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Statement before the

Joint Economic Committee

"Barriers to Supply Chain Modernization and Factor Productivity Enhancements"

A Testimony by:

Sujai Shivakumar, Ph.D.
Senior Fellow, Center for Strategic and International Studies
and Director Renewing American Innovation

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210 Cannon House Office Building

Chairman Schweikert, Ranking Member Hassan, distinguished Members of the Committee, my name is Sujai Shivakumar, and I am honored to share my views with you on this important topic pertaining to our nation's innovation strategy. I am a Senior Fellow at the Center for Strategic and International Studies, where I direct the program on Renewing American Innovation. As a bipartisan, nonprofit policy research organization dedicated to advancing practical ideas to address the world's challenges, CSIS's purpose is to define the future of national security. The program on Renewing American Innovation aims to revitalize innovation system to enhance our economic competitiveness and strengthen our national security in the emerging world order. CSIS does not take policy positions, so the views represented in this testimony are my own.

Thank you for giving me the opportunity to testify today about how we must center manufacturing in our nation's innovation system for greater economic competitiveness, broad-based workforce participation, technological leadership, and national security.

Rebuilding U.S. capacity to innovate and manufacture advanced technologies is critical for U.S. economic competitiveness and national security. Renewing manufacturing in the United States is a national strategic objective: manufacturing not only creates jobs, stimulates economic growth, and reduces dependency on foreign suppliers like China, but also reinforces the U.S. innovation system by reconnecting R&D to production.

Innovation without production is a recipe for vulnerability: when technologies are invented in the United States but scaled and manufactured elsewhere, we forfeit not only economic returns but also the technical know-how, iterative learning, and supply chain coordination that are critical to sustained technological advantage.

In the United States, short-term financial pressures on firms, weak workforce training systems, and persistent scale-up challenges have delinked innovation from production.[1] Public capital markets and shareholder expectations often reward short-term returns over long-term investment in new production capacity. As a result, many American firms have prioritized outsourcing and offshoring, eroding domestic capabilities over time. The structural separation between "innovate here" and "produce there" has led to an erosion of the "industrial commons"—the networks of skills, suppliers, and know-how needed to support manufacturing innovation. This separation not only limits America's ability to capture the full economic and security benefits of its advanced innovations but also threatens the nation's long-term capacity to invent, build, and lead in critical sectors.

The consequences of this structural R&D-manufacturing gap are evident. As the United States outsourced more development and manufacturing work, it steadily degraded the industrial commons. As a result, many foundational technologies—such as solar panels, lithium batteries, and semiconductor components—originated in U.S. labs but were scaled and industrialized in East Asia.[2] This pattern has eroded manufacturing leadership and generated national security vulnerabilities.

[1] National Research Council, *Government-Industry Partnerships for the Development of New Technologies* (Washington, DC: The National Academies Press, 2003), https://doi.org/10.17226/10584.
[2] Harvard Business Review, "Restoring American Competitiveness," July 1, 2009, https://hbr.org/2009/07/restoring-american-competitiveness.

The ambitious CHIPS and Science Act, passed with strong bipartisan support in 2022, shows what focused policies can achieve. It is already reshoring advanced semiconductor manufacturing to the United States. The CHIPS Act's comprehensive approach establishes direct federal incentives to expand domestic semiconductor fabrication, builds up the broader ecosystem of suppliers and facilities, and invests in the workforce pipeline needed to sustain long-term competitiveness.

About 95 percent of CHIPS Act incentives will support semiconductor fabrication, focusing on bolstering some of the most capital-intensive segments of the value chain.[3] These incentives span the semiconductor value chain, from integrated device manufacturers (IDMs), which design and manufacture their own chips, to contract manufacturers (foundries), which manufacture chips designed by other firms, to outsourced semiconductor assembly and test (OSAT) firms, which assemble, package, and test the chips to ensure they work.

Most CHIPS funds are designed to boost fabrication capacity—and are successfully catalyzing private investment. The legislation has already begun to unlock an unprecedented wave of private capital and commitments to build domestically. In fact, since the CHIPS Act was signed, the Semiconductor Industry Association reports over $540 billion in U.S. semiconductor investments, investments which are projected to triple total U.S. chip manufacturing capacity over the next decade.[4] Even though numbers for both demand and supply are in flux,[5] they represent a dramatic, game-changing surge in U.S. manufacturing capacity for both advanced and mature chips.

However, this new impetus to renew manufacturing has also revealed critical challenges in the U.S. manufacturing supply chain and ecosystem, particularly on the workforce, infrastructure, and regulatory fronts.

- **Support Talent Development:** First, the semiconductor industry requires both highly skilled engineers and technically trained workers, yet the U.S. education and training systems have not scaled to meet this demand. A 2022 report released by the Semiconductor Industry Association (SIA) found that 58 percent of necessary manufacturing and design jobs might go unfilled by 2030.[6] Institutions like Purdue University are addressing this volume gap, but more support for their exceptional efforts and those of other universities are needed. We must continue to attract and retain talent from both inside and outside our borders.[7]

[3] Chris Borges, Yutong Deng, and Julie Heng, "Innovation Lightbulb: Tracking CHIPS Act Incentives," CSIS, April 25, 2025, https://www.csis.org/analysis/innovation-lightbulb-tracking-chips-act-incentives.
[4] Semiconductor Industry Association, "2024 State of the U.S. Semiconductor Industry," Accessed May 30, 2025, https://www.semiconductors.org/2024-state-of-the-u-s-semiconductor-industry/.
[5] Kearney PERLab and SEMI. "Braving the Storm: Navigating an Uncertain Future | State of Semiconductors 2025," https://www.kearney.com/service/product-excellence-and-renewal-lab/state-of-semiconductors-2025.
[6] Semiconductor Industry Association, "Chipping Away: Assessing and Addressing the Labor Market Gap Facing the U.S. Semiconductor Industry," Accessed May 30, 2025, https://www.semiconductors.org/chipping-away-assessing-and-addressing-the-labor-market-gap-facing-the-u-s-semiconductor-industry/.
[7] Remco Zwetsloot, *Winning the Tech Talent Competition*, (Washington, DC: CSIS, October 2021), https://www.csis.org/analysis/winning-tech-talent-competition; Julie Heng and Yutong Deng, "Innovation Lightbulb: Not Just Attracting But Retaining International STEM Students," CSIS, April 11, 2025, https://www.csis.org/analysis/innovation-lightbulb-not-just-attracting-retaining-international-stem-students.

Decades of underinvestment and neglect in vocational education, fragmented apprenticeship systems, and the absence of a coherent federal-state workforce strategy have created a mismatch between industry needs and available and potential talent. Moreover, misaligned incentives across educational institutions, students, employers, and policymakers have stymied systemic reform. If we are to meet the workforce demands of this unique industry, we must prioritize national strategies for technical education, such as successful programs from The National Institute for Industry and Career Advancement (NIICA).[8]

- **Bolster Infrastructure Needs:** Second, we face infrastructure gaps. New fabs cannot operate efficiently without upgrades to reliable electricity, transportation, and water systems with the necessary capacity—all areas of longtime neglect.[9] Accordingly, the United States needs to make infrastructure investments into utilities and supply chains to support semiconductor manufacturing. These are not just technical bottlenecks but national challenges, which make legislation like the Inflation Reduction Act and Bipartisan Infrastructure Law key supports and proactive investments for innovation and manufacturing.

- **Reform Obstructive Regulations:** Third, we face outdated and dysfunctional regulatory processes. Projects that are urgent for national competitiveness often face years-long hurdles driven by permitting delays, lengthy environmental reviews, and inconsistent local approvals.[10] For example, according to the Council on Environmental Quality (CEQ), between 2013–2018, the Environmental Impact Statements required under The National Environmental Policy Act (NEPA) took an average of 4.5 years to complete.[11] Modernizing regulatory frameworks to ensure clarity, speed, and predictability, while still safeguarding environmental and community protections, is essential for rebuilding manufacturing at speed and scale.

Can tariffs encourage manufacturing renewal in the U.S.? The threat of high tariffs is now being used as a negotiating tool in trade talks with a number of foreign countries. In making the case for tariffs, the administration has claimed that higher import costs will stimulate domestic production. There is unquestionably a need to address unfair trade practices and non-market behavior by other countries. However, in today's era of globalized innovation and manufacturing, tariffs alone are not sufficient to convince firms to rebuild industrial capacity. In fact, high or

[8] NIICA, "The National Institute for Industry and Career Advancement," https://www.niica.org.
[9] John VerWey, "No Permits, No Fabs," Center for Security and Emerging Technology, October 2021, https://doi.org/10.51593/20210053.
[10] President's Council of Advisors on Science and Technology, *Report to the President: Ensuring Long-Term U.S. Leadership in Semiconductors* (Washington, DC: Executive Office of the President, January 2017), https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/PCAST/pcast_ensuring_long-term_us_leadership_in_semiconductors.pdf.
[11] Phillip Singerman, Sujai Shivakumar, Gregory Arcuri, and Hideki Tomoshige, "Streamlining the Permitting Process for Fab Construction," CSIS, *Commentary,* August 29, 2022, https://www.csis.org/analysis/streamlining-permitting-process-fab-construction; Phillip Singerman and Alexander Kersten, "Implementing CHIPS: The Nepa Permitting Challenge," CSIS, *Commentary,* May 1, 2023, https://www.csis.org/analysis/implementing-chips-nepa-permitting-challenge.

volatile tariffs can introduce uncertainty, reduce investment confidence, and risk spurring the development of parallel supply chains that bypass the United States.[12]

Consider how the imposition of Biden-era export controls, for example, has spurred China to double down on its existing deeply subsidized development efforts. The result has been increased state investment, the emergence of new AI chip architectures like DeepSeek, and a sharp rise in research output in critical technology fields. According to the Emerging Technology Observatory at Georgetown University, China is at present producing twice as many research papers as the United States on chip design and production, reflecting their high-level focus on this industry.[13] These efforts are showing substantial and even surprising progress and are only destined to grow,[14] because China sees this as a vital national competition. Meanwhile, the United States debates whether we should stay in the market for advanced U.S.-owned semiconductor production.[15] The answer, of course, is that we should.

In short, a tariff-only strategy does not address the necessary incentives for investment, workforce development, infrastructure build out, and regulatory relief for renewing U.S. manufacturing. We can work to reroute semiconductor manufacturing supply chains, but we also need to invest in a domestic ecosystem that can support it—indeed, allow it to flourish. The successful CHIPS and Science Act is a start to the response, but far more is needed. It cannot be a "one and done" approach. We need expanded support for semiconductor research to maintain the U.S. edge in chip design and materials science. We also need stronger public-private partnerships to facilitate shared infrastructure, accelerate tech transfer, and support innovative firms through the "valley of death." We have to see this contest as a long-term game. Follow-on support for the industry through tax incentives and related programs will be needed. For the United States to succeed in this high-stakes competition, substantial and sustained public support will be essential.

[12] Sujai Shivakumar, Charles Wessner, and Tom Howell, "The Limits of Chip Export Controls in Meeting the China Challenge," CSIS, *Commentary*, April 14, 2025, https://www.csis.org/analysis/limits-chip-export-controls-meeting-china-challenge.
[13] Iris Deng, "China Leads US in Quantity, Quality of Chip Research, Report Finds," South China Morning Post, March 5, 2025, https://www.scmp.com/tech/tech-war/article/3301171/tech-war-china-leads-us-quantity-quality-semiconductor-research-report-finds.
[14] Sujai Shivakumar, Charles Wessner, and Thomas Howell, *Investing in Science and Technology* (Washington, DC: CSIS, June 2024), https://www.csis.org/analysis/investing-science-and-technology.
[15] Sujai Shivakumar, Charles Wessner, and Thomas Howell, *Too Good to Lose: America's Stake in Intel* (Washington, DC: CSIS, November 2024), https://www.csis.org/analysis/too-good-lose-americas-stake-intel.