SEMICONDUCTOR INDUSTRY ASSOCIATION

March 17, 2025

Via Regulatory Portal

Mr. Eddie Garcia
Procurement Analyst
Office of Federal Procurement Policy
Office of Management and Budget
725 17th St. NW
Washington, D.C. 20503

Re: Request for Information on Advancing the Domestic Manufacturing of Semiconductors in Commercial Information Technology (90 FR 3963, January 15, 2025)

Dear Mr. Garcia:

The Semiconductor Industry Association ("SIA") welcomes the opportunity to submit these comments to the Office of Management and Budget ("OMB") in response to its *Request for Information (RFI) on Advancing the Domestic Manufacturing of Semiconductors in Commercial Information Technology ("IT")*, 90 Fed. Reg. 3963 (January 15, 2025) (the "Request"). SIA shares the goal to build the resilience of domestic semiconductor manufacturing and appreciates efforts by the government to increase demand for Made-in-America chips at home and in overseas markets.

The semiconductor industry is critical to U.S. economic competitiveness and national security in an era of digital transformation, artificial intelligence, Industry 4.0, connected vehicles, and 5G/6G communications. Strengthening American and global semiconductor supply chains, including through demand-side drivers such as federal procurement policy, is a top priority for SIA and its members. Collaboration and two-way information sharing between government and industry will be critical in successfully achieving shared supply chain objectives related to the semiconductor industry, and we look forward to a robust public-private partnership on these issues going forward.

SIA appreciates the OMB's efforts to better understand how the Federal acquisition system can leverage domestic sources for semiconductors to ensure a safe and secure supply chain for U.S. government procured commercial IT products and services.

I. INTRODUCTION AND BACKGROUND

SIA has been the voice of the U.S. semiconductor industry for nearly 50 years. SIA member companies, representing more than 99% of the U.S. semiconductor industry by revenue as well as major non-U.S. chips firms, are engaged in the full range of research, design, and manufacture, and back-end assembly, test, and packaging of semiconductors. The U.S. is a global leader in the semiconductor industry. We strongly believe continued U.S. leadership in semiconductor technology will drive economic strength, national security, and global competitiveness. More information about SIA and the semiconductor industry is available at www.semiconductors.org.

Semiconductors are the bedrock of today's global economy, powering and enabling a host of American technologies, industrial products, and virtually everything digital from cellphones and cars to supercomputers, AI applications, and medical equipment. Few industries, if any, have a supply chain and development ecosystem as complex, geographically widespread, and interdependent as the semiconductor industry. A joint report by the Boston Consulting Group ("BCG") and SIA found that more than 120 countries are involved in the semiconductor production supply chain.[1]

Semiconductor content in everyday electronic products and industrial machinery continues to grow significantly, driven by increasing electrification and digitization across end markets. According to one research consultancy, semiconductor content in electronic systems reached 33 percent in 2021.[2] Nearly 50 percent of all medical devices now contain semiconductor content, spanning insulin pumps to pacemakers to MRI machines. In the automotive industry, S&P AutoTechInsight projected that the value of average semiconductor content per vehicle will increase 80 percent over the next seven years from $854 in 2022 to $1,542 in 2029.[3] The aerospace and defense industries are also highly dependent on semiconductors, from so-called "legacy" or mature-node chips to the most advanced AI processors.

Maintaining a strong U.S. semiconductor research, design, manufacturing, and supplier base is an economic and a national security imperative and is critical to ensuring a safe and secure supply chain for U.S. government procured commercial IT products and services. Building on initial U.S. investments announced during President Trump's first term, SIA member companies are investing more than half-a-trillion dollars to manufacture and develop more semiconductors in the United States. These investments are creating and supporting hundreds of thousands of high-paying jobs throughout our economy, and securing and stabilizing American supply chains. Based on our current trajectory, the U.S. is projected to triple its chipmaking capacity by 2032, growing at a rate

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[1] Semiconductor Industry Association and Boston Consulting Group, *Emerging Resilience in the Semiconductor Supply Chain*, April 2021. https://www.semiconductors.org/wp-content/uploads/2021/05/BCG-x-SIA-Strengthening-the-Global-Semiconductor-Value-Chain-April-2021_1.pdf

[2] Jessie Shen, *Semi content in electronic systems reaches record high in 2021, says IC Insights,* DIGITIMES, Jan. 17, 2022. https://www.digitimes.com/news/a20220114VL201.html

[3] Automotive Semiconductor Market Tracker – January 2023, Mar. 2, 2023, https://autotechinsight.ihsmarkit.com/shop/product/5003356/automotive-semiconductor-market-trackerjanuary-2023; *See* also Semiconductor Intelligence, *Automotive lone bright spot*, Mar. 28, 2023. https://www.semiconductorintelligence.com/automotive-lone-bright-spot/

that leads the world and increasing America's share of global semiconductor capacity for the first time in four decades.

It is imperative that we maintain this momentum, because, despite our significant and transformative progress in the U.S., competitors around the world continue their efforts to challenge U.S. semiconductor leadership. Our industry faces increasing competition from other countries that provide significant non-market state support and measures that discriminate against U.S. chip suppliers. *See* SIA's recent submission[4] to inform the Office of the U.S. Trade Representative's Section 301 investigation regarding China's acts, policies, and practices related to targeting of the semiconductor industry for dominance.

America must run faster to win the technology race of the future. To achieve this goal, it is imperative the CHIPS Act grant and research programs be implemented efficiently and without disruption. The United States should build on the momentum achieved to date by extending the CHIPS Act tax credit to spur additional investments in the domestic semiconductor ecosystem and bolster our supply chain, and by expanding the credit to cover semiconductor design to maintain U.S. technology leadership. To complement efforts in building out domestic semiconductor capacity, we must undertake additional measures and initiatives to increase the market base for Made-in-America chips and boost demand here at home and around the world. Government procurement policy is one important lever for the U.S. government to explore, both domestically and with other likeminded governments, to increase demand for semiconductors produced in the United States.

SIA appreciates the opportunity to provide comments as the OMB considers how the federal acquisition system can help create more demand for domestically manufactured semiconductors. These steps will help ensure a resilient supply chain and support American semiconductor manufacturing and jobs, therefore fueling continued U.S. semiconductor leadership.

II. SEMICONDUCTOR DATA

Shifts in end-use market share reflect growing innovation and demand for semiconductors in the automotive, industrial, and consumer markets, with global sales on course to reach $1 trillion by 2030.

Total global semiconductor sales reached $627.6 billion in 2024. As a share of total semiconductor sales, direct sales to the government are small – accounting for around 1.7 percent of industry revenue, or less than $2.3 billion in the United States,[5] and just 0.9 percent, or roughly $5 billion, worldwide.[6] Of course, when factoring in chips incorporated into IT end products, the government

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[4] Semiconductor Industry Association, *Re: Request for Public Comments: China's Acts, Policies, and Practices Related to Targeting of the Semiconductor Industry for Dominance*, February 5, 2025. https://www.semiconductors.org/wp-content/uploads/2025/02/USTR-2024-0024-00109674-CAT-5016-Public-Document.pdf

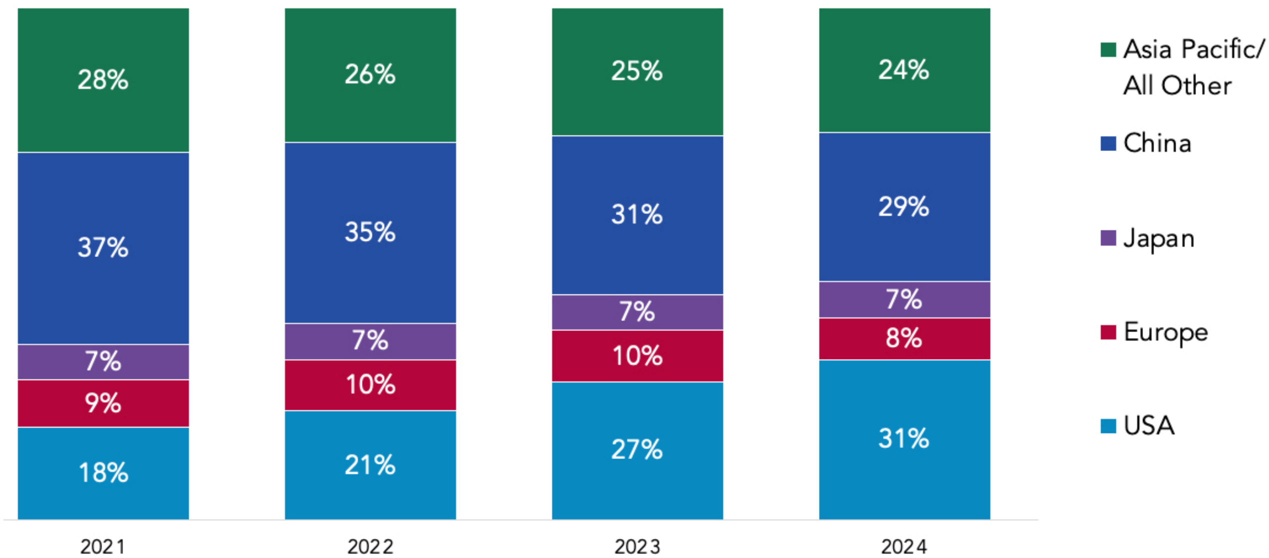
[5] For this submission, the WSTS Americas region data is a proxy for the United States because WSTS data includes the United States.

[6] These shipment figures do not include revenue derived from commercial IT products such as workstations or data centers. World Semiconductor Trade Statistics, *End-Use Survey 2023*, January 2024.

procurement market for semiconductors is likely higher. Semiconductor sales for consumer electronics, computers, and telecom end-uses accounted for 5.7 percent, 32.2 percent, and 35.9 percent, respectively, of total U.S. semiconductor industry revenue.

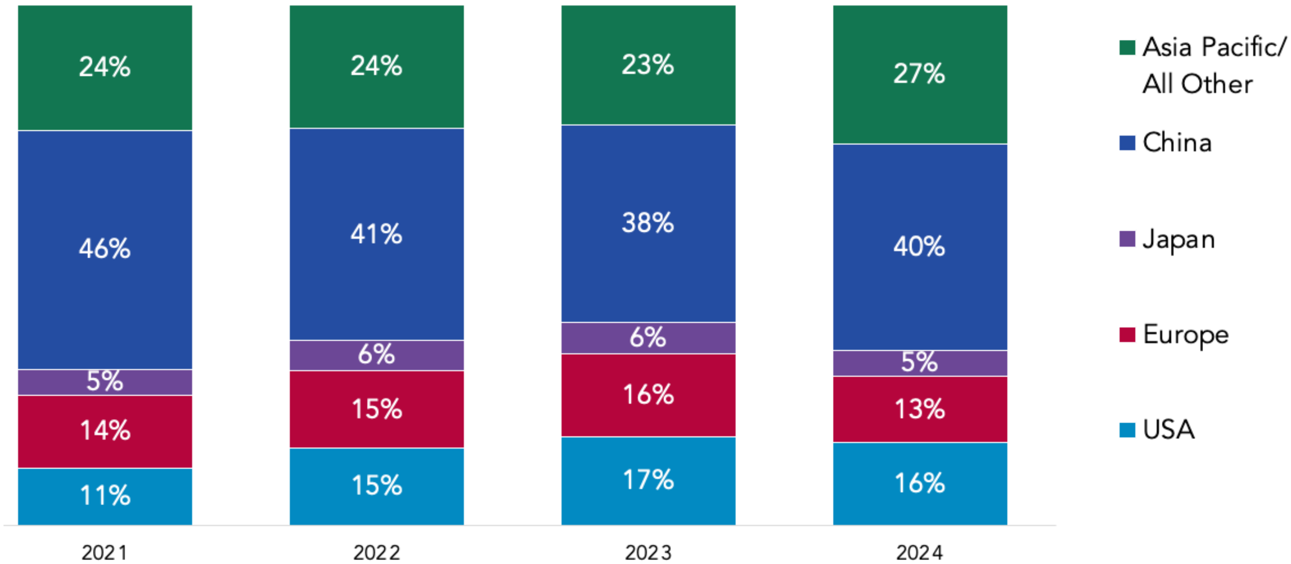
Since governments purchase semiconductors directly and indirectly through their procurement processes, there is a valuable opportunity to spur demand, both domestically and together with trusted partners, for semiconductors manufactured in the United States and in allied countries. As shown in Figures 1 and 2, U.S.-headquartered semiconductor companies' sales in the United States account for just under one-third of total revenue, but less than one-fifth of sales by volume, on average. Pursuing and aligning government procurement sourcing guidelines jointly with other likeminded governments will be more effective in generating demand for our chips.

Figure 1: U.S. Chip Sales by Region (by Revenue), 2021-2024



Source: World Semiconductor Trade Statistics, *Americas by base report*, accessed February 20, 2025.

Figure 2: U.S. Chip Sales by Region (by Unit Shipments), 2021-2024



Source: World Semiconductor Trade Statistics, *Americas by base report*, accessed February 20, 2025.

III. COMMENTS AND RECOMMENDATIONS

Section A contains our general views regarding the scope of the Request, recommendations to mitigate the risk posed by undue dependence on foreign manufacturing, and help reduce costs currently associated with domestic fabrication, assembly, test, and packaging. **Section B** contains our responses to the certain questions posed to industry stakeholders in the Request.

A. General Comments on the Request

In strengthening the domestic manufacturing base, it is essential for the Federal Government to coordinate with U.S. industry stakeholders to fully understand and evaluate semiconductor manufacturing needs and vulnerabilities, including for critical material inputs. Although there are existing federal procurement statutes that incentivize U.S. government agency purchasing of domestic products,[7] these statutes were established before globally integrated semiconductor supply chains developed. Therefore, any procurement incentives should be tailored to the current landscape of the semiconductor supply chain and also take into account how other competitor nations treat semiconductor purchases in government procurement.[8] Of particular relevance, current forecasted U.S. manufacturing capacity is unlikely to be able to meet total U.S. demand

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[7] For example, the Berry Amendment requires the Department of Defense to purchase certain items such as clothing, textile, and food to protect the domestic manufacturing base and maintain the safety and security of armed forces during times of war. 41 U.S.C. § 4862: The Defense Federal Acquisition Regulation Supplement implements the Berry Amendment (DFARS 225.7002 Restrictions on food, clothing, fabrics, and hand or measuring tools).

[8] Of note, China established a measure called "Domestic Product Standards and Implementation Policies in Government Procurement" to develop a new standard for evaluating a "China domestic product" and provide a 20 percent price deduction in evaluating government procurement bids.

and the cost of fully indigenizing the supply chain within the United States is cost prohibitive. Given that reality, sourcing of chips from trusted partners and allies should continue for Federal IT purposes to ensure economic and national security.

B. SIA Responses to Specific Questions from the Request

The following are SIA's responses to certain questions posed in the Request.

2. ***Once you have determined that there is sufficient domestic manufacturing of semiconductors, what factors, including economic incentives, would affect your willingness to take advantage of this supply? In responding, please identify your market segment.***

Response: Certain original equipment manufacturers, integrators, and other customers of SIA member companies have indicated there is interest and willingness to use domestically manufactured semiconductors as long as they meet specific commercial requirements with regard to cost and performance, and there is sufficient capacity onshore. However, U.S.-based semiconductor manufacturing facilities face a significant cost disadvantage due to decades of investment by foreign governments to support semiconductor manufacturing outside the United States. A report issued by SIA and the Boston Consulting Group found that the total cost of ownership (TCO) for a U.S.-based wafer fabrication (fab) manufacturing facility is roughly 25-50 percent higher than the equivalent fab in other countries.[9]

To overcome these longstanding cost disadvantages, it is imperative to sustain the investments being made in the U.S. semiconductor ecosystem. Governments around the world have heavily invested in the development of their own semiconductor manufacturing industries, resulting in an unlevel playing field for investment in the United States.

Incentives, such as the advanced manufacturing investment credit (AMIC), have helped start to reverse the decades-long decline in U.S. semiconductor manufacturing capacity. However, the AMIC is set to expire in 2026, threatening the ability of companies to make sustained, long-term investments in the United States' semiconductor manufacturing capabilities in the face of growing global competition. We recommend extending the AMIC beyond its expiration date, expanding it to include advanced semiconductor design, and making it permanent to solidify U.S. semiconductor innovation capacity and its leadership in the semiconductor industry.

Similar structural and other cost barriers exist for fabless companies seeking to shift production of a specific product lines from an overseas fab to a U.S.-based fab. The Federal Government should

[9] Semiconductor Industry Association and Boston Consulting Group, *Government Incentives and US Competitiveness in Semiconductor Manufacturing*, September 2020. https://www.semiconductors.org/wp-content/uploads/2020/09/Government-Incentives-and-US-Competitiveness-in-Semiconductor-Manufacturing-Sep-2020.pdf

explore incentive strategies that reduce the costs of migrating production from an overseas manufacturing location to a U.S.-based manufacturing location, particularly for semiconductor design companies and end users.

4. ***Last year, the Federal Government purchased approximately $10 billion on IT hardware, including approximately 1.5 million mobile devices and 1.3 million laptops, around $14 billion of cloud computing, including data centers, and $5.43 billion of telecom services.***

   f. ***Are there particular categories of semiconductors that would be easier to source domestically or ones that would be more difficult?***

Response: As noted in SIA's submission to USTR,[10] there is a growing concentration of mature-node[11] capacity in China, and capacity for mature node chips continues to grow at a pace more than four times the growth in global demand for these chips. From 2015 to 2023, China's share of global mature-node semiconductor capacity almost doubled from 19 percent to 33 percent—growing at an average annual rate of 12.1 percent. By comparison, demand for global mature node semiconductors grew only 2.9 percent annually over the same period. In the United States and the rest of world, mature-node capacity grew at annual rates of around 1.3 percent and 1.8 percent, respectively, slightly lower than overall global demand. Figure 3 shows U.S. company market share for select mature node semiconductor segments, along with the share of manufacturing capacity for each segment located in the United States.

Figure 3: U.S. Share of Market and Capacity by Select Mature-node Product Segments

Product Segment	U.S.-Headquartered firm market share*	U.S. Capacity Share
Discrete	22.2%	3.1%
Sensors & Actuators	39.8%	27.6%
Analog	61.7%	16.7%
Mature-node Logic	13.2%	9.3%

Source: SIA analysis on WSTS, "Bluebook 2024," Feb. 2025. SIA analysis on SEMI, *World Fab Forecast—Q4 2024*, December 19, 2024

* Data represents market share of U.S. headquartered companies based on total chip sales for both commercial and government end uses.

The growing concentration of mature-node capacity in China risks crowding out investment in mature-node chips in the U.S. and other countries, or even forcing market-based competitors, including U.S. headquartered companies, out of the market altogether. A recent report from the Department of Commerce underscored this risk, finding that "capacity expansion in China is

[10] Semiconductor Industry Association, *Re: Request for Public Comments: China's Acts, Policies, and Practices Related to Targeting of the Semiconductor Industry for Dominance*, February 5, 2025. https://www.semiconductors.org/wp-content/uploads/2025/02/USTR-2024-0024-00109674-CAT-5016-Public-Document.pdf

[11] For purposes of this submission, "mature-node" or "legacy" semiconductors refer to chips fabricated using process technologies for chips with larger feature sizes typically 28nm and higher transistor architectures, and equivalent specifications for memory chips.

beginning to cause pricing pressure, and that the combination of subsidies for foundries and downstream industries in China, as well as pressure to use PRC-origin content in China, may impact [U.S. chips suppliers'] competitive positions."[12] The same report estimated that the median price of mature-node semiconductor wafers from China-based foundries was 10 percent lower than from foundries in the rest of the world,[13] though this price delta can be significantly larger for specific products (e.g. silicon carbide devices and materials).

Continuation of these trends present significant downstream effects, resulting in supply chain dependencies not only for the semiconductor industry in the United States but across the myriad downstream industries that integrate mature-node semiconductor technologies into finished products and ultimately sell these products to the Federal Government, including the market segments of interest for purposes of this Request. Without adequate incentives to expand capacity in mature node chips in the United States and other allied and partner countries, demand for foundry capacity outside of China will continue to outstrip supply, which could undermine the global competitiveness of U.S. fabless companies. It would therefore be prudent for OMB to expand the scope of this inquiry and related efforts to include chips designed by U.S. fabless companies and manufactured in foundries located in allied or partner countries in addition to chips manufactured in the United States.

It is unlikely that the United States will be able to fully meet domestic demand with only U.S.-based semiconductor capacity for the foreseeable future until significant shifts in demand patterns establish stronger business cases for greater investments in U.S. semiconductor manufacturing capacity. Continued development of emerging technologies, such as artificial intelligence, the electrification of vehicles are two such demand drivers, as are market-opening trade deals.

For leading-edge semiconductors, chipmakers are rapidly expanding capacity in the United States for leading-edge semiconductors found in smartphones, computers, data centers, and other commercial IT devices, spurred in large part by CHIPS Act incentives and related programs. Similarly, additional demand signals and continued incentives will help sustain and accelerate this trend, and procurement incentives should be tailored to the current landscape of the semiconductor supply chain.

By contrast, policy measures that raise the cost of domestic semiconductor manufacturing risk slowing down expansion of U.S. semiconductor manufacturing capabilities across the board.

6. ***What, if any, significant domestic supply chain vulnerabilities surrounding semiconductors are you aware of and what could be done to reduce or eliminate those vulnerabilities? Are there other vulnerabilities of which we should be aware?***

Response: As noted above, the cost of operating a semiconductor fab in the United States is significantly higher and the time to construct semiconductor fabs is much longer than other

[12] Bureau of Industry and Security, *Public Report on the Use of Mature-Node Semiconductors*, December 2024. https://www.bis.gov/media/documents/public-report-use-mature-node-semiconductors-december-2024
[13] *Ibid.*

locations due to a variety of factors. For example, regulatory challenges such as burdensome environmental regulations and permitting processes, as well as limited access to reliable and affordable electricity can create vulnerabilities in the domestic semiconductor supply chain. The National Environmental Policy Act (NEPA) and other duplicative laws at the state and federal levels can make the environment review and permitting process for building domestic semiconductor manufacturing capacity lengthy, expensive, and difficult to navigate compared to other countries. Requiring both federal and a stringent state level review significantly increases compliance burdens and could substantially impact the ability to accurately meet the growing market demand for semiconductors. The Federal Government should therefore take action to streamline federal permitting processes to avoid duplicative reviews and unnecessary delays that can last years.

Another factor that affects competitiveness of fab construction and operation in the United States is overly restrictive construction codes. Compared to allied countries in Asia, for example, U.S. fab construction is more restricted on height and story limits, basement depth, and requires many more egress corridors and stairwells—all of which drive space inefficiencies, higher construction costs, and larger land requirements. Further, U.S. fabs are required to have significantly higher exhaust ventilation rates and outside air makeup rates for utility and support spaces, which results in increased facility system sizes, construction costs, operating expenses, and energy consumption. Updates to these construction codes to improve these inefficiencies and costs would help address this challenge within the domestic supply chain.

Another significant challenge that creates a vulnerability for the semiconductor supply chain in the United States is a significant shortage of skilled and highly educated workers, particularly in the categories of technicians, engineers, and computer scientists. We estimate a workforce gap for technicians of 20 percent and a 39 percent workforce gap for both engineers and computer scientists.[14] By 2030, roughly 67,000 jobs in the U.S. semiconductor industry risk going unfilled at current degree completion rates. Without action to address this gap, 58 percent of projected new semiconductor industry technical jobs and roughly 80 percent of projected new jobs in technical occupations, including technicians, engineers, and computer scientists, risk going unfilled. Member companies have begun taking action to address these gaps, but shortages are likely to persist, especially among workers with advanced degrees.

Moreover, the United States currently lacks a skilled employment base of construction workers with customized training both for the construction of the fab and for the ongoing maintenance and repair of facilities. Semiconductor companies will have to compete for talent across multiple sectors, including residential housing, for construction workers of all types—from earthwork specialists to skilled electricians—in an already tight labor market. Therefore, a critical component to securing U.S. leadership and the future success of semiconductor manufacturing requires an ecosystem to cultivate a workforce capable of building these unique and specialized buildings.

[14] Semiconductor Industry Association and Oxford Economics, *Chipping Away – Addressing the Labor Market Gap Facing the U.S. Semiconductor Industry*, July 2023. https://www.semiconductors.org/wp-content/uploads/2023/07/SIA_July2023_ChippingAway_website.pdf

In addition, certain global suppliers of critical material inputs for semiconductor manufacturing, as well as suppliers of advanced packaging substrates and components for printed circuit board manufacturing outside the United States, have a competitive advantage to domestic suppliers due to large-scale production and lower costs of producing these inputs. For example, critical minerals such as refined gallium and germanium are largely concentrated in China. China's July 2023 announcement of export restrictions on gallium and germanium followed by full export bans on these materials in 2024 targeted at the United States highlights the crucial need to invest in domestic processing and refining capabilities and work with allies to find alternative sources for these critical inputs. In parallel, it is essential to ensure that measures such as tariffs do not create additional costs to sourcing these critical material inputs for semiconductor manufacturing.

7. ***To meet Federal sustainability purchasing requirements, should domestically-produced commercial IT products with domestic semiconductors include specifications, standards, or ecolabels recommended by the Environmental Protection Agency (EPA) for Federal purchasing or be capable of meeting EPA's Framework for the Assessment of Environmental Performance Standards and Ecolabels for Federal Purchasing for future inclusion?***

Response: Semiconductor manufacturers who adhere to industry standards that ensure sustainable operations of facilities should be exempt from additional environmental standards. As part of a federal procurement process, semiconductor manufacturers would have the capability to provide information about which standards apply in their manufacturing operations.

Questions for Domestic Manufacturers of Semiconductors:

8. ***What is the anticipated timeline for domestic production and anticipated capacity of various types of semiconductors, including but not limited to memory chips, logic chips such as microprocessors and microcontrollers, complex systems-on-a-chip, and discrete, analog, and optoelectronic chips?***

Response: The anticipated timeline for expanding domestic production and anticipated capacity can vary greatly depending on the type of product. While semiconductor manufacturers in certain product segments have access to domestic capacity, significant and enduring demand shifts would drive the business case for further capacity expansion. In general, greenfield semiconductor projects can take up to 5 years,[15] whereas brownfield capacity expansions can reduce this timeline by one to two years.[16]

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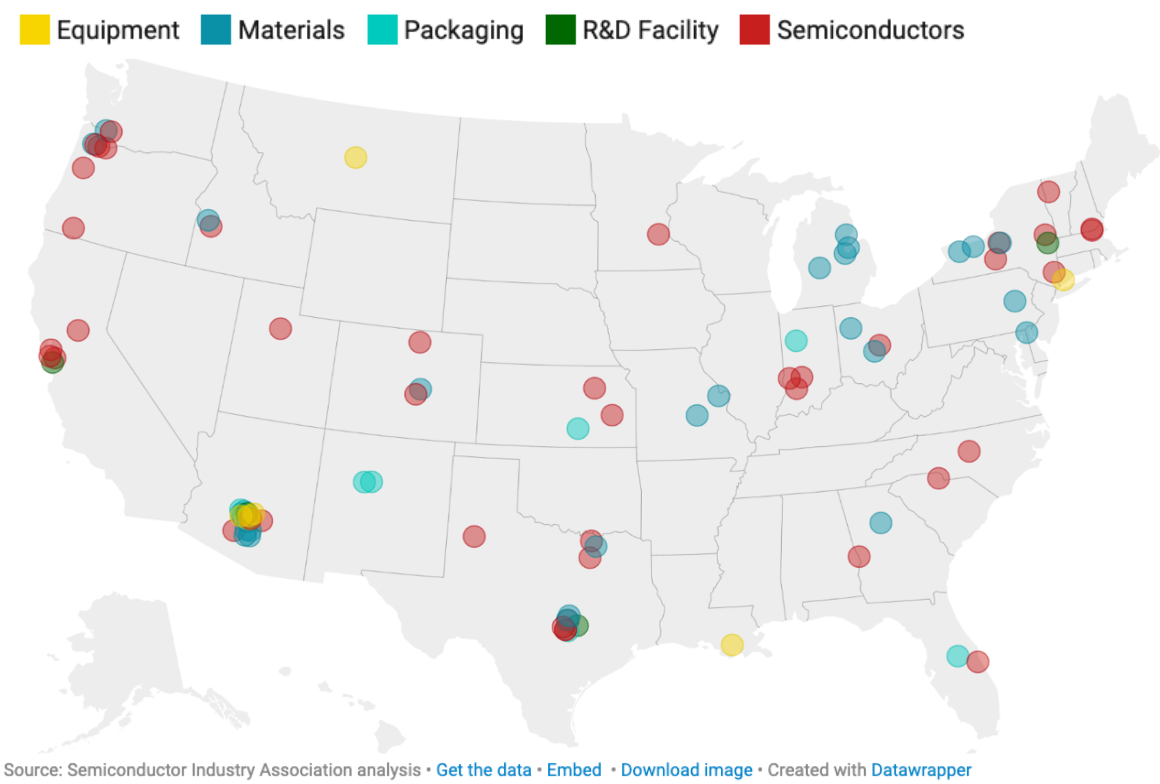
[15] Semiconductor Industry Association and Boston Consulting Group, *Emerging Resilience in the Semiconductor Supply Chain*, May 2024. https://www.semiconductors.org/emerging-resilience-in-the-semiconductor-supply-chain/
[16] Boston Consulting Group, *Navigating the Costly Economics of Chip Making*, September 2023. https://www.bcg.com/publications/2023/navigating-the-semiconductor-manufacturing-costs

SIA member companies are continuing to make important investments across the semiconductor ecosystem in the United States, as shown in Figure 5.[17] As of January 22, 2025, companies in the semiconductor ecosystem had announced more than 90 new manufacturing projects in the U.S. since the CHIPS Act was first introduced in Congress, totaling nearly $550 billion in announced investments across 23 states.[18] These investments are projected to create tens of thousands of direct jobs and support hundreds of thousands of additional jobs throughout the U.S. economy.[19] In the decade following enactment of the CHIPS Act, the United States is projected to more than triple its semiconductor manufacturing capacity, the highest projected rate of growth in the world through 2032.[20] Although some of these fabrication facilities have started producing chips, most others will do so closer to the end of the decade and beyond.

Figure 5: Semiconductor supply chain investments announced from May 2020 – Aug 2024



For example, manufacturers in the United States are already producing foundational analog and logic chips. With the announced expansion plans, the U.S. domestic supply of these semiconductors will continue to increase over the coming years. Domestic manufacturing capacity

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[17] Semiconductor Industry Association, *The CHIPS Act Has Already Sparked $450 Billion in Private Investments forU.S. Semiconductor Production*, August 28, 2024. https://www.semiconductors.org/the-chips-act-has-already-sparked-200-billion-in-private-investments-for-u-s-semiconductor-production/

[18] Semiconductor Industry Association, *2024 State of the U.S. Semiconductor Industry*, October 2024. https://www.semiconductors.org/2024-state-of-the-u-s-semiconductor-industry/

[19] Ibid.

[20] Ibid.

and advanced test and packaging of optoelectronic or photonic integrated circuits using indium phosphide substrates is also expected to increase ten-fold by 2030. In addition, there is an effort to onshore dynamic random-access memory (DRAM) production to the United States and produce additional wafers to meet demand for semiconductors used in artificial intelligence applications, automotive, aerospace, defense, and other industrial markets, in line with industry demand trends.

9. How much time do you need from the placement of an order from an IT hardware manufacturer to deliver the semiconductors?

Response: According to SIA member companies, the amount of time needed from the placement of an order from an IT hardware manufacturer to deliver the semiconductors varies by product, inventory strategies, magnitude of the order, and location of manufacturer (domestic or outside the United States), ranging from a couple of days to several months to over a year for in-demand products.

10. What is the anticipated timeline for domestic production and capacity of associated components, including, but not limited to, packaging of chips, mother boards, etc.?

Response: It is essential to continue support for back-end assembly, test, and packaging (ATP) operations to support scaling up domestic semiconductor manufacturing. The $95 billion ATP market is currently geographically concentrated in locations with lower labor costs—primarily in Asia—in particular for conventional packaging,[21] which accounts for over 50 percent of global ATP activity. China alone accounts for approximately 30 percent of global ATP capacity.[22] Of 36 ATP facilities announced since 2020, 14 are projected to be built in China.

Through the International Technology Security and Innovation (ITSI) Fund, established and funded by Congress, the State Department has been implementing important industrial policy programs to advance secure semiconductor supply chains by expanding and diversifying downstream capacity in partner countries in the Indo-Pacific and Western Hemisphere, in particular for assembly, testing, and packaging capacity to complement ongoing U.S. investments in wafer fabrication capacity. SIA and its member companies support continued funding for ITSI programming so the State Department can continue to advance these critical efforts in support of working with U.S. allies and partners to diversify and strengthen U.S. semiconductor supply chains.

[21] Conventional semiconductor packaging refers to traditional methods of enclosing and protecting a single chip with basic connections, usually using wire bonding to connect the chip to a printed circuit board. Typically, this process is more labor-intensive and requires less exacting standards than "front-end" semiconductor wafer fabrication. Advanced packaging involves more complex techniques to integrate multiple chips on a single substrate for emerging technology applications that require higher performance.

[22] Semiconductor Industry Association and Boston Consulting Group, *Emerging Resilience in the Semiconductor Supply Chain*, May 2024. https://www.semiconductors.org/wp-content/uploads/2024/05/Report_Emerging-Resilience-in-the-Semiconductor-Supply-Chain.pdf

Of note, with respect to advanced packaging, some SIA member companies have existing domestic capacity, and companies have announced additional planned investments over the coming years.

11. What raw materials used in semiconductor manufacturing are in limited or constrained supply and could prevent scale up of your domestic manufacturing operations?

Response: Semiconductor fabrication requires a large number of inputs, including thousands of different materials, chemicals, and industrial gases—each of which needs to be manufactured to exacting standards and some of which have very specific storage and travel requirements. While some are commodity materials widely used in a range of industrial processes such as copper and aluminum, others, such as polysilicon, are specific to the semiconductor manufacturing process because of the required purity levels, design specifications, or other performance requirements. Many suppliers of these inputs are international despite efforts to strengthen domestic supply chains, which can lead to supply chain vulnerabilities.[23]

Silicon, gallium, and germanium are the most common semiconductor minerals for manufacturing wafers. Other metals and minerals such as palladium, tungsten, arsenic, iridium, titanium, copper, and cobalt are also necessary inputs for semiconductor manufacturing and packaging. Mineral supply chains for semiconductor uses are complex, often unique to each mineral, and are often linked to strategic competitors. The minerals must be mined as raw ore, then processed to exacting standards. The minerals or metals are then used in doping (the process of adding impurities to pure materials to alter their properties), metal development for interconnects, insulator development for isolation, and chemical processes for cleaning and etching (eliminating undesired substances from the surface of the semiconductor chip). Many of these critical materials have vulnerable supply chains largely concentrated in China. For example, China produces 98 percent of the world's refined gallium and controls 68 percent of refined germanium production, 80 percent of tungsten, 40 percent of arsenic trioxide, and 67 percent of titanium. In July 2023, China announced export restrictions on gallium and germanium followed by full export bans on these materials in 2024 targeted at the United States. In addition, Russia produces over 40 percent of the world's palladium from only two top-performing projects. In 2021, the United States imported 35 percent of its palladium from Russia. The geopolitical tensions resulting from Russia's 2022 invasion of Ukraine restricted the availability of palladium, highlighting the urgency to secure alternative sources of these critical minerals.[24]

In 2022, the U.S. produced zero arsenic, zero gallium, less than 2 percent of global refined germanium, and less than 1 percent of titanium. The United States should look to allies and trusted

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[23] Semiconductor Industry Association, *Comments of the Semiconductor Industry Association (SIA) on the CHIPS Program Office Request for Information On Implementation of the CHIPS Incentives Program*, November 14, 2022. https://www.semiconductors.org/wp-content/uploads/2022/11/SIA-CPO-CHIPS-RFI-Response-11_14_22.pdf

[24] Center for Strategic International Studies, *From Mine to Microchip – Addressing Critical Mineral Supply Chain Risks in Semiconductor Production*, October 7, 2024. https://www.csis.org/analysis/mine-microchip

partners to establish mutually beneficial partnerships that ensure reliable access to certain critical materials, including by providing incentives to develop processing and refining capabilities.[25]

Currently, only the United States and some of its allies have the ability manufacture the highest purity polysilicon used in nearly all semiconductor chips. China manufactures only a nominal amount of polysilicon for use in lower-end semiconductor applications. It is therefore imperative that the United States invest further in maintaining these manufacturing capabilities to ensure it remains at the forefront of these critical manufacturing processes.

Furthermore, semiconductor manufacturing utilizes a range of per- and poly-fluoroalkyl substances (PFAS) due to their unique properties and performance characteristics. Given its carbon-fluorine chemistry, PFAS-containing materials offer a unique set of surface tension, durability, thermal stability, inertness, corrosion resistance, and chemical compatibility that many semiconductor applications require. Accordingly, for most uses, there are no currently available alternatives. However, these substances are increasingly facing restrictive regulation due to potential environmental concerns and health impacts. Although the semiconductor industry and their suppliers are investing heavily in technologies to reduce consumption and emissions of PFAS, as well as to identify, qualify, and integrate alternatives that meet performance requirements, the availability of certain types of PFAS could decline if suppliers exit the market or are subject to manufacturing restrictions, which could in turn prevent scale up of domestic semiconductor manufacturing.

13. ***What, if any, factors (for example, workforce, permitting, access to high quality power/water, etc.) are causing significant delays in bringing domestic manufacturing facilities online?***

Response: Several factors may contribute to delays in bringing domestic manufacturing facilities online, including environmental regulations and permitting processes, access to reliable and affordable electricity, shortages of workforce with necessary skills, and the need for demand signals that create the necessary business case to justify expansion in the United States.

In the regulatory space, as noted above, the NEPA and other environmental laws at the state and federal levels—many duplicative—can make the environment review and permitting processes lengthy, expensive, and difficult to navigate, without meaningfully improving environmental protection objectives. The compounding effect of both federal and state level reviews significantly increases compliance burdens and can delay U.S. semiconductor manufacturing expansions. Reforms to the environmental and wastewater permitting process would help bring domestic manufacturing facilities online faster.

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[25] For example, Australia is the top producer of bauxite and home to the largest zinc reserves in the world but lacks midstream processing capacity. In addition, Peru has the largest zinc smelting plant in Latin America but does not produce germanium or gallium. CSIS, *Critical Mineral and the Future of the U.S. Economy*, February 2025. https://csis-website-prod.s3.amazonaws.com/s3fs-public/2025-02/250210_Baskaran_Critical_Minerals.pdf?VersionId=Tfu2TnNrQGlN7ol8HSCakMUT8HTwYukd

While the industry employs extensive controls to manage these chemicals, to reduce environmental releases,[26] and to minimize human exposures, the industry needs an effective regulatory system to remain innovative and competitive and to continue to achieve high standards of worker safety and environmental protection. Ensuring continued use of existing chemicals and driving timely approvals of new chemicals are necessary to sustain business operations and continued innovation, and to preserve American leadership in this critical sector. Without access to critical substances that are otherwise readily available abroad, the United States will not be able to scale up domestic manufacturing or compete with foreign jurisdictions. Accordingly, the Environmental Protection Agency (EPA) should ensure that new chemicals to be used in the semiconductor industry are subject to an efficient and streamlined review and approval process.

In addition, the United States is experiencing large growth in semiconductor manufacturing, data centers, and manufacturing for other industrial industries, such as vehicles and batteries. This manufacturing boom will require a record level of electrical power to match U.S. electrical demand over the next decade. Government efforts should include improving reliability of the electricity grid through support for grid enhancing technologies, maintaining low energy costs by expanding transmission infrastructure through federal permitting reform and increasing generating capacity, particularly carbon-free base load energy sources such as nuclear and hydropower to meet customer demands. Expanding energy demand coupled with aging energy infrastructure will likely exacerbate pricing pressure for semiconductor manufacturing companies and weaken the competitiveness of the United States to attract semiconductor investments and expand the industry's existing footprint. The Federal Government must ensure that it can permit both the power generation and the power transmission facilities that will be required to meet this demand.

As outlined in response to question 6, gaps in the workforce can also impede further expansion of U.S. semiconductor manufacturing capacity. Addressing this shortfall requires a comprehensive approach. Steps the Federal Government can take include increasing and sustaining funding for federal R&D programs to train and build the pipeline of scientists and engineers needed to drive innovation in the semiconductor industry and other strategic technologies, and expanding skills training initiatives such as through increased funding for apprenticeship programs and university semiconductor design programs. It can also support opportunities for underrepresented sources of talent such as veterans and military spouses, rural students, and others, and improve affordability through increasing the availability of federal funding for scholarships, fellowships, and other programs that encourage enrollment in critical areas of study. Particular attention should be on

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[26] For example, the industry has taken measures to minimize emissions of greenhouse gases for semiconductor manufacturing in the United States. The semiconductor industry represents about 0.068% of all greenhouse gas (GHG) emissions and about 0.29% of industrial sector emissions in the United States. The industry's GHG emissions have been virtually flat since 2005, despite increasing output and process complexity. EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022*. https://www.epa.gov/system/files/documents/2024-04/us-ghg-inventory-2024-main-text_04-18-2024.pdf. Similarly, data available in the EPA Toxics Release Inventory (TRI) show the semiconductor manufacturing sector represents only 0.17% of all releases for relevant substances. EPA, *EPA Toxics Release Inventory (TRI) Program*, 2023. https://www.epa.gov/toxics-release-inventory-tri-program. The semiconductor industry has also been a leader in phasing out and reducing use of chemicals of concern in response to evolving science on chemical risks, eliminating substances such as TCE, EGEs, and TCA, which are the chemicals cited as chemicals of concern in industry health studies from the 1980s and 1990s.

increasing the number of domestic students seeking advanced degrees in key fields, as more than half of students in many such U.S. programs are currently foreign born. In the absence of sufficient U.S.-developed talent, it will remain imperative to increase access to temporary workers through expansion of the green cards and H1B visas.

Finally, to justify long-term, capital-intensive investments in U.S. semiconductor production, chipmakers need confidence there will be sufficient market demand for their products and/or foundry services. New measures or financial incentives that facilitate increased consumption of U.S.-made semiconductors could accelerate customer orders, and in turn support additional investments in domestic semiconductor manufacturing capacity. The Federal Government should also evaluate procurement policies of other countries to identify trusted partners and develop an arrangement specific to semiconductors. This type of arrangement would create demand for U.S. and allied-made semiconductors through global government procurement markets that would complement U.S. supply-side measures and ultimately strengthen U.S. semiconductor manufacturing.

14. What types of innovations can help make the manufacturing market more efficient?

Response: One innovation contributing to a more efficient manufacturing market falls within the back-end packaging segment of the semiconductor supply chain. Packaging is the process of encapsulating fabricated chips in various materials such as metal, glass, or plastic to protect them against corrosion and enabling them to connect to external devices. Advanced semiconductor packaging is a subset of traditional packaging and is an assortment of approaches for packaging chips that boost computational capabilities while lowering power consumption and cost.[27] Given the significant number of tools and equipment that are required in advanced packaging and the corresponding labor required to operate them, increased automation of tool operation would help offset the higher U.S. labor costs that represent a large portion of advanced packaging costs.

Developing technologies to process and refine more raw materials to increase the supply of critical material inputs for semiconductor manufacturing could also help make the manufacturing market more efficient. As described earlier, there should be incentives for the United States and trusted partners to develop these technologies and enable U.S. semiconductor manufacturing companies to source certain critical material inputs domestically and from allied countries.

Semiconductor manufacturers could further incorporate innovations such as robotics, artificial intelligence, and machine-learning tools within various segments of the semiconductor manufacturing process to improve industrial automation and sensing. These capabilities would help maintain quality control and predictive maintenance ahead of potential defects, contamination, or malfunctions resulting in unplanned downtime of semiconductor manufacturing equipment. Relatedly, a "digital twin" is a relatively new technology that incorporates a virtual model of a physical process or entity informed by data inputs through physical sensors that can help optimize semiconductor production and improve quality and efficiency.

[27] CSIS, *Advanced Packaging and the Future of Moore's Law*, June 2023. https://www.csis.org/analysis/advanced-packaging-and-future-moores-law

III. CONCLUSION

SIA appreciates the opportunity to provide these comments and is available to provide additional information or assistance as the OMB may require. If you have any additional questions or would like to discuss these comments further, please contact SIA via cesko@semiconductors.org or moleary@semiconductors.org.

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