for these officials may help prevent the need for escalation and customs appeals for reclassification.[112]

Behind-the-border barriers loom large in this context, with infrastructure shortfalls and bureaucratic challenges combining to create real hurdles that shape foreign investment decisions in advanced technology manufacturing.

JUDICIAL REFORMS

India's judicial system represents another severe constraint on the country's readiness to incorporate investment from multinationals. Judicial capacity is limited, and it takes an average of three-and-a-half to four years for a contract to be enforced due to a backlog of cases and time-consuming judicial procedures.[113] There are also extra regulations that apply only to foreign companies and stringent investment limits in many sectors.

TRANSPARENCY

Foreign investors also cite challenges in engaging with government stakeholders and have expressed concerns over potential retribution if they identify specific problems with governance, logistics, or regulation that require addressing. While the level of corruption in India has declined somewhat, it still remains a significant concern, with India ranking 91 of 182 countries in Transparency International's 2025 Corruption Perceptions Index.[114] In the short term, these governance and rule-of-law issues remain salient for businesses despite all the opportunities India offers.

Falling investment is another area to watch. The absence of needed reforms in these areas appear to be stalling the inflow of foreign direct investment to India. According to the Reserve Bank of India's Monthly Bulletin data, India has seen only modest year-over-year growth in 12-month foreign direct investment inflow (new equity) and a 96 percent drop in net foreign direct investment compared to 2024, continuing a slide from the mid-2021 peak.[115] This trend has continued in 2026.[116] While reform is very much on the government's agenda, these improvements need to be implemented and sustained to allow deeper international cooperation and significant investment in semiconductor manufacturing.

Conclusion

India faces a pivotal moment in its quest to expand its role in the global semiconductor ecosystem and secure its position as a key node in the supply chain. While the country has long been a hub of top-quality design talent, recent investments in R&D centers, fabrication facilities, and policy incentives mark a strategic shift toward full-spectrum capabilities from design to manufacturing. While these goals are laudable, India must now translate intent into execution, for which significant additional investment under ISM 2.0 will be essential. Success will depend on addressing persistent regulatory, infrastructure, and trade-related hurdles, while sustaining political will and policy consistency.

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Looking ahead, India's ability to convert early momentum into durable manufacturing capacity will hinge on whether ISM 2.0 delivers sustained funding, credible governance, and predictable implementation across states. If New Delhi can pair regulatory streamlining and trade facilitation with reliable power, water, and logistics, India could become a meaningful diversification node—especially for advanced packaging, legacy node fabs, and materials ecosystems. Over the next decade, deeper collaboration with partners such as the United States, Singapore, and the United

Kingdom will be most impactful when it accelerates talent, R&D, and standards alignment while crowding in private capital at scale.

About the Authors

Sujai Shivakumar directs Renewing American Innovation at the Center for Strategic and International Studies (CSIS), where he also serves as a senior fellow. Dr. Shivakumar brings over two decades of experience in policy studies related to U.S. competitiveness, innovation, and industrial strategy. Previously, he directed the Innovation Policy Forum at the National Academies of Sciences, Engineering, and Medicine, where he led major studies on U.S. policies supporting advanced manufacturing, small business growth, workforce development, and entrepreneurship. He also contributed to a landmark National Academies study on strategies adopted by U.S. states and regions to foster entrepreneurship, technology transfer, and regional high-tech ecosystems. Reflecting his expertise, Dr. Shivakumar has testified before the Senate Committee on Commerce, Science, and Transportation; the Senate Commerce Subcommittee on Oceans, Fisheries, Climate Change, and Manufacturing regarding the role of small- and medium-sized enterprises in advancing domestic manufacturing; and the Joint Economic Committee on strengthening U.S. manufacturing for national security and economic leadership. His analysis has been featured in leading publications including the *Financial Times* and the *Wall Street Journal*. Dr. Shivakumar holds a doctorate in economics from George Mason University and served as an Earhart Foundation scholar at the Ostrom Workshop at Indiana University Bloomington. He is the author of *The Constitution of Development* and coauthor, with Nobel Laureate Elinor Ostrom, of T*he Samaritan's Dilemma: The Political Economy of Development Aid*. During his tenure at the National Academies, he contributed to more than 50 assessments of U.S. and foreign innovation programs.

Hideki Tomoshige is a fellow for RAI at CSIS, where he supports research on U.S. science and technology policy, regional innovation hubs, export controls, and other economic security policies.

He has written extensively on strategic investment policy for the semiconductor and quantum industries in the United States and the legislative process relative to Committee on Foreign Investment in the United States (CFIUS) reform. Prior to joining RAI, he conducted research on economic security policy and cybersecurity policy for a member of parliament in Japan's Diet. Hideki earned his MA in American foreign policy and international economics from the Johns Hopkins University School of Advanced International Studies (SAIS) and his BA in law from Keio University.

Jeffrey D. Bean is a fellow for technology policy and editor at Observer Research Foundation (ORF) America. He manages research on critical and emerging technologies, particularly semiconductors and AI, implements the activities of the Global Cyber Policy Dialogues, and leads engagement on U.S.-India tech policy issues in Washington. Concurrently, as editor, he reviews all long-form research reports ahead of publication for the organization. Prior to joining ORF America, he was a visiting fellow at East-West Center and at Tama University, where he conducted research on U.S.-Japan relations and emerging technology supply chain disruption with a focus on semiconductors. Previously, Mr. Bean was editor of the Asia Policy Blog, *CogitAsia*, for CSIS, where he oversaw publications and produced podcasts for the CSIS Asia Program. In this role, Mr. Bean was responsible for tracking political, trade, technology, and security developments throughout the Indo-Pacific. Mr. Bean holds an MA in security policy studies from the George Washington University's Elliott School of International Affairs where he was a highest honors fellow, and a BA in international affairs and political science from James Madison University.

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