

The G7's Way Forward For Semiconductor Infrastructure Development in the Indo-Pacific



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The June announcement of the Group of Seven's (G7) Partnership for Global Infrastructure and Investment (PGII) reflects the shared urgency to secure global supply chains and compete with China's ambitious Belt and Road Initiative; importantly, it provides the financial momentum to actually do so. Intended for low- and middle-income countries, the investment funds establish global supply chain resiliency as a top priority, alongside the expansion of open trade and enhancement of national and regional security. How this investment will impact critical infrastructure and the semiconductor industry remains to be seen, but as a key arena for manufacturing, assembly, and testing, the Indo-Pacific region should be central to the G7's strategy.

While the PGII pledged over \$600 billion in sustainable infrastructure development, the announcement provided few details on where and how the money will be spent.¹ This briefing recommends more than 20 ways to invest in the semiconductor supply chain and offers approaches for greater G7 coordination that extends beyond financial support. Through coordinated semiconductor innovation, ecosystem development, technology protections, talent expansion, and trade liberalization, the G7 can aid the region's industries, improve supply chain resiliency, and build strategic influence in the Indo-Pacific.

An Integrated and Costly Semiconductor Industry

The semiconductor industry is one of the world's most highly complex and integrated industries, enabling rapid leaps in technological development on one hand, while creating several points of vulnerability on the other. The global semiconductor network's reliance on free trade to transfer products, intellectual property (IP), and other goods reflects one such dependency. The Semiconductor Industry Association identified the following additional vulnerabilities threatening semiconductor supply: geographic concentration of manufacturing, design, and other production; geopolitical tensions leading to security threats and material shortages; protectionist trade policies; talent shortages; and a lack of

1 The White House, "FACT SHEET: President Biden and G7 Leaders Formally Launch the Partnership for Global Infrastructure and Investment," June 26, 2022, <https://www.whitehouse.gov/briefing-room/statements-releases/2022/06/26/fact-sheet-president-biden-and-g7-leaders-formally-launch-the-partnership-for-global-infrastructure-and-investment/>.

new research funding.² Shoring up the supply chain will entail an equally integrated strategy that takes into account these multifaceted risks.

Semiconductors are also an extremely costly industry, thanks to the complexity of designing and manufacturing chips, as well as the level of specialty of material inputs, the scale of production, and the technical knowledge required for production. Strong global demand for semiconductors drives these costs further. As a basis of multiple end products that touch nearly all aspects of modern life, demand for semiconductors has only continued to swell, driving sales up 13.3 percent in Q2 of 2022, compared to the same period last year.³ Demand for cutting-edge semiconductor technology is also increasing, with AI-related semiconductors expected to grow 50 percent annually from 2019 to 2022.⁴ Semiconductors are expected to grow from a \$570 billion global industry today to a \$1 trillion one by the end of this decade. Achieving that growth will require enormous capital investment (cap ex), with the industry investing a total of \$339 billion in cap ex across 2021 and 2022 alone. To meet global demand, industry experts estimate that an additional \$3 trillion in capital and R&D investment is needed.⁵

Given the high level of global integration and enormous financial costs of operation, plurilateral investments in semiconductors are a necessity. The G7's PGII provides an opportunity to fund such investments where they will have the greatest impact: the Indo Pacific. G7 nations can look to the Quad's example for guidance. In September 2021, the Quad—Australia, India, Japan, and the United States—announced a Semiconductor Supply Chain Initiative focused on resiliency.⁶ As members of both the G7 and the Quad, Japan and the United States should be leaders in the Indo-Pacific in order to achieve semiconductor resiliency and competitiveness.

2 Antonio Varas, Raj Varadarajan, Jimmy Goodrich, Falan Yinug, "Strengthening the Global Semiconductor Supply Chain in an Uncertain Era," Boston Consulting Group & Semiconductor Industry Association, April 2021. <https://www.semiconductors.org/strengthening-the-global-semiconductor-supply-chain-in-an-uncertain-era/>

3 Semiconductor Industry Association, "Global Semiconductor Sales Increase 13.3% in Q2 2022 Compared to Q2 2021," August 1, 2022, <https://www.semiconductors.org/global-semiconductor-sales-increase-13-3-in-q2-2022-compared-to-q2-2021/>.

4 Trisha Ray, Sangeet Jain, Arjun Jayakumar, and Anurag Reddy, "The Digital Indo-Pacific: Regional Connectivity and Resilience," Observer Research Foundation, February 15, 2021, <https://www.orfonline.org/research/the-digital-indo-pacific-regional-connectivity-and-resilience/>.

5 Varas et al, 2021.

6 The White House, "FACT SHEET: Quad Leaders' Summit," September 24, 2021, <https://www.whitehouse.gov/briefing-room/statements-releases/2021/09/24/fact-sheet-quad-leaders-summit/>.

A Coordinated G7 Strategy

The complexities and prohibitive costs of manufacturing necessitate an allied approach to strengthening the supply chain.⁷ Beyond the financial support of the PGII, G7 nations should engage Indo-Pacific nations, of which there is some overlap, in a dialogue that seeks cooperative agreements and a shared understanding of extant threats in the supply chain. Through coordinated technology development, ecosystem support, and technology protections, G7 leaders can comprehensively bolster the semiconductor industry in the Indo-Pacific.

Technology Development

To augment future technological innovations, G7 leaders must invest in advanced manufacturing cooperation and collaborative, pre-competitive R&D. Funding should be targeted to encourage reciprocal R&D agreements and integrated research partnerships among universities, private institutions, government agencies, and public-private associations. A key vulnerability at certain points of the supply chain is the high degree of geographic specialization, which can lead to bottlenecks and other disruptions. In fact, the Boston Consulting Group has identified more than 50 points of high geographical concentration across the supply chain where one single region accounts for over 65 percent of the market share at a certain point in the semiconductor supply chain.⁸ Investment incentives for production diversification can reduce the risk that a disruption in any one nation has an outsize effect on the rest of the supply chain. To start, channel investments where infrastructure already exists. For instance, G7 funds could go toward existing design firms in India or manufacturing hubs in Singapore where there are not already high levels of geographic concentration in these fields, compared to other nations.⁹

Another way to boost R&D collaboration in the Indo-Pacific would be by creating a G7 jointly operated R&D fab for semiconductor prototyping and testing and G7 centers of excellence to develop leadership, best practices,

7 Stephen Ezell, "An Allied Approach to Semiconductor Leadership" (ITIF, September 2020), <https://d1bcsfjk95uj19.cloudfront.net/sites/default/files/2020-allied-approach-semiconductor-leadership.pdf>

8 Antonio Varas et al., "Strengthening the Global Semiconductor Supply Chain in an Uncertain Era" (BCG and SIA, April 2021), <https://www.semiconductors.org/strengthening-the-global-semiconductor-supply-chain-in-an-uncertain-era/>.

9 Ray et al, 2021.

research, and training in specialized areas.¹⁰ Coordinated R&D and design should be met with strong pre-standardization policies for emerging technologies, such as common technical standards, terminology, methodology, and concepts.¹¹ Crucially, joint standards establish foundations for better data gathering and, thereby, better assessment of supply chains. Pre-standardization policies also ensure information sharing among allied countries, even if the national legal policies differ.

The G7 technology development strategy should also foster innovation-focused dialogue among allied nations in the Indo-Pacific. For example, an innovation policy experts' group could exchange knowledge on innovation methods, increase development and application of digital technologies enabled by semiconductors (e.g., IoT/AI/robotics, etc.), address how to use such technologies to bolster faltering productivity levels, and communicate findings to enable responsive policymaking.¹²

Semiconductor Ecosystem Support

Reinforcing the supply chain also entails strengthening the ecosystem that supports semiconductor design and manufacturing. Thus, a G7 allied approach should include investment for ecosystem supports like joint mapping and predictive analysis, secure computing infrastructure, and rules in the competitive market. Joint mapping can be used to identify current gaps in the supply chain, while predictive analysis using AI/ML technology can forecast future shortages for early action. Together, these technologies form a critical knowledge advantage, but their success ultimately relies on good data collection and sharing practices, in addition to greater development of AI capabilities.

The ecosystem surrounding semiconductors extends to the digital integration and security of networks. In the Indo-Pacific, the funding and adoption of Open Radio Access Network (“ORAN”) equipment is critical to the security of networks and development of 5G and 6G digital connectivity. The G7 should look to the Quad’s “Memorandum of Cooperation on 5G Supplier

10 Stephen Ezell, Pranay Kotasthane, and Glenn Downey, “Semiconductors—it takes a village to raise a chip,” *The Times of India*, May 24, 2022. <https://timesofindia.indiatimes.com/india/3-ideas-for-4-countries-hunting-for-chips/articleshow/91748347.cms>.

11 Nigel Cory, “Comments to the U.S. Commerce Department on the Indo-Pacific Economic Framework,” Information Technology and Innovation Foundation, March 21, 2022, <https://www2.itif.org/2022-indo-pacific-economic-framework.pdf>.

12 *Ibid.*

Diversification and Open RAN” and “International Standards Cooperation Network” to guide its own cooperative digital agreements in the region.¹³

Further, the G7 should work with Indo-Pacific leaders to form cooperative rules and norms governing ecosystem development. At the competitive-market level, this partnership could include cooperative development financing; export credits that incentivize partnerships with allied vendors and companies; and shared standards of globalized development.¹⁴

Strategic development financing—when successful—spurs additional investment from other actors, such as in the private sector. Take, for instance, the swell of private-sector investment that followed a U.S. government-led initiative in 2018; the effort—involving the U.S. Department of State, U.S. Agency for International Development (USAID), and other agencies—contributed \$2.9 billion in Indo-Pacific infrastructure aid and prompted millions more from private contributions.¹⁵ To build on these investments, the G7’s PGII initiative should involve experienced operators in the region, like the U.S. International Development Finance Corporation (DFC), among others.

G7 leaders can generate an even greater impact by working collaboratively with like-minded nations to target financing opportunities and encourage funding from Indo-Pacific governments. Importantly, such collaboration can foster greater adoption of semiconductors and supporting technologies, including AI, high-performance computing, and 5G. In this sense, cooperative development financing increases the supply of semiconductors, as well as the demand. When paired with other incentives, like export credits, and shared development standards, such coordination will better position the G7’s PGII to offer an alternative to China’s Belt and Road Initiative.

Technology Protections: IP Protections, Export Controls, and Foreign Investment Screening

The semiconductor supply chain also hinges on strong technology protections, including management of IP, export controls, and foreign investment

13 The White House, “FACT SHEET: Quad Leaders’ Tokyo Summit 2022,” May 23, 2022, <https://www.whitehouse.gov/briefing-room/statements-releases/2022/05/23/fact-sheet-quad-leaders-tokyo-summit-2022/>.

14 Ezell, Kotasthane, and Downey, 2022.

15 Ezell, 2020.

screening. For each of these protections, the G7 and Indo-Pacific leaders should strive for reciprocal agreements among like-minded nations.

Foremost, IP and related trade secrets must be protected against theft. IP is the backbone of semiconductor design, and it provides important market protections like combating the sale of counterfeit semiconductors and related products. Broader IP information sharing, as well as more robust protections for trade secrets and penalties against their theft, are a start. Allied nations can go further by maintaining a comprehensive index of IP theft in order to better track and prevent threats. In particular, G7 nations need to build a consolidated list of foreign enterprises that engage in unrelenting unfair trade practices such as IP theft and cyberespionage and collaborate to collectively block such firms from enjoying access to G7 markets. And this should go beyond blocking the import of specific products that have benefited from pilfered IP or technology—as the United States' 337 rules at the U.S. International Trade Commission has done—but to wholesale blocking of the infringing firm's access to G7 markets entirely.

The G7 and Indo-Pacific nations can further protect technology by collaborating on export controls and agreeing upon the use of narrow and targeted controls as deemed strictly necessary by the level of sensitivity or threat. Multilateral controls can effectively protect sensitive technologies, while avoiding the dangers that unilateral controls may pose for global partnerships. Additionally, G7 leaders can align investment screening practices as an extra safeguard against malfeasance.¹⁶

Talent Supply Chain Resiliency

Underlying the resiliency of semiconductor supply chains is that of talent supply chains. The present talent shortage most acutely threatens the pace of innovation and chip design.¹⁷ But the shortage's effects spill over into other stages of semiconductor production, including predictive software and systems development, validation and testing, and end-market expertise.¹⁸ The need for highly skilled workers must be met with greater investment in science

¹⁶ Ibid.

¹⁷ Varas et al, 2021.

¹⁸ Selena Loh LaCroix, "Talent solutions for today's semiconductor shortage," Korn Ferry, October 12, 2021, <https://www.kornferry.com/insights/featured-topics/talent-recruitment/talent-solutions-for-todays-semiconductor-shortage>.

and engineering programs, particularly at the graduate level. Further, immigration laws must facilitate the flow of global talent and ensure that education programs are able to attract international students.

Yet, if G7 leaders truly want to evade the worst threats of the talent shortage, they must think outside of the typical boxes of education investments and changes to immigration law. Further, the talent pipeline must be addressed comprehensively, not just at the levels of training and recruitment. Some ideas for an unconventional G7 talent strategy could involve the following:

- **Targeted education for impact.** Investment in education and training centers could be targeted to match national competencies and strengths—for example, education investment in Japan could emphasize silicon and semiconductor manufacturing equipment.¹⁹ This approach would ensure simultaneously diverse yet complementary training that strategically prepares workers throughout the industry. Another opportunity for targeted programs could be to accelerate training in specific technical areas where the need is greatest. In such cases, governments should work with the private sector and universities to identify and fill training gaps.
- **A competitive recruitment and engagement plan.** The abundance of software and consumer technology jobs creates significant talent pool competition. In order to compete for high-skilled workers, G7 nations need an engaging recruitment plan that attracts applicants through effective marketing and branding and matches recent graduates with relevant work based on skills and interests. The marketing strategy, in particular, is key to recruiting diverse candidates. By communicating the tremendous impact of semiconductors in everyday life, as well as the scope of specialties and room for growth in the semiconductor industry, the marketing plan could engage new applicants who would otherwise enter adjacent fields.²⁰

19 Semi village

20 Loh LaCroix, 2021.

- **Train for crisis management.** The climate and health crises of the last two years are not isolated events; rather, crises will inevitably grow worse and become more disruptive. Supply chain resiliency requires a flexible workforce that can adapt to unforeseen challenges and crises, whether they be climate-related, political, or global health-related. Training for crisis management should involve predictive analysis instruction and cross-functional training, as duties are likely to shift in a time of crisis. In order to navigate crises, the semiconductor workforce must be agile, flexible, and alert to new challenges.
- **Upskill current talent.** Investment must be made throughout the talent pipeline, including current talent. Upskilling workers is important for adapting to new technologies and, even more so, is crucial for talent retention. Nurturing current talent ensures comprehensive reinforcement of the talent supply chain at all stages.
- **More flexible industry.** Employees in the semiconductor industry report lower worker satisfaction levels than those of other tech companies.²¹ This finding clearly poses retention challenges, but when taken together with other trends in the employment market, it signals the need for the industry to change its workstyle, particularly with regard to worker flexibility. Elsewhere in the tech market, employees are still able to work from home, a pandemic practice that appeals to many who do not wish to return to the office or to relocate, if needed. Some parts of the industry are also seen as more attractive than others due to real and perceived differences in compensation, benefits, and career opportunities. Improving talent pipelines will ultimately require more flexible offices and attractive benefits in order to compete.

21 Ondrej Burkacky, Ulrike Kingsbury, Andrea Pedroni, Guilietta Poltronieri, Matt Schrimper, and Brooke Weddle, "How semiconductor makers can turn a talent challenge into a competitive advantage," McKinsey & Company, September 7, 2022, <https://www.mckinsey.com/our-insights/how-semiconductor-makers-can-turn-a-talent-challenge-into-a-competitive-advantage>.

Supportive Trade Rules and Regulations

Semiconductors represent the fourth-largest globally traded good, behind crude and refined oil and motor vehicles.²² Fortifying the supply chain means promoting greater trade liberalization in the Indo-Pacific region. Strong trade regimes that promote openness and free trade are crucial for the transfer of knowledge and technology, especially as components of greater innovation and learning. They are also important for fostering regional connectivity and resilience to supply chain shocks.

The Indo-Pacific region already has a rich environment of formalized trade agreements: the ASEAN Free Trade Area, the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), the Asia-Pacific Trade Agreement, and the Regional Comprehensive Economic Partnership (RCEP) to name a few, as well as independent ASEAN agreements with individual nations.²³ The region also has a diverse range of trade regimes, from the very liberal to the more protectionist. Yet, the trade environment still faces high regional transaction costs, barriers to technology flows, and missed opportunities for economic growth through trade. The G7 can support the Indo-Pacific in realizing these opportunities through development of a coherent agreement and updates to existing trade partnerships. The ultimate goal of these negotiations should be a free and open Indo-Pacific.

As part of a comprehensive Indo-Pacific trade strategy, G7 nations should advocate for an ITA expansion. Following the establishment of the WTO's Information Technology Agreement (ITA) in 1997 and its expansion in 2015, the semiconductor industry experienced a 20 percent increase in trade, and participating nations experienced a boost in economic growth thanks to lower price of ICT goods.²⁴ A further expansion of the ITA would eliminate tariffs on another 250 ICT product categories, including at least 60 next-generation semiconductors and semiconductor products or inputs. The reduction in prices via tariff elimination an ITA-3 could deliver carries the potential for an additional \$784

22 Varas et al, 2021.

23 Ray et al, 2021.

24 Ibid.

billion in global economic growth over 10 years.²⁵ With the adoption of a so-called ITA-3, signatory countries could also spur deeper participation in global value chains and faster adoption of new ICT technologies, the impact of which could have tremendous ripple effects throughout the semiconductor industry.

Multiple and Multi-layered Alignments

Lastly, G7 nations could raise the efficiency of the Indo-Pacific's multiple and multi-layered national alignments. As a very large and diverse region, varying geopolitical, national, and economic interests compel the formation of many alliances. However, the presence of distinct yet sometimes overlapping alliances—the Quad and the Supply Chain Resilience Initiative (SCRI) share Australia, India, and Japan as core members, for instance—creates redundancies and inefficiencies in reaching their common goal of supply chain resiliency. Without adequate information sharing between these groups, their efforts to improve resiliency may be less effective. By communicating more often, combining talents where possible, and balancing priorities when necessary, major groups focused on the Indo-Pacific can maximize impact. The G7 nations should become leaders in this space by setting an example.

Conclusion

The G7 nations need to turn their words into action in enacting new policies to support a free, open, and inclusive Indo-Pacific by recognizing the centrality of semiconductors to their national and economic security goals, and by acting to develop a coordinated semiconductor-specific infrastructure strategy in the Indo-Pacific. The PGII's investment funds could be used to build infrastructure for R&D and advanced manufacturing capacity, improve identification and prediction of supply chain shortages, support digital infrastructure for semiconductor development, incentivize allied vendor partnerships, and draw new talent. Beyond funding infrastructure, the G7 should also take leadership roles in plurilateral agreements and in creative solutions for resilient supply chains.

25 Stephen Ezell and Luke Dascoli, "How an Information Technology Agreement 3.0 Would Bolster Global Economic Growth and Opportunity," Information Technology and Innovation, September 2021, <https://d1bcsfjk95uj19.cloudfront.net/sites/default/files/2021-ITA-3.pdf>.



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