# INDIA-EUROPE COOPERATION IN SEMICONDUCTORS: ANOTHER LINK IN THE CHAIN

by
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Semiconductors are indisputably strategic commodities today and serve as the foundation for an array of both critical and emerging technologies. Semiconductors pose a dilemma between economic gain and security risk due to their importance in both civilian and military products. Semiconductor Global Value Chains (GVCs) are dominated by the U.S., Taiwan, South Korea, Japan, Europe, and China. The pandemic exposed supply-chain vulnerabilities due to overdependence on a single hub (China) in the global economy; thus, calls have been raised to "de-risk" GVCs to reduce reliance on China. The concept of the 'Indo-Pacific' in International Relations has gained currency in recent years within the context of China's rise and the growth of several minilateral frameworks like the Quadrilateral Security Dialogue (Quad), AUKUS, Indo-Pacific Economic Framework (IPEF), Supply Chain Resilience Initiative (SCRI), etc. are typically seen as balancing mechanisms by regional powers combined with the U.S. against an intensifying perception of threat from the Chinese.

For middle and emerging powers like India, the intensifying U.S.-China rivalry in the Indo-Pacific has created the challenge of navigating through this competition to safeguard their interests while sustaining a degree of independent agency. How the government and private sector manage the semiconductor global value chains (GVCs) will have a direct impact on India's global competitiveness and national security in this backdrop.

**Weaponization of Trade?**

The process of manufacturing chips can be divided into three stages: R&D and chip design, fabrication, and advanced testing and packaging. R&D and chip design require a considerable amount of funding and human resources, while fabrication is a highly technical process that demands significant capital expenditure. Due to the dual-use nature of Industry 4.0 technologies and the experience of supply-chain disruption during the pandemic, governments are seeking to de-risk from China and develop secure supply chains through reshoring and friend-shoring tactics to protect intellectual property, research, and development. Such "diversification" calls are also raised in the context of the perceived threat of 'weaponized economic interdependence' in the current climate of U.S.-China rivalry.

The most recent focus is on the "China plus One" Strategy or just the Plus One strategy to break away from over-dependence on a single hub to bypass the 'panopticon and chokepoint effects' in the global economy. States gather strategic information when they are the hubs in an economy when employing the panopticon effect and can deny/choke network access to adversaries in the 'chokepoint effect' as explained by Henry Farrell and Abraham Newman. India's considerable reliance on imported semiconductors, with roughly 95 percent of its supply coming from states like China, Taiwan, South Korea, and Singapore, has exposed vulnerabilities, predominantly apparent during the pandemic The Ukraine conflict has caused a neon gas shortage for Europe, neon gas being crucial for powering advanced semiconductor lithography machines.

**Globalized Network**

Semiconductors have become an essential component in our everyday routines, utilized in everything from our personal computers and smartphones to our household appliances, vehicles, and even critical infrastructure like missile guidance systems and electrical grids. The manufacturing process for semiconductors is highly complex, spanning over 500 discrete stages taking anywhere from four to six months to complete. This process involves specialized design software, fabrication plants, and dedicated testing facilities, resulting in a remarkably complex and segmented supply chain that extends across the globe. According to estimates by Accenture, before reaching consumers, a typical IC chip has to go through more than 70 international borders. The Indo-Pacific region plays an important role in mapping the semiconductor supply chain. The United

States leads in the semiconductor design segment, with U.S. firms capturing more than 40 percent of the global IC design market share, which includes electronic design automation (EDA), semiconductor IP, and design services revenue. Huawei is working to develop China's indigenous design capacity. Intel, Cadence, ARM, and other U.S. and UK firms are leading in the core IP market. In 2019, the U.S. and UK together accounted for more than 90 percent of the core IP market, according to an evaluation by Georgetown CSET. In 2021, Taiwan dominated the market for fabrication materials with the largest market share. However, Europe and China had the smallest market shares with 9% and 15%, respectively. Despite Europe's small share in terms of sales volume, it plays a critical role in the materials supply chain, especially in the supply of chemicals.

On the other hand, China has a stronger position in the supply of raw materials, particularly in low-grade gallium, tungsten, and magnesium. Still, it lags in the manufacture of these materials. China has been mining rare earth ores since the 1970s, hogging around 70 percent of the mine production of rare earths today. With recent Chinese export restrictions on critical minerals like gallium and germanium (both crucial for computer chips, iPhones, electric vehicles, turbines, etc.) for national security interests, there are concerns about inflationary pressures that could impact the supply chains for chip-making. Silicon wafers make up the largest portion of the materials market and the market for silicon wafer suppliers has become increasingly concentrated over the last 20 years. Sumco (Japan), GlobalWafers (USA), Siltronic (Germany), SK Siltron (South Korea), and Soitec (France) collectively make up 65 percent of the global silicon wafer market.

Semiconductor manufacturing equipment (SME) is expensive and concentrated in key companies and regions due to its difficulty in production with precision, scale, speed, purity, and dependability. The Indo-Pacific region has a large SME market, with equipment suppliers from the region capturing 77 percent of the global market share. U.S. and Japanese SME industries are the largest, along with the Netherlands, dominating the supply of SME. Japan's position is similarly strong in the market for test equipment. The Indo-Pacific region (including the U.S.) holds the vast majority of the world's semiconductor wafer fabrication facilities.

**Securing Sustainable Supply Chains**

With the brief aforementioned map of the semiconductor supply-chain industry-market share, one can understand how the Indo-Pacific states along with the U.S. and Europe dominate the chip GVCs. It is crucial to establish coordination between the major Indo-Pacific states and the European Union in this backdrop to facilitate secure and sustainable chip supply chains. Governments worldwide have launched initiatives to restructure the semiconductor supply chain in alignment with their national security and geopolitical objectives. Under the Biden administration, the shift toward a more expansive definition of national security in trade policy is evident in the Bureau of Industry and Security (BIS) export controls on advanced semiconductor chips and the tools used to manufacture them, the Chips and Science Act (2022), Chip 4 alliance, and the U.S-EU Trade and Technology Council (TTC).

Meanwhile, India is positioning itself as a dependable location for semiconductor and electronics manufacturing with its "India Semiconductor Mission", Production-Linked Incentive Schemes, and other recent investment announcements in chip fabrication units and electronics. These are coupled with trilateral/minilateral collaborations with like-minded states like Japan, Australia, France, Taiwan, the U.S., etc., in the sector of critical and emerging technologies to build resilient supply chains of which "semiconductors" are an integral component.

The IPEF, spearheaded by the U.S., is a global partnership consisting of 14 members, including the Quad states. It is a comprehensive agreement that covers four main areas: trade, supply chains, decarbonization and infrastructure, and fair economy issues like anti-corruption and transparency. The supply chains pillar of IPEF is particularly important as it includes specific modules to identify critical sectors and goods, increase resiliency and investment in those sectors, enhance information sharing and

transparency, improve supply chain logistics, and protect the role of workers. This approach to techno-industrialism and economic security in the 'chip domain' has been adopted by major Quad members.

A Memorandum of Understanding was signed between India and the European Commission on Working Arrangements on Semiconductors Ecosystems, its supply chain, and innovation under the framework of the EU-India Trade and Technology Council (TTC) in November 2023. Both G2G and B2B bilateral cooperation will be promoted to boost the resilience of semiconductor supply chains and leverage complementary strengths to encourage collaboration in the field of semiconductors. This MoU establishes a framework for sharing knowledge and best practices, which will work together to implement industrial policies in a coordinated manner. The agreement acknowledges the significance of collaborative efforts in preventing vulnerabilities by exchanging information on trade barriers and disruptions. This cooperative endeavour is in line with government programmes in India, like the National Policy on Electronics (NPE), which promotes indigenous manufacturing and lessens reliance on imports.

Due to the economic impact of semiconductor production facilities on local economies, state and local governments have generally funded the majority of chip subsidies in Europe and India. In this instance, transparency refers to highlighting the benefits of pooling resources, information, and skills to develop a more inclusive and collaborative strategy. The EU and India must deepen their connections with global semiconductor companies to guarantee fruitful cooperation in the semiconductor mission. This entails utilizing their technology and experience through cooperative research projects, knowledge sharing, and skill enhancement. Further, it highlights the importance of technology partnerships and joint ventures in manufacturing facilities, which will contribute to the development of robust supply chains.

India can facilitate this framework to bring greater synergy and embolden more Quad-Europe engagements along with the enlisted minilaterals like SCRI and IPEF to enhance supply-chain resilience and economic security in the long run, especially in the chip domain. Most nations like India, Japan, South Korea, Taiwan, China, and the U.S. have come up with major policy announcements vis-à-vis the semiconductor trade in the post-pandemic years to avoid geoeconomic tensions and possibilities of weaponization of trade. European nations have material market strength as well as chip tech-design competence. More Quad-EU TTC cooperation must also be encouraged in this regard for Indo-Pacific supply-chain sustainability along with technology transfers. It is noteworthy that policies have become just as essential as market forces in the context of the global semiconductor sector. National security and technological sovereignty are factors that are being taken into account when developing present and future policies (as well as the subsidies that go along with them), in addition to economic concerns. EU-India policy cooperation with minilateral frameworks of SCRI, IPEF, Quad, and other India-Europe trilateral cooperation frameworks have scope to harness supply-chain resilience with individual technological and economic sovereignty, thereby avoiding panopticons and chokepoints in the global chip economic markets.

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