INDIA SEMICONDUCTOR SECTOR:

Increasing India's Role within the Global Semiconductor Value Chain

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Overview

The Semiconductor Industry Association (SIA) welcomes the Government of India's passage of the $10.2 Billion Semicon India Program (Program for Development of Semiconductors and Display Manufacturing Ecosystem in India) for the development of a sustainable semiconductor ecosystem in India. SIA further appreciates the Government of India's receptiveness to recommendations to bolster the country's Semicon incentivization program. It is encouraging to see uniform fiscal support of 50% of project cost on a pari-passu basis across technology nodes and the inclusion of discrete semiconductor fabs as modifications made basis industry feedback to expand the scope of the program.

SIA supports India's ambitious efforts to apply market-based incentives to help strengthen its role within the global semiconductor value chain, from research and development to design and manufacturing. SIA believes transparent, predictable, and market-based incentives that are consistent with international trade obligations, coupled with positive investment, regulatory, and trade policy framework would best fuel India's semiconductor industry development.

Supported by a globally integrated supply chain, many SIA companies have businesses and cooperative partnerships in India, which has contributed to the growth of India's electronics sector and the broader economy. The SIA member companies have invested heavily in the Indian information and communications technology (ICT) ecosystem through the establishment of research and design centers. In total, India accounts for 20% of the total global design workforce, a testament to the highly talented pool of Indian engineers. SIA values the high caliber of Indian engineers and staff and sees growth along with India's dynamic and fast-changing technology market.

Following a series of constructive meetings with senior government officials in India in October 2022, SIA together with the in-country partner, APCO Worldwide has put together this white paper for the Government of India. The paper details macro principal recommendations for India's approach to the semiconductor ecosystem and offerings as well as highlights specific issues that have been raised as concerns that affect India's favorability as an investment and/or expansion destination.

A Global Semiconductor Value Chain

Semiconductors are the foundation of everything digital in today's world – from transportation and artificial intelligence (AI) to 5G and quantum computing and beyond. The success of the semiconductor industry has hinged on its ability to operate globally, innovate and protect intellectual property (IP), and build efficient and cost-effective supply chains around the world. All phases of the semiconductor value chain — research, design, manufacturing, assembly, and packaging — occur in a globally integrated network.

The global structure of the semiconductor supply chain, developed over the past four decades, has enabled the industry to deliver continual cost reductions and performance gains that ultimately have made possible the explosion in end-user adoption of information technology and digital services. Semiconductors are highly complex products to design and manufacture and rely on a complex and global supply chain for raw materials, equipment, research and development (R&D), technology, human talent, testing, and distribution. This is a key aspect of the industry's success.

The need for deep technical know-how and scale has resulted in a highly specialized global value chain in which regions perform different roles according to their comparative advantages. All countries, including the U.S., are interdependent in this integrated global value chain, relying on free trade to move materials, equipment, IP, and products around the world to the optimal location for performing each activity.

Key Pillars - Global Semiconductor Supply Chain

The need for deep technology expertise and massive scale has resulted in a complex global semiconductor supply chain structure. The six main pillars upon which the success of the global semiconductor industry depends have been identified as follows:

- **Free and Open Markets**: Maintaining a free and open market is the first step to becoming more integrated with the global semiconductor supply chain. Free and fair access to global markets is essential to the industry's success, including open trade in goods with minimal restrictions (tariffs or non-tariff barriers) on trade in semiconductors; the use of open, consensus-based, and voluntary global standards; and open and fair competition without discriminatory regulatory restrictions.
- **Intellectual Property Protection**: Intellectual property is the lifeblood of the semiconductor industry. Enforcing IP rights is essential to the industry's success and competitiveness. The high level of investment in research and development by the semiconductor industry results in valuable IP (patents, trade secrets, trademarks, copyright, trade secret, source code, etc.), and strong protection and enforcement of this IP is critical to this industry.
- **Supply Chain Integration:** It is vital to provide infrastructure support to domestic semiconductor industry ecosystems, such as through the creation of special economic zones and science parks that: provide access to land, electricity, and water; and space for other supply chain companies to integrate into a large design and manufacturing ecosystem. Identifying and providing convenient locations, simplified or expedited procedures, and eased regulations all help expedite production capabilities while maintaining global supply chain sustainability expectations.
- **Research and Development**: The semiconductor industry is one of the most R&D-intensive industries in the world. This requires strong investment in and support for both public and private

fundamental research in materials, new process technologies, and other areas that drive advancements and innovation in semiconductor design and manufacturing.

- **Workforce Development:** Leadership in semiconductor research, design, and manufacturing require access to the best and brightest scientists and engineers from around the world.
- **Market-Based Government Incentives**: Targeted, market-based, and World Trade Organisation (WTO)-consistent government incentives, including favorable loans, tax credits, and manufacturing and design grants, are fundamental to supporting the investments required for new semiconductor manufacturing and design investments.

These pillars have enabled the global industry to consistently achieve technological advances, manufacturing breakthroughs, and cost reductions over several decades. They are also essential to the continued growth and innovation in the development of regional semiconductor industries.

India and the Global Semiconductor Value Chain

India accounts for 1% of global trade in semiconductors, and 0.5% of global semiconductor sales, according to the World Semiconductor Trade Statistics (WSTS) organization. While small, India's role in the trade and sale of semiconductors has grown significantly. According to the United Nations Comtrade database, annual IC imports into India in 2018 jumped by 218% to $8 billion, after consistently modest annual imports ranging from $1.5-2 billion from 2014-2017. In 2021, India's IC imports further grew to $12 billion.

The broader Indian ICT market is burgeoning, and India accounts for nearly $150 billion in total sales, with growth projected to accelerate over the next decade. For example, in 2021, India accounted for 12% of global smartphone sales. As a result, an increasing amount of original design manufacturer (ODM) electronics assembly is happening in India, which will provide a stronger incentive for more upstream electronics investment to occur. India's role in the global semiconductor value chain does not reflect its larger presence in the downstream ICT ecosystem.

SIA welcomes India's goal to become both a more powerful digital economy and a hub for electronics and semiconductor innovation within the global value chain. Building a fab is a multi-billion dollar investment that requires an extensive supply chain for components, machinery, equipment, and expertise, most of which India cannot supply domestically and must import from abroad.

For India to best attract foreign investment and maintain the supply chain necessary to enhance its semiconductor ecosystem, it should work toward creating a competitive policy environment that creates a level playing field between foreign and domestic players, as well as a fair intellectual property regime. The following section details the recommendations for the Government of India to consider while developing and further refining the country's Semicon offering that is globally competitive and advantageous.

Policy Recommendations

As India considers public policies and investments to spur growth in the domestic semiconductor value chain, it should uphold several key principles and best practices:

I. Market-Based

To build a thriving semiconductor ecosystem, the Government of India (GOI) should consider enacting market-based incentive programs aimed at advancing India's semiconductor research, design and production capabilities. Most importantly, markets should be open to all market participants. The competitiveness of companies and their products, not the interventions of governments, should be the principal driver of industrial success. Government support for the build-up of the domestic semiconductor manufacturing sector should also take into account the expected global need for new capacity to meet the expected growth in worldwide demand. Governments should carefully assess whether firms or projects under consideration for a public financial incentive are based on real-world market demand and have the capability and know-how to sustain themselves in the highly competitive global marketplace. In general, except for requirements for national defense applications, incentives should be aimed at promoting both greenfield and brownfield projects.

II. Targeted & Practical

The semiconductor global value chain enables countries to focus on activities where they have a competitive advantage in trade for other goods and services. In the semiconductor global value chain, countries "trade in tasks" within specific segments of the value chain. Therefore, the GOI should focus its public investments on enhancing existing strengths while also filling in key gaps and addressing vulnerabilities that have the most direct consequence on supply chain resiliency.

a) Research & Design

Semiconductor research and design, including hardware and software, is an important part of the semiconductor value chain. Knowledge and skill-intensive, semiconductor design takes up 53% of global semiconductor industry R&D expenditure and accounts for 50% value add of the entire sector's activity. Chip design firms develop nanometer-scale ICs which perform the critical tasks that make electronic devices work, such as computing, storage, connectivity to networks, and power management.

India should leverage its existing strengths and further develop its capability in chip design. India already accounts for 20% of the global design workforce and possesses the outstanding talent and world-class universities. Rather than solely prioritizing chip manufacturing, India should also seek to focus resources on further bolstering its leading role in semiconductor research and design. With targeted and market-driven government support, India has the potential to build a thriving, competitive fabless chip design industry ecosystem.

To this end, the GOI should consider significantly stepping up investment to promote workforce development and R&D in chip design to keep pace with rapid industry innovation and growth. India's Design Linked Incentive (DLI) scheme currently for semiconductors does not incentivize global design players to expand investments and presence in the country. While semiconductor design does not require large amounts of capital expenditure, each successive generation of semiconductors requires greater investment in design and R&D. Development costs have been rising rapidly as chips have become

increasingly complex. The total development cost of a new state-of-the-art system-on-chip for a flagship smartphone, including the specialized blocks required to process audio, and video, or provide high-speed wireless connectivity, could well exceed $1 billion. For instance, the top five design firms invested $68 billion in R&D in the five years between 2015 and 2019, equivalent to 22% of their revenues.

Additionally, innovations in semiconductor design are driven by highly skilled workers with specialized expertise. India should continue to invest in further expanding science and engineering education across an array of disciplines, including electrical and mechanical engineering, computer science, and software engineering, to cultivate the much-needed highly skilled talent in the semiconductor industry.

b) Manufacturing

As India considers significant public investments to build a domestic semiconductor manufacturing ecosystem, the GOI should target segments that best leverage its existing strengths. For example, given India's strong demand for consumer electronics and communications, and increasing downstream assembly activity in this space, India could concentrate its resources towards incentivizing the design, fabrication, and/or assembly of those associated semiconductors.

The annual capital expenditure of foundry companies is typically around 35% of their revenues, and the total cost for building and operating an advanced logic or memory fab now exceeds $20 billion. However, other aspects of the value chain have lower barriers to entry. For example, for firms specializing in Outsourced Semiconductor Assembly and Test (OSATs), capital expenditure typically runs at less than half that level, at approximately 15% of revenue. OSATs provide assembly, packaging, and test services under contract to both integrated device manufacturers (IDMs) and fabless companies. Given the lower relative capital intensity, the cost of labor is a key competitive factor for OSAT firms, and India is uniquely positioned to tap into that competitive advantage.

Prioritizing investment in the OSAT sector as well as power semiconductor, and discrete manufacturing as priorities under Semicon India offer to be far more effective and attainable. Today, more than 60% of the world's back-end semiconductor OSAT capacity is in China and Taiwan, and 9 of the 10 largest OSAT firms by revenue are headquartered in mainland China, Taiwan, and Singapore. However, recently OSAT firms have also started to diversify their global footprint and build new capacity in other locations with reduced labor costs, such as Malaysia and Mexico, and other parts of the world, offering India an opportunity to tap into this trend.

Other segments of the semiconductor supply chain with lower barriers to entry includes semiconductor packaging materials and substrates; chip module assembly; and semiconductor equipment parts, components, and spares. Southeast Asia is already a hub for much of this sector's economic activity, so it is also an opportunity for India to strengthen its role in this important supply chain segment. In short, India should consider encouraging and prioritizing investment in activities in which the domestic industry has a competitive advantage in the short- to medium-term. In the long-term, India's comparative advantage is not static, as its economic and structural policy environment changes, with numerous opportunities for India in the future to move up the global semiconductor value chain.

III. Geographically Concentrated (Clustering)

For India to succeed in developing a semiconductor industry, it should develop an ecosystem in a single or select few locations. It will not be feasible to have a fab in isolation from suppliers or with suppliers scattered all over the country.

It has been encouraging to note India's development of rail and other infrastructure in the current environment. As such, India should examine the merits of establishing special semiconductor trade or development zones centered around 1-2 geographic clusters to help spur development. Such zones would be entirely integrated with the global semiconductor value chain and trading regime, meaning zero import or export tariffs, with customs and trade clearance facilitation processes that meet international standards. Ideally, such zones would be co-located with regions within India that have an existing industry ecosystem adjacent to the semiconductor industry, such as electronics manufacturing, and a robust workforce employed in either semiconductor design or research. In addition, the region should be close to existing or newly developed higher education institutions to allow for continuous training of talent and engineers.

Other regions have been highly successful at leveraging clusters to accelerate semiconductor ecosystem development. Some countries promote their domestic semiconductor industry ecosystem by building supporting infrastructure around fab locations at no cost to the semiconductor producer. China bestows particularly comprehensive benefits in this regard, typically including housing, telecommunications, and the infrastructure for utilities and logistics. Other Asian countries – such as Taiwan, Singapore, and South Korea – also provide infrastructure support, often by way of special economic zones and science parks. In Taiwan, for instance, in addition to providing access to land, electricity, and water, science parks also allot space for other supply chain companies to integrate into a larger manufacturing ecosystem. The South Korean government cooperates beyond utilities and infrastructure to identify and provide convenient locations, simplified or expedited procedures, and eased regulations.

Examples of Successful Clustering

Portland, Oregon, United States: The U.S. benefits from several semiconductor clusters, including Oregon's "Silicon Forest" which has contributed to the sector's tremendous innovation. Semiconductors & Electronics is Oregon's largest manufacturing sector in employment, exports, and contribution to state GDP. Both the state of Oregon and the city of Hillsboro extend generous tax incentives, tax credits, and abatement programs—including no state sales tax—to encourage semiconductor companies to invest in the region. The "Silicon Forest" has also enabled a semiconductor startup ecosystem, as new, vibrant, semiconductor design companies have been founded in Portland. Earlier this year, Oregon formed a new, high-profile task force dedicated to attracting more jobs from the semiconductor and microchip industries. The task force will form six working groups comprised of stakeholders from all over Oregon to assess key factors that impact semiconductor design and manufacturing. Those workgroups will focus on the availability of industrial land, research and design investments, workforce capacity, tax incentives, regulations, and strategies to recruit investment.

Taiwan: Taiwan offers generous land subsidies for chip production facilities, including two years of free rent for fabs located in seven industrial parks, free land in Kaohsiung for up to five years, and industrial park land in Yilan, Yunlin, and Binghai offered at 70% of the market price. Until 2011, Taiwan offered chipmakers a 5-year corporate tax exemption for facilities located in science-based industrial parks, and until 2010, a 13% tax credit for equipment purchases. Since 2016, Taiwan has offered generous tax credits to "5+N Innovative Industries" (including semiconductors), which include a 15% R&D tax credit, business income tax exemptions for royalties on imported production technologies, import tariff exemptions for companies located in science parks, a 5% equipment tax credit for 5G system expenditures, and up to 200% credit for self-developed IP R&D expenditures.

IV. Embrace Global Value Chains and Open Borders

The global semiconductor supply chain helps drive innovation in semiconductor technology while reducing costs and creating enormous value for consumers, businesses, and governments who use semiconductors and products enabled by semiconductors. The GOI should consider creating policies that facilitate deeper integration into global value chains. These include policies that support openness to international trade (removal of tariff and non-tariff barriers), establishing transparent and predictable investment environments, and ensuring sound legal systems and intellectual property protection. At the same time, the GOI should avoid cybersecurity barriers, import substitution policies, forced technology transfer, and barriers to digital trade.

Access to global markets through trade agreements and the free flow of commercial goods is critical for building a successful semiconductor industry. When making investment decisions, semiconductor companies tend to seek the lowest tariffs, competitive prices, market efficiency, and greatest access to products, technologies, and resources. For example, a broad cross-section of the global ICT industry, including SIA and the World Semiconductor Council (WSC), considers the Information Technology Agreement (ITA-1) and its 2015 expansion (ITA-2) to be one of the most meaningful and commercially successful WTO agreements because it has contributed enormously to lowering consumer prices and the cost of trade, thereby promoting jobs, productivity, innovation, and economic growth. The benefits of ITA expansion to its signatories are significant and immediate. ITA-2, which the WTO estimated would eliminate tariffs on an additional $1.3 trillion in the annual global trade of ICT parts and products, represented the first major tariff-cutting deal completed at the WTO in two decades. Specifically important for the semiconductor industry, being a member and strong advocate of the ITA often serves as a strong signal that a competitive business exists in any given country, and many semiconductor companies have professed that they will only do business in ITA-member countries.

V. Consistent with International Obligations

Government incentive programs should also be consistent with relevant international trade obligations under the WTO. The WTO permits market-based incentives that help foster trade and improve a nation's economic development, which India's semiconductor program is poised to do. The WTO also has developed specific and useful rules against incentive programs that have goals of import substitution or are contingent upon export credit. Thankfully, there is sufficient space within the bounds of these rules to leverage fiscal incentives to develop a robust semiconductor value chain within India.

In addition to the WTO, India should also examine best practices and guidelines formulated by the World Semiconductor Council (WSC) on government incentives. The WSC meets annually and issues a joint statement that includes a set of recommendations to the governments and authorities of the participating regions. For several years, the global industry has worked diligently to obtain agreement on a set of guidelines and best practices on how to address and communicate regional support programs in the industry. In its statement in support of the regional support guidelines and practices, the governments associated with the WSC highlighted that regional support programs should be "guided by the principles of openness, transparency, and inclusiveness." It further noted that "government action should be guided by market-based principles, and that competitiveness of companies and their products, not the intervention of governments and authorities, should be the principal driver of innovation, industrial success, and international trade."

VI. Non-Discriminatory

Lastly, as the GOI rolls out an incentives policy supporting the semiconductor industry, it should ensure that such incentives create a level playing field for all companies. The incentives should not be aimed at directing market outcomes through government ownership of capacity or manufacturing companies. A semiconductor ecosystem within India that is welcoming to all firms and all forms of business models and partnerships is likely to be the most successful. An open and market-based incentive policy would minimize the risk of creating global overcapacity, something not in the interest of India or the global semiconductor industry.

The GOI should make equitable and fully transparent its eligibility criteria for granting government incentives and base it on the merits of the application. To fulfil the GOI's goal of building a competitive semiconductor industry, it is critical to ensure incentives are available to all entities, irrespective of the location of the company's headquarters or the nature of the company's corporate structure. The application process should be applied consistently across all companies throughout the entire application process.

Proposed India – U.S. Sector Cadence

India and the US have a growing convergence of strategic interests and both sides seek a resilient and rules-based international order that safeguards sovereignty and economic integrity. The India – U.S. '2+2' dialogue led to fruitful conversations between Prime Minister Narendra Modi and President Joe Biden and created the ground for a more ambitious and strategic engagement between the two sides.

Along with other countries like the U.S., India has been looking to forge strategic alliances around semiconductors. India could have a large role to play in the semiconductor industry, as the world's fifth-largest economy looks to boost its domestic chip sector. Recognizing this potential, the Semiconductor Industry Association (SIA) has already had an explanatory delegation to India and an initial C-Suite level business delegation in April 2022 and October 2022 respectively.

SIA, headquartered in Washington DC, represents 99 percent of the U.S. semiconductor industry by revenue and nearly two-thirds of non-U.S. chip firms with over 100 member companies including all major leaders in the semiconductor space such as Intel, Micron, Global Foundries, Analog Devices, Qualcomm, and Nvidia, among others. SIA has been the voice of the U.S. semiconductor industry, a key driver of global competitiveness in this sector, and advocates for public policies that provide a fair field for competition as well as promote fair and open trade.

SIA proposes a regular cadence between India and the U.S., both at the government and industry levels, to enhance cooperation in the semiconductor sector. An SIA + India Working Group could provide the platform to strategize, engage and plan Semicon and allied initiatives on a regular basis with Indian Government and industry.

About the Organizations

SIA

The Semiconductor Industry Association (SIA) is the voice of the semiconductor industry, one of America's top export industries and a key driver of America's economic strength, national security, and global competitiveness. SIA represents 99% of the U.S. semiconductor industry by revenue and nearly two-thirds of non-U.S. chip firms. Through this coalition, SIA seeks to strengthen leadership of semiconductor manufacturing, design, and research by working with Congress, the Administration, and key industry stakeholders around the world to encourage policies that fuel innovation, propel business, and drive international competition. Learn more at www.semiconductors.org.

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APCO Worldwide

APCO Worldwide is an advisory and advocacy communications consultancy helping leading public and private sector organizations be catalysts for progress by navigating the challenges of today, acting with agility, anticipating social risk and building organizational reputations, relationships and solutions to succeed. APCO Worldwide in India began operations in 2007, and our regional operation is one of the largest and most successful in our global network. We take an integrated approach to consulting, which is based on our strong public affairs heritage, our nuanced understanding of strategic communications and remarkable research, creative and digital capabilities. This is supported by our global perspective and local knowledge, enabling us to address complex issues for our clients and deliver path-breaking campaigns. https://apcoworldwide.com/

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