

**Comments of the
Semiconductor Industry Association (SIA)
On the
CHIPS Program Office Request for Information
On
Implementation of the CHIPS Incentives Program**

87 Fed. Reg. 61570 (Oct. 12, 2022)

November 14, 2022

The Semiconductor Industry Association (SIA)¹ appreciates the opportunity to comment on the Request for Information (RFI) by the CHIPS Program Office (CPO) within the National Institute of Standards and Technology (NIST).

As the CPO advances its important work in implementing the incentives funded in the historic CHIPS and Science Act, SIA calls on the CPO to be guided by the following principles.

1. Achieve prompt, transparent, workable, and efficient implementation of the CHIPS incentives

Given the critical importance of semiconductors to the economy, national security, technology leadership, and supply chain resilience, and the important role of the CHIPS Act in strengthening U.S. leadership in these areas, it is imperative for the CHIPS Act to be promptly and effectively implemented. The CPO should work quickly to resolve the issues raised in this RFI, as well as other implementation details. Among the most pressing issues the CPO needs to provide companies with clarity on include the following:

- Factors to be considered by Commerce in funding decisions – The CPO has stated numerous considerations that will be prioritized in evaluating project applications. In order to best implement the CHIPS incentive programs, it will be important for the CPO to provide transparency to applicants regarding how their applications will be evaluated and how the various priorities will be weighed relative to each other. SIA recommends the CPO publish a rubric or scoring system in order to allow applicants to best prepare their submission to the CPO, ensuring the evaluation process is merit-based, consistent with the goals of the legislation, and streamlined for the CPO.
- Size of grants – The CHIPS strategy document states: “The value of the total financial assistance may vary considerably, depending on the specifics of each project.”² How will the Department determine how much grant funding will go to each project? Is Commerce

¹ The Semiconductor Industry Association (SIA) is the voice of the semiconductor industry, one of America’s top export industries and a key driver of America’s economic strength, national security, and global competitiveness. Semiconductors – the tiny chips that enable modern technologies – power incredible products and services that have transformed our lives and our economy. The semiconductor industry directly employs over a quarter of a million workers in the United States, and U.S. semiconductor company sales totaled \$258 billion in 2021. SIA represents 99 percent of the U.S. semiconductor industry by revenue and nearly two-thirds of non-U.S. chip firms. Through this coalition, SIA seeks to strengthen leadership of semiconductor manufacturing, design, and research by working with Congress, the Administration, and key industry stakeholders around the world to encourage policies that fuel innovation, propel business, and drive international competition. Additional information is available at www.semiconductors.org.

² Department of Commerce, “A Strategy for the CHIPS for America Fund,” September 2022 (hereafter, “CHIPS strategy document”), at 10.

considering a target amount or cost share, either in absolute terms, relative to the size of the project, relative to the size of the state or local incentive, or other factors? In other jurisdictions that use grants to incentivize the semiconductor industry, the grants are typically a percentage of the project based on factors such as size, type of technology, and other considerations.

- Funding allocation among types of projects – The CHIPS strategy document states the CPO intends to devote about \$28 billion toward advanced technologies³ and about \$10 billion to more mature technologies, equipment, and material.⁴ How did CPO reach this conclusion? Has the CPO assessed whether the proposed amounts will be sufficient to meet the goals of the CHIPS Act? SIA recommends that CPO retain flexibility in determining allocations based on the breadth and scope of applications it receives in order to fulfill the objectives of the law, strengthening all segments of the U.S. semiconductor industry, rather than predetermining technology-specific allocations of funds. CPO could make an initial assessment upon the receipt of initial applications and then periodically update the allocation as new awards are granted.
- Impact of the ITC – The CHIPS Strategy document indicates that the advanced manufacturing investment credit (ITC) will “reduce the required share of federal CHIPS incentive funding allocated” for leading edge projects⁵ and for mature/current generation technologies it is “assessing the ITC impact on allocations between programs.”⁶ The CHIPS Act, as originally introduced, included both the manufacturing incentive grants, and the investment tax credit, because both are needed to close the 30-50 percent cost differential to manufacture semiconductors in the U.S. compared with our global competitors. Congress envisioned these two tools working in tandem to incentivize company behavior. Accordingly, if the manufacturing incentive awards are reduced due to an applicant’s intent to claim the ITC, the result would be an overall non-competitive incentive package. SIA recommends the CPO treat the ITC as a complement to financial assistance from the grant program as Congress intended, not as a partial substitute to those funds. Moreover, the CHIPS strategy document states that a project’s financial plan “should include an analysis of how the ITC will impact the financial results of the project.”⁷ An important concern, however, is that in some cases it could take several years for an applicant to determine the degree and total amount that its project will benefit from the ITC due to years-long IRS audits for some companies.
- Requirements governing funding recipients – Potential CHIPS applicants need advance notice of the restrictions applicable to the incentives, such as the restrictions applicable to investments in countries of concern. SIA recommends that Commerce make available the requirements governing “significant transactions” and “material expansions” in China and other countries of concern, so applicants have an opportunity to review the requirements in advance of application submission. Will Commerce issue a single agreement applicable to all entities, or prepare individual agreements? SIA recommends that all applicants are subject to the same required agreement with respect to significant transactions in foreign countries of concern. In addition, Congress made various changes to the program rules, including requiring applicants to provide information about

³ CHIPS strategy document, at 9

⁴ CHIPS strategy document, at 10

⁵ CHIPS strategy document, at 9

⁶ CHIPS strategy document, at 10

⁷ CHIPS strategy document, at 17

supply chains and steps to address counterfeiting, among other requirements. Commerce should clarify its expectations of applicants in this regard. Finally, it would be helpful if Commerce could clarify other potential requirements, such as the applicability of Buy America provisions, to recipients of Federal financial assistance.

- Intellectual Property – The CPO should guarantee companies retain the rights to their intellectual property and have the ability to commercialize technology developed with CHIPS incentives. The absence of such assurances would inhibit innovation through the CHIPS incentives program and deter companies from taking CHIPS grants in some cases.

Among other things, the CPO should publish a draft application for funding and provide an opportunity for feedback from interested parties. Such a step would provide valuable information to the CPO while also helping guide companies who may be interested in applying for funds, as well as to ensure that all information requested in the application is viable for applicants to provide within a reasonable time frame.

2. Engage with the semiconductor industry and other stakeholders

The CPO should maintain a regular and ongoing dialogue with the semiconductor industry and other key stakeholders to inform its policies related to the CHIPS program. In addition to convening webinars, issuing strategy documents, seeking information in RFIs, and other means for disseminating information and soliciting feedback, the CPO should regularly engage with the semiconductor industry on key policies related to the program, through the SIA, via direct engagement with companies, and other relevant stakeholders. While CPO needs clear rules of engagement to ensure fairness, the CPO requires the benefit of industry's expertise to implement programs that deliver on the objectives of the CHIPS Act. SIA recommends the CPO also make available an email point of contact where applicants may send technical and process questions during the application process and beyond. If askchips@chips.gov is the appropriate point of contact for potential applicants, the CPO should clarify as such.

3. Enable semiconductor projects under the CHIPS for America Fund to be implemented without regulatory delay

The CPO and the administration as a whole should work to ensure the effective implementation of the CHIPS Act by addressing other barriers that may impede CHIPS projects. For example, projects receiving CHIPS funding will be subject to review under the National Environmental Policy Act (NEPA), which could pose significant delays in the disbursement of CHIPS funds and result in delays in the construction and operation of facilities.

To avoid this outcome, the CPO should work to provide a categorical exclusion for CHIPS projects based on criteria developed after consultation with affected stakeholders. At minimum, the CPO should ensure the Department of Commerce has the administrative ability to streamline and expedite reviews to the greatest extent possible, for instance by utilizing tools under the Permitting Action Plan. Delays due to burdensome reviews would put at risk the economic, supply chain, and national security benefits that are the very purpose of the CHIPS Act.

4. Support a holistic approach to address talent and workforce gaps, as well as to build a semiconductor workforce pipeline for the future

It is clear the success of CHIPS will depend in large part on access to a skilled workforce. As government and industry work on long-term domestic solutions to address STEM education and worker training, access to the best and brightest from around the world – including students with advanced degrees in STEM fields from U.S. colleges and universities – is a critical part of a near term solution to the workforce needs of the U.S. semiconductor industry. It should be noted that universities are key partners in basic research and in the activities associated with the NSTC, NAPMP, Manufacturing USA Institutes, and the DOD Microelectronics Commons. Many of the students working on these semiconductor related programs, especially at the graduate level will be foreign nationals. It is imperative to keep as much of that talent in the United States as possible. Accordingly, the administration should leverage the administrative tools within its authority to enable foreign students and other foreign nationals to work and remain at semiconductor companies in the U.S., as well as to engage with Congress on legislative paths to address emergent workforce needs in the semiconductor industry, including increased access to green cards.

SIA's response's to the CPOs specific requests for information are set forth below.

Use of grants, loans, and loan guarantees

1. The Department may allocate up to \$6 billion out of the \$39 billion of total incentives to support loans and loan guarantees to covered entities. This \$6 billion has a significant multiplier effect: the principal amount of financing available through loans and loan guarantees could be leveraged to support up to \$75 billion in loans and loan guarantees. This leverage will help the CPO achieve the needed scale of investment by facilitating additional private capital and providing access to debt for companies with reasonable prospects for repayment. Applicants will be encouraged to consider loans or loan guarantees as part of their federal assistance application package. Which types of companies in the supply chain would benefit most from the use of the loans or loan guarantees to supplement or in lieu of CHIPS grants?

SIA Response: The incentives authorized and funded as part of the CHIPS Act were created to incentivize semiconductor manufacturing in the U.S. by reducing the substantial cost differential – largely due to the significant incentives offered by our global competitors – between building and operating facilities in the U.S. compared with overseas. Accordingly, to our understanding, the vast majority of SIA member companies do not intend to seek federal loans or guarantees as part of the CHIPS program.

The challenge is not the lack of access to private sector financing that has prevented investment in the U.S., and the offering of loans or loan guarantees is unlikely to improve the competitiveness of manufacturing in the U.S. While Commerce has the statutory authority to leverage loans or loan guarantees in appropriate circumstances, we fear that diverting as much as \$6 billion for this purpose may dilute the overall effectiveness of the CHIPS incentive program and divert limited resources from grants needed to attract semiconductor manufacturers and suppliers to invest in the U.S. and rebuild our domestic semiconductor ecosystem. The CHIPS Act is not intended to assist companies that are struggling financially and cannot access private capital. The goal is to level the playing field such that the U.S.

rebuilds domestic manufacturing capability that is critical to national and economic security, key goals identified in the CHIPS strategy document.⁸

In addition, we are concerned that administrative delays and challenges associated with setting up a loan guarantee program could hinder the Commerce Department's ability to award grants in a timely fashion. In other contexts, Commerce faced challenges with implementing loan programs.⁹ The Department should not let a similar lack of interest and administrative challenges with respect to loans hold up the implementation and ultimate success of the main focus of the incentives program, nor should the Department reserve a subset of funds for loans and loan guarantees if there is not reasonable demand for this use of funds.

2. How should CHIPS financial assistance (grants, loans and/or loan guarantees) be designed to be additive to, rather than a substitute for, private sector equity or debt capital?

SIA Response: CHIPS financial assistance is inherently additive to, rather than a substitute for, private sector equity or debt capital. Private financing can alleviate a company's cash flow challenges and allow it to invest more than it otherwise could, but it will not reduce the costs of building, equipping and operating semiconductor facilities in the U.S. compared to other attractive locations. Additionally, increasing leverage through such financing will likely increase risk. Likewise, loans and loan guarantees are tools that can be appropriate in some instances, but by and large they cannot be substitutes for an incentive that levels the playing field with our global competitors. In contrast, CHIPS grants will help level the playing field by reducing facility costs in the U.S., just as foreign government incentives do in competing locations overseas.

The CHIPS strategy document suggests that companies should consider bigger projects than they would without government assistance.¹⁰ While this is an important consideration, the Department should also consider the extent to which these investments would otherwise not take place in the U.S. without incentives. "Upscaling" a project would require additional incentives, not additional private sector equity or debt capital, as SIA's response to Question 1 notes that access to capital is typically not a substantial barrier to investment.

By SIA's analysis (Appendix A), companies in the semiconductor ecosystem have committed \$170 billion to new projects across America for semiconductor manufacturing, semiconductor manufacturing equipment, and semiconductor manufacturing materials. This record demonstrates the CHIPS financial assistance is encouraging private investment and is not serving as a substitute for such private sector financing.

⁸ CHIPS strategy document, at 6.

⁹ Previously, the Department failed to implement the Federal Loan Guarantees for Innovative Technologies in Manufacturing (ITM) program authorized under the America COMPETES Reauthorization Act of 2010 (Section 602, America COMPETES Reauthorization Act of 2010, Pub. L. No. 111-358, § 602 (2011)). As documented in multiple reports, the Government Accountability Office (GAO) found that despite receiving Congressional appropriations, the Economic Development Administration never took key steps such as issuing program regulations, hiring additional staff, developing marketing materials, and conducting outreach to implement the program over a number of years. Commerce officials noted that it would be difficult to implement the program without duplicating already available federal programs, and they perceived little demand for the program or lender interest. Ultimately no loan guarantees were ever issued, and Congress ended program funding. (Government Accountability Office Reports, available at <https://www.gao.gov/products/gao-16-271>, <https://www.gao.gov/products/gao-18-276r>, <https://www.gao.gov/products/gao-20-326r>, and <https://www.gao.gov/products/gao-22-105512>.)

¹⁰ CHIPS strategy document, at 14

3. What information is available on how foreign and domestic companies engaged in semiconductor manufacturing or suppliers to that industry evaluate whether to invest in a discrete project – for example, through internal rates of return (IRR)? Do evaluations and IRRs differ by producer, project, technology, or segment of industry?

SIA Response: We are not aware of publicly available information responsive to this question, and in any event the information to be considered by foreign and domestic companies engaged in semiconductor manufacturing or suppliers would likely vary substantially by company depending on their own particular circumstances, including but not limited to, the project, location, technology, industry segment, economic factors, company strategy, market conditions, and other considerations.

4. What debt/equity ratios have semiconductor manufacturers or suppliers used in previous projects that are individually financed?

SIA Response: SIA is not aware of information on debt/equity ratios used by semiconductor manufacturers or suppliers in previous projects.

5. Does the industry, including foreign and domestic firms, finance semiconductor manufacturing or supplier investments on a limited recourse or nonrecourse project finance basis? What proportion of investments are financed this way?

SIA Response: SIA is not aware of information responsive to this question on an industry-wide level. Companies use a wide range of financing practices for their investments.

6. How does access to debt and capital markets differ for companies across the semiconductor sector? Which parts of the sector struggle to access debt and equity capital?

SIA Response: To our knowledge, access to debt and capital markets is not an issue for the semiconductor industry at large. As we stated in our response to Question 1, to our knowledge, the vast majority of SIA member companies do not intend to seek federal loans or loan guarantees as part of the CHIPS program. Some early-stage companies may not yet be profitable and therefore may face more limited and/or higher interest debt and equity options.

Financial assistance for upstream suppliers and materials used to manufacture semiconductors

7. For purposes of this set of questions, the upstream supply chain refers to companies that provide materials (including minerals, chemicals, slurries, gases, photomasks, photoresists), equipment, or other inputs (including specialized services) for the semiconductor manufacturing process. Which elements of the upstream supply chain could constrain the ability to expand domestic semiconductor production? For example, if U.S. semiconductor production were to increase by 30%, would suppliers be able to keep pace? Please specify in terms of categories like industrial gases, raw materials, specialty chemicals, wafers, photoresists, and/or photomasks.

SIA Response: As a general matter, access to a number of all supplier inputs will naturally increase in order to keep pace with expansion in chipmaking capacity over time. Many suppliers

(e.g., semiconductor manufacturing equipment makers and materials manufacturers) have already anticipated increased demand and have ongoing efforts to expand manufacturing capabilities. However, in order to meet the expected spike in domestic fabrication demand, we must ensure that the semiconductor manufacturing equipment sector has access to the critical semiconductor inputs it needs to enable efficient delivery of equipment. Ensuring access to these critical inputs will help prevent supply chain bottlenecks which have contributed to the global chip shortage in the past.¹¹ Additionally, manufacturers face a potential shortage of ABF substrates that could negatively impact or disrupt manufacturing as their capacity increases. Finally, import restrictions on raw materials can cause disruptions. While the U.S. needs to encourage responsible, resilient, and sustainable upstream supply chains, many of the suppliers will be international, even if we are successful in strengthening domestic participation. The White House report on the semiconductor supply chain, conducted under E.O. 14017 100-day supply chain review, includes an assessment of key semiconductor materials (e.g., polysilicon, wafers, photomasks and photoresists, ultra-pure and regular chemicals and gases, and raw materials) and semiconductor manufacturing equipment.¹² This report summarizes the vulnerabilities of key parts of the supply chain.

Most importantly, the CPO should recognize that capacity by suppliers will grow in response to market demands and supply chain adjustments, as chipmakers collaborate and invest in new materials, equipment and other inputs to expand their operations.

8. The CHIPS Act of 2022 increased the eligibility for Section 9902 incentives to include facilities and equipment for the fabrication, assembly, testing, production, or research and development of materials used to manufacture semiconductors. Which materials should be included in the definition of “materials used to manufacture semiconductors” and why? For each material identified, if a new facility were constructed for the production of that material, what typical percentage of that facility’s equipment and output would be expected to be used for semiconductor production, as opposed to other manufacturing processes?

SIA Response: To ensure the limited CHIPS funding is used in a targeted and effective manner to benefit the semiconductor ecosystem and strengthen the U.S. supply chain, we believe the definition of “materials used to manufacture semiconductors” should be defined in a focused manner and target materials that are:

- A) Essential to the semiconductor fabrication process,
- B) Direct inputs (i.e., not feedstocks in the process of making materials for the supply chain) in either front end or back end manufacturing processes,
- C) Not commodity products of general use in a wide range of manufacturing processes outside of semiconductors.

Semiconductor fabrication requires a large number of inputs, including over 300 different materials, chemicals, and industrial gases.¹³ While some are commodity materials widely used in a range of industrial processes, others are specific to the semiconductor manufacturing process because of the required purity levels, design specifications, or other performance

¹¹ SEMI, [“The Equipment Multiplier Effect on the Chip Shortage.”](#) May 2022

¹² The White House, [“Building Resilient Supply Chains, Revitalizing American Manufacturing, and Fostering Broad-Based Growth: 100-Day Reviews under Executive Order 14017”](#), June 2021, at 21; hereafter “White House Supply Chain Review.”

¹³ Semiconductor Industry Association & Boston Consulting Group, [“Strengthening the Global Semiconductor Supply Chain in an Uncertain Era”](#), April 2020, at 8; hereafter “SIA/BCG Supply Chain Report”

attributes. A 2014 SIA public comment to the OSTP states: “In many instances, there are no known alternatives to these materials that satisfy our functional needs, and therefore a secure and continuous supply of critical materials is of critical importance to our industry.”¹⁴

Semiconductor materials, especially for the most advanced fabrication processes for logic and memory chips, are required to be at purity levels “so extreme that trace contaminants below parts-per-billion can cause millions in dollars of commercial yield losses.”¹⁵

We anticipate that materials suppliers will increase investment in the semiconductor supply chain to meet the growing U.S. semiconductor manufacturing capacity, and CHIPS funding should be targeted at projects that would otherwise not be located in the U.S.

The following is an overview of some of the key materials used in semiconductor manufacturing.¹⁶

Front-end Manufacturing Materials

The general categories of front-end materials that should be included in the definition of materials are:

- Ultra high-purity polysilicon: Polysilicon is the semiconductor in a semiconductor chip. The polysilicon used in the semiconductor supply chain must be of ultra-high purity – 99.999999999 percent pure.
- Silicon and Compound semiconductor ingots, wafers, and epi layer: Materials such as polysilicon is melted, formed into single crystal ingots which are then sliced into wafers, cleaned, polished, and oxidized in preparation for circuit imprinting within fabrication facilities. Compound semiconductors such as gallium arsenide (GaAs), gallium nitride (GaN) and silicon carbide (SiC) are crucial for national defense and future high efficiency electrification and communication needs and are made from materials that undergo a similar transformation process as polysilicon. Gallium is necessary for the production of GaAs, GaN, and GaN-on-Si wafers.
- Lithography materials:
 - Photomask: A plate covered with patterns used in the lithography process. The patterns consist of opaque and clear areas that prevent or allow light through.
 - Photoresist: A special material that undergoes a chemical reaction upon exposure to light. Silicon wafers are covered with a photoresist layer, which is imprinted with the patterns contained in the photomask during the lithography process.

¹⁴ Semiconductor Industry Association, “[Comments of the SIA on the notice of RFI on ‘Critical and Strategic Materials Supply Chains,’](#) Sept. 2014, at 1; hereafter “SIA Supply Chain Public Comment, September 2014.”

¹⁵ TECHCET, “[Semi Wet Chemicals US\\$2B Market Threatened by Localization,](#)” Dec. 2020

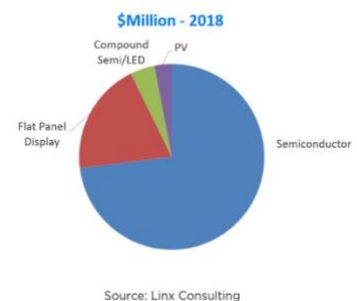
¹⁶ For more information, SIA refers the CPO to the following resources:

- [SIA Supply Chain Public Comment](#), September 2014
- [SIA Supply Chain Public Comment](#), April 2021
- [SIA Supply Chain Public Comment](#), November 2021
- [SIA/BCG Supply Chain Report](#), April 2021
- Saif M. Khan, Alexander Mann, and Dahlia Peterson at Center for Security and Emerging Technology, “[The Semiconductor Supply Chain: Assessing National Competitiveness,](#)” January 2021 (hereafter “CSET Supply Chain Issue Brief”)
- [White House Supply Chain Review](#), June 2021

Note that this information is provided in response to the question. SIA’s inclusion of these materials and manufacturing inputs should not be construed as a recommendation for CHIPS investments.

- Antireflective coatings: Coating that reduces reflectivity at resist interfaces, thus providing better line width control with minimal loss of resist performance.
- Wet processing chemicals: The fabrication process uses a range of specialty chemicals that are used in the etching and cleaning steps of semiconductor manufacturing, and include solvents, acids, etchants, strippers, and other products.
- Chemical Mechanical Planarization (CMP): Materials used for polishing the surface of the wafer after the film deposition step to provide a flat surface (e.g., pads and slurries).
- Sputtering Targets: Highly precise machined alloys (e.g., copper) used to deposit the metal needed to create the interconnects of the transistors on the wafer.
- Deposition materials (e.g., high purity elemental metal targets and precursor chemicals)
- Gases: Used to protect wafers from atmospheric exposure. Other gases are used in the semiconductor manufacturing process as dopants, dry etchants, and in chemical vapor deposition (CVD).
 - Electronic bulk gases (EBG) are important to semiconductor manufacturing, but note that these gases are also used in a variety of industries. The uses of EBG are described below.¹⁷
 - Nitrogen: Used for purging vacuum pumps, in abatement systems, and as a process gas.
 - Hydrogen: Used during epitaxial deposition of silicon and silicon germanium and for surface preparation.
 - Argon: Used for plasma deposition and etching processes as well as deep UV lithography lasers used to pattern the smallest features in semiconductor chips. Tools using small droplets of liquid argon are employed to clean debris from the smallest, most fragile chip structures.
 - Helium: Used in electronics manufacturing at hundreds of points in the fab for cooling, plasma processing, and leak detection.
 - Oxygen: Used for growing oxide layers in etching. Ultra-pure liquid oxygen (LOX) can be provided on-site with less than 10 ppb impurities without the need for an external purifier.
 - Carbon dioxide: Used to support leading-edge immersion lithography, specialized cryogenic cleaning applications, and DI (deionized) water treatment.
 - Electronic specialty gases (ESG): Because of the precision involved in semiconductor manufacturing, hundreds of very high purity gases are needed. Typically this is between 99.998% to 99.99994% purity, but varies between the gases supplied and the application.¹⁸ Unlike for electronic bulk gases that are used for a wide range of applications, semiconductors dominate the end-use applications for the ESG market.¹⁹ 31% of all U.S. semiconductor ultra-high purity chemicals are imported.²⁰

Figure 1 - ESG Market by End-Use Applications



¹⁷ Linde, [“Leading in Electronic Gases: Supplying the semiconductor, solar, display, and LED markets,”](#) 2016, at 8.

¹⁸ Process Sensing Technologies, [“Achieving sub-ppb impurity detection to ensure the purity of electronic specialty gases.”](#)

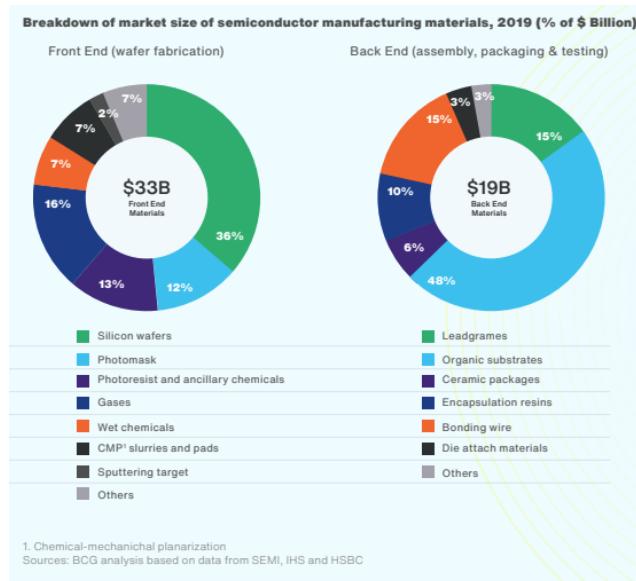
¹⁹ SEMI, [“Opportunities in Electronic Specialty Gases,”](#) Oct. 2019

²⁰ TECHCET, [“CMC Advisory Alert: The impact of expansion on the materials supply chains,”](#) Aug. 2021, at 13.

Back-end Manufacturing Materials

Back-end materials, while also essential to semiconductor manufacturing, typically have relatively lower technical barriers to produce compared to the wafer fabrication materials described above.²¹ Back-end materials may include leadframes, organic substrates, ceramic packages, permanent magnets, encapsulation resins, bonding wires, die-attached materials, dicing materials (e.g., dicing blades and dicing tape), high-density packaging materials (e.g., interposers, bonding adhesives, epoxies and underfill, high-quality polymer substrates), polyimides and bumping and metallization materials.

The chart to the right shows the breakdown of the global sale of semiconductor manufacturing materials in 2019 across the key families used in front-end and back-end manufacturing. SEMI’s Materials Market Data Subscription reports that as of 2021, the semiconductor materials market has expanded to \$64.3 billion in revenue.²² Continued growth is anticipated as semiconductor manufacturing facilities across the globe come online in the coming years.



Given the large and diverse range of materials inputs in the process, there is no single fixed percentage of a facility’s equipment and output that should be considered by CPO for CHIPS grants. However, to ensure that limited funds are used effectively, CPO should require a very significant percentage of a facility to be dedicated to producing materials that are essential for and meet the unique performance specifications of semiconductor manufacturing.

9. Which materials used to produce semiconductors and semiconductor manufacturing equipment are currently produced within the U.S. and which are not? Are there technological or other limitations that currently inhibit production of such materials in the United States? Which materials and equipment, if any, have contributed to production delays or other inventory challenges? Which do you think are most likely to contribute to delays or challenges in the future?

SIA Response: There is a wide range of domestic capabilities across various equipment and materials used in semiconductor manufacturing. The U.S. maintains industry leadership in deposition, etch and clean, testing tools, and other critical areas of the semiconductor manufacturing process. Some areas where domestic capability is relatively low include

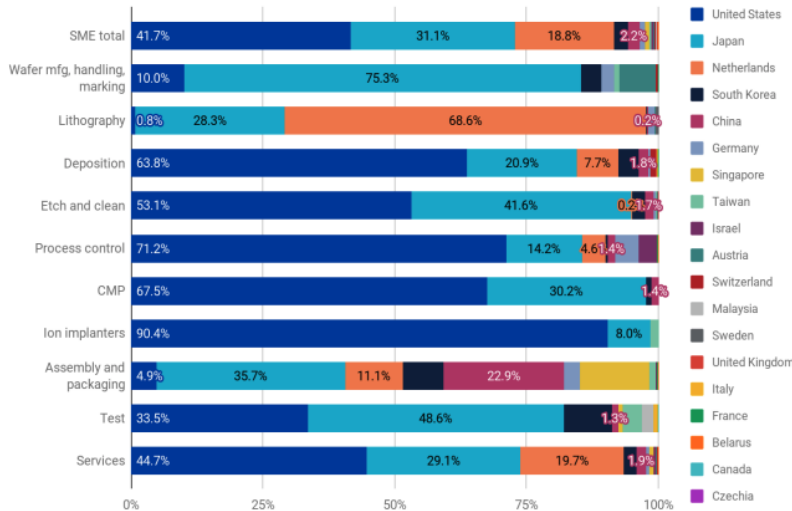
²¹ SIA/BCG Supply Chain Report, at 22.

²² SEMI, [“Global Semiconductor Materials Market Revenue Tops \\$64 Billion in 2021 to Set New Record, SEMI Reports,”](#) March 2022.

lithography tools, assembly and packaging tools, wafer manufacturing tools, raw materials, wafers, photoresist, permanent magnets, advanced optics, and specialized glass components.²³

The breakdown of **semiconductor manufacturing equipment manufacturing** by firm headquarters is below.²⁴ Tooling systems that are used in the etching, deposition, and other process control are primarily produced by U.S. semiconductor equipment manufacturers, widely considered fundamental enablers of the semiconductor industrial base.

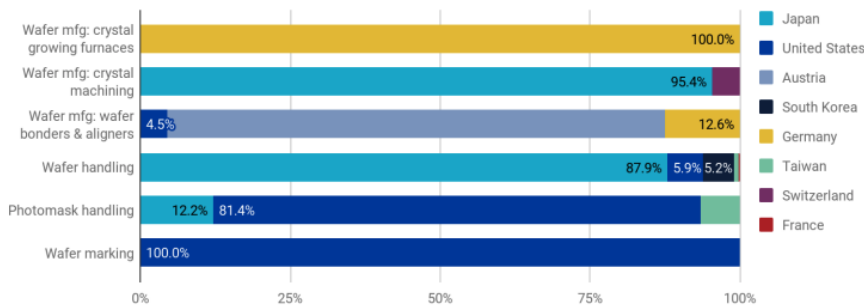
Figure 14: 2019 SME country shares by firm headquarters



Source: VLSI Research

The breakdown of **semiconductor wafer manufacturing, marking, and handling** by firm headquarters is below.²⁵ There is currently a limited number of wafer manufacturing sites in the U.S., particularly at 300mm production.²⁶

Figure 15: 2019 wafer manufacturing, wafer marking, and handling country shares by firm headquarters



Source: VLSI Research

²³ CSET Supply Chain Issue Brief, at 10

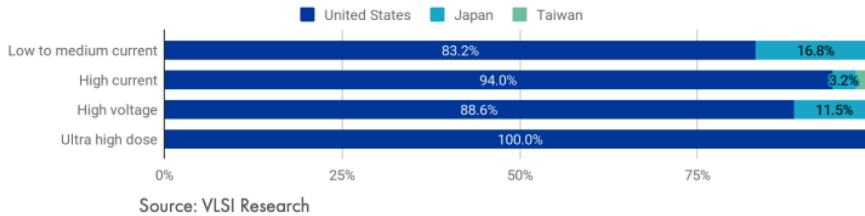
²⁴ CSET Supply Chain Issue Brief, at 26

²⁵ CSET Supply Chain Issue Brief, at 27

²⁶ SIA Supply Chain Public Comment, April 2021, at 33.

The breakdown of **semiconductor ion implanters** by firm headquarters is below.²⁷ While the U.S. has reliance on foreign industry for many pieces of equipment and materials, the U.S. is the world leader in ion implanters.

Figure 16: 2019 ion implanters country shares by firm headquarters



Comments regarding other chemicals and materials:

- Ultra-high purity isopropyl alcohol (UHP IPA) - “UHP IPA is currently being sourced from Taiwan for U.S. fabs.”²⁸
- WF6 – “There is One WF6 manufacturing site in the U.S. owned by Japanese company.”²⁹
- Ultra-pure hydrogen fluoride (UPHF) - “UPHF is another key material used extensively throughout the semiconductor manufacturing process for wet etch and cleaning of semiconductor wafers. One manufacturer of UPHF has a facility in the U.S.”³⁰
- Sputtering targets – “Similarly, sputtering targets are provided by 4 primary suppliers constituting 90% of the market, most of which is outside the US. One manufacturer produces targets for advanced semiconductors in the US.”³¹
- Electronic Polymers – A large portion of the world’s electronic polymers used in photolithography, masking, and spin on dielectric applications in the chip manufacturing process are supplied by companies based outside of the U.S. Three companies make up U.S.-based supply.³²
- Wet chemicals – “The wet chemicals supply-chain (HF, H2SO4, HCL, H2O2, H3PO4, NH4OH) runs extremely lean with such low profits that all chemical manufacturers within N. America have not committed to further expansion, for fear of losing money or they have exited the semiconductor industry. These materials continue to have supply-chain shortages virtually every year for U.S. chip fabs.”³³
- Noble gases - Vulnerabilities in the supply of noble gases such as helium, xenon, krypton, and neon have been and remain a significant concern for the industry. These gases are typically supplied from a limited number of validated sources that are located in areas of geopolitical concern (Russia, Ukraine, Qatar).³⁴

Note that this information is provided in response to the question. SIA’s inclusion of these materials and manufacturing inputs should not be construed as a recommendation for CHIPS investments.

²⁷ CSET Supply Chain Issue Brief, at 29

²⁸ SIA Supply Chain April 2021 Public Comment, citing TECHCET at 33.

²⁹ Ibid.

³⁰ Semiconductor Industry Association, “[Comments of the Semiconductor Industry Association, Re: Notice of Request for Public Comments on Risks in the Semiconductor Supply Chain.](#)” Nov. 2021, at 7; hereafter “SIA Supply Chain November 2021 Public Comment.”

³¹ Ibid.

³² Ibid.

³³ H2O2, H2SO4 and NH4OH are high consumption materials that have to be delivered by trailer tanker trucks. It is not realistic to import these chemicals due to the high volume required. The quality of these bulk materials in particle and metallic contamination are poor compared to that in Asia due to lack of investment to improve production quality.

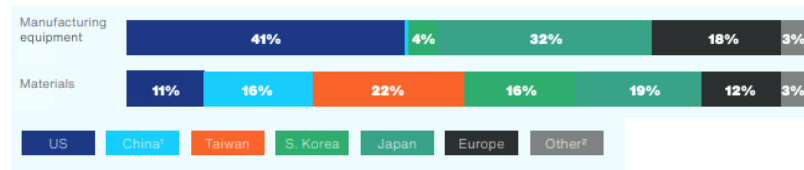
³⁴ SIA Supply Chain April 2021 Public Comment, at 19.

10. How are upstream suppliers concentrated geographically? Are any concentrated in a manner that could constrain the ability to expand semiconductor manufacturing?

SIA Response: There are hundreds of unique materials that are critical to semiconductor manufacturing, and many have concentration risks.³⁵



Upstream suppliers of equipment are generally concentrated within the U.S., Japan, and Europe.³⁶ Upstream suppliers of materials are less geographically concentrated, but it is similarly common for individual companies to have dominating market shares in specific chemicals or individual companies to be the largest suppliers of specific gases or critical minerals.³⁷ The breakdown of equipment-making and materials production by region is below.



There are approximately 50 different types of sophisticated wafer processing and testing equipment used in the semiconductor supply chain.³⁸

Deposition	Lithography	Material removal and cleaning	Process control (metrology and inspection)	Other wafer fabrication equipment	Assembly equipment	Total
RTP and oxidation diffusion	Photoresist processing	Doping equipment	Manufacturing automation	Test and related equipment		
# Equipment types						
12	4	6	1	12	4	16
				2	2+	3
					5	50+

Using a threshold of 65% global market share as a percent of revenues, 23 equipment types are concentrated in the U.S. (e.g., doping, process control), 12 equipment types are concentrated in

³⁵ SIA Supply Chain April 2021 Public Comment, at 20.

³⁶ SIA/BCG Supply Chain Report, at 31.

³⁷ Ibid.

³⁸ SIA/BCG Supply Chain Report, at 20.

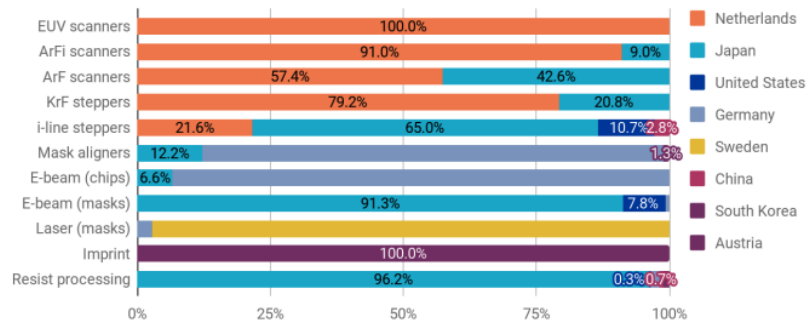
Japan (e.g., photoresist processing), and three equipment types are concentrated in Europe (e.g., EUV lithography).

Using the same 65% threshold, the photoresist market is concentrated in Japan, the silicon wafer and packaging substrates market is concentrated in Japan and Taiwan, and the specialty gases market (in aggregate) is concentrated in Europe. In general, materials like substrates, CMP slurries, EUV and DUV photoresist and blanks are concentrated in East Asia, specifically in Japan.³⁹

Lithography Equipment:

The lithography equipment market is geographically concentrated in Europe and Japan.⁴⁰

Figure 17: 2019 lithography country shares by firm headquarters

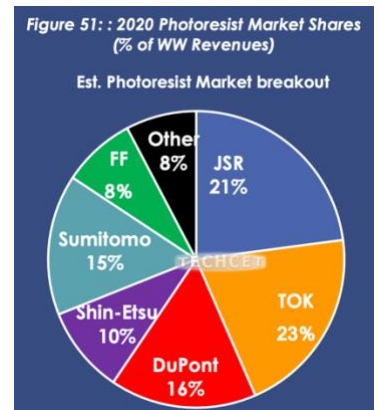


Source: VLSI Research

Photoresist:

Ninety percent of semiconductor photoresist production takes place in Japan, and the U.S. and Korea share the remainder.⁴¹ Many photoresist companies have carved out specific niches where they lead in technology and production competency. The share of production that goes toward semiconductor manufacturing varies by company and material. Examples are listed below.⁴²

- Shin-Etsu makes precoated quartz mask blanks(used in the exposure tool), SiARC and Photoresist
- TOK primarily makes Photoresist, developer and edge bead remover.
- JSR manufactures Bottom Antireflective coatings, rinses developers and Photoresist
- Dupont Printed Circuit board patterning materials, BARC, CMP products, developers and Photoresist
- Fujifilm makes CMP chemicals, cleans, edge bead, and Photoresist
- Merck makes Flat panel Photoresist, cleans, BARC, and TARC



³⁹ Ibid.

⁴⁰ CSET Supply Chain Issue Brief, at 30

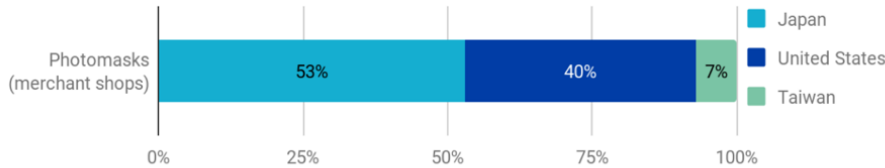
⁴¹ CSET Supply Chain Issue Brief, at 59

⁴² TECHCET, "2021 TECHCET'S Critical Minerals Report: Lithography Materials," 2021, at 119

Photomasks:

While large semiconductor manufacturing companies often have in-house photomask operations, fabless semiconductor firms rely on merchant photomask manufacturers headquartered in Japan, the United States, and Taiwan.⁴³

Figure 31: Merchant mask shop country shares by firm headquarters



Source: CSET estimates based on financial statements

Critical Minerals

Many critical minerals used in U.S. semiconductor manufacturing are exported predominantly by China. The U.S. Geological Survey (USGS) tracks minerals that are critical to the aerospace, defense, energy, telecommunications, and transportation sectors – almost all of these minerals have semiconductor applications to varying degrees. Of the 2018 list of critical minerals, using 2021 data, the U.S. has a net import reliance of more than 70% for 24 minerals, and 100% net import reliance for 11 minerals. China was also the primary import source for 11 critical minerals from 2017-2020.⁴⁴ The below table also reflects the geographic concentration of critical minerals by leading producing country and share of world production total. The Department of Defense supply chain review of critical minerals and materials, as included in the White House 100-day Supply Chain Review, provides additional information.⁴⁵

⁴³ CSET Supply Chain Issue Brief, at 58

⁴⁴ Department of the Interior, U.S. Geological Survey, [“Mineral Commodity Summaries 2022.”](#) Jan. 2022, at 22.

⁴⁵ White House Supply Chain Review, at 151.

Table 4.—Salient Critical Minerals Statistics in 2021¹
(Metric tons, mine production, unless otherwise specified)

Critical mineral	United States				Net import reliance as a percentage of apparent consumption	World				
	Primary production	Secondary production	Apparent consumption	Net import reliance as a percentage of apparent consumption		Primary import source (2017–20)	Leading producing country	Production in leading country	World production total	Percentage of world total
Aluminum (bauxite)	W	—	² 3,600,000	>75		Jamaica	Australia	110,000,000	³ 390,000,000	28
Antimony	—	4,100	⁴ 28,000	84		China	China	60,000	110,000	55
Arsenic	—	—	⁵ 8,800	100		China	Peru	⁶ 27,000	⁶ 59,000	46
Barite	W	—	W	>75		China	China	2,800,000	⁷ 7,300,000	38
Beryllium	170	NA	200	16		Kazakhstan	United States	170	260	65
Bismuth ⁷	—	80	810	90		China	China	16,000	19,000	84
Chromium	—	120,000	590,000	80		South Africa	South Africa	18,000,000	41,000,000	44
Cobalt	700	1,600	6,700	76		Norway	Congo (Kinshasa)	120,000	170,000	71
Fluorspar	NA	—	450,000	100		Mexico	China	5,400,000	8,600,000	63
Gallium	—	—	² 16	100		China	China	420	430	98
Germanium ⁷	—	W	⁵ 30	>50		China	China	95	² 140	68
Graphite (natural)	—	—	45,000	100		China	China	820,000	1,000,000	82
Helium ⁸	71	NA	40	E		Qatar	United States	71	160	44
Indium ⁷	—	NA	⁵ 170	100		China	China	530	920	58
Lithium	W	W	⁶ 2,000	>25		Argentina	Australia	55,000	³ 100,000	55
Magnesium ⁷	W	98,000	² 50,000	<50		Canada	China	800,000	³ 950,000	84
Manganese	—	—	640,000	100		Gabon	South Africa	7,400,000	20,000,000	37
Niobium	—	NA	7,000	100		Brazil	Brazil	66,000	75,000	88
Palladium (platinum-group metal)	14	42	90	37		Russia	South Africa	80	200	40
Platinum (platinum-group metal)	4	7	37	70		South Africa	South Africa	130	180	72
Potash	480,000	—	7,400,000	93		Canada	Canada	14,000,000	46,000,000	30
Rare-earth elements ⁹	43,000	—	¹⁰ 6,100	>90		China	China	168,000	280,000	60
Rhenium	9	NA	32	72		Chile	Chile	29	59	49
Scandium	—	—	NA	100		NA	China	NA	NA	NA
Strontium	—	—	4,800	100		Mexico	Spain	150,000	360,000	42
Tantalum	—	NA	710	100		China	Congo (Kinshasa)	700	2,100	33
Tellurium ⁷	W	—	W	>95		Canada	China	340	⁷ 580	59
Tin	—	10,000	45,000	78		Indonesia	China	91,000	300,000	30
Titanium ⁷	W	W	² W	>90		Japan	China	120,000	³ 210,000	57
Tungsten	—	W	W	>50		China	China	66,000	79,000	84
Vanadium	—	NA	3,600	100		Canada	China	73,000	110,000	66
Zirconium	¹¹ 20,000	—	¹¹ 30,000	<25		South Africa	Australia	400,000	1,200,000	33

E Net exporter. NA Not available. W Withheld to avoid disclosing company proprietary data. — Zero.

¹Critical minerals as published in the Federal Register on May 18, 2018 (83 FR 23295). Not all critical minerals are listed here. Those not shown include mineral commodities for which not enough information is available regarding U.S. or world production. The critical minerals cesium, hafnium, and rubidium are not listed in the table because it is thought there is no U.S. production for these commodities.

²Reported consumption.

³Excludes U.S. production.

⁴Antimony in oxide and unwrought metal, powder.

⁵Estimated consumption.

⁶Arsenic trioxide.

⁷Refinery production.

⁸Million cubic meters.

⁹Data include lanthanides and yttrium but exclude most scandium.

¹⁰Compounds and metals. The United States is a net exporter of mineral concentrates.

¹¹Rounded to one significant digit to avoid disclosing company proprietary data.

Polysilicon

The semiconductor-grade polysilicon employed to make the silicon ingot that is subsequently sliced into wafers must have a purity level greater than 11 nines (99.99999999%), and is provided primarily by four companies – Wacker Chemie (Germany), Hemlock Semiconductor (U.S.), Tokuyama Corporation (Japan), and Mitsubishi Corporation (Japan) – with a combined global market share above 90%.⁴⁶

11. Which materials or equipment critical to semiconductor production are only or predominately available from a single source?

SIA Response: The CSET Emerging Technology Observatory has published a “Semiconductor Supply Chain Explorer” that allows users to assess the geographic concentration of different equipment and materials, as well as to identify any sole source suppliers or sole country suppliers.⁴⁷

12. How do upstream suppliers work with fabs on new facility proposals? What types of agreements or commitments do fabs offer upstream suppliers to co-locate with new construction?

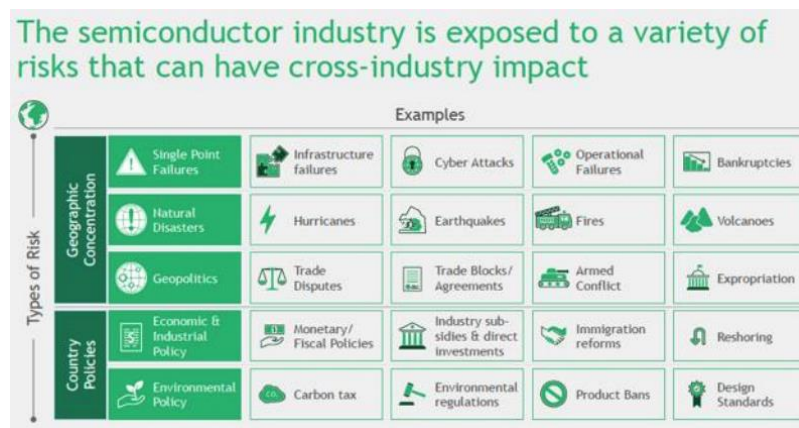
⁴⁶ SIA Supply Chain April 2021 Public Comment, at 8.

⁴⁷ <https://chipexplorer.eto.tech/>

SIA Response: Semiconductor companies typically enter into long-term contracts and agreements and qualify multiple suppliers and production sources to mitigate the risk of supply disruptions and price fluctuations.⁴⁸ Industrial gas suppliers, for example, may also co-locate with fabs to develop on-site plants that provide direct supply lines. For major projects, co-location and/or onsite presence may often be written into the contract with the supplier, vendor, or specialist. Each project, company, and supplier relationship will vary greatly.

13. What have been the biggest supply chain bottlenecks for U.S. semiconductor fabs over the past five years?

SIA Response: Supply chain disruptions and bottlenecks have occurred during times of geopolitical tensions, natural disasters, or other causes. Broadly speaking, there are a number of types of supply chain risks that the semiconductor industry faces that could affect various bottlenecks.⁴⁹



Most significantly, the COVID-19 pandemic caused various disruptions to the semiconductor supply chain, including fab shutdowns, materials and equipment shipping delays, restrictions to the movement of essential manufacturing personnel, and more.

In February 2021, cold weather and surging demand for electricity caused power and ultimately water outages across Texas, forcing closures across factories and stores. Chipmakers, including auto chip makers (NXP Semiconductor, Infineon Technologies AG, and Samsung) were among those forced to shut down production plants in Austin.⁵⁰

In March 2021, a fire broke out at Renesas Electronics' flagship factory in Naka, Japan, damaging 17 plating machines and shutting down production lines that mass-produce 300-mm semiconductor wafers for three months. The company holds nearly 20% of the global market share for microcontrollers used in cars and other machines.⁵¹

Tensions between Japan and Korea in 2019 resulted in export restrictions of key chemicals and equipment from Japan to Korea that had rippling effects on the U.S. industry.⁵²

⁴⁸ SIA Supply Chain Public Comment September 2014, at 7.

⁴⁹ SIA Supply Chain April 2021 Public Comment, at 18.

⁵⁰ Bloomberg, "[Texas power failures shut chip factories, squeezing tight supply.](#)" Feb. 2021.

⁵¹ Nikkei, "[Renasas expects bigger damage from fire at its chip factory.](#)" March 2021.

⁵² USITC, "[The South Korea-Japan Trade Dispute in Context: Semiconductor Manufacturing, Chemicals, and Concentrated Supply Chains.](#)" Oct. 2019.

Intellectual property

14. The CHIPS Act of 2022 requires that applicants submit “policies and procedures to combat cloning, counterfeiting, and relabeling of semiconductors.” Are there standard policies and procedures that companies or industry groups use to achieve this goal? Which industry or publicly defined standards should be used to measure the effectiveness of efforts to combat cloning, counterfeiting, or relabeling?

SIA Response:

The trade in counterfeit and pirated goods threatens America’s innovation economy, the competitiveness of our businesses, the livelihoods of U.S. workers, and, in some cases, national security. To combat the illicit trade of counterfeit chips, most semiconductor companies maintain programs to address counterfeits. These programs generally employ a risk-based analysis, and given the wide variety of types of semiconductors, cost points, and susceptibility to counterfeiting, companies typically employ differing approaches in their programs to minimize the risk of counterfeit semiconductors. Additionally, U.S. Customs and Border Protection (CBP) deploys a comprehensive program to address the importation of these goods. As with CBP programs, rather than taking a one-size-fits-all approach, we recommend that the CHIPS program encourage applicants to describe their risk-based approach, where applicable, to its specific product types and end-markets, including conformance to standards,.

There are existing industry standards⁵³ and federal regulations⁵⁴ relating to combating counterfeit semiconductors for very specific applications, particularly in the national security space. For example, DFARS 252.246-7007I requires companies to act in 12 areas. The DFARS rule below is provided only for completeness as an example for regulations in very limited applications and should not be construed as a recommendation for required guidance.

- 1) Training of personnel;
- 2) Inspection and testing of Electronic Parts;
- 3) Processes to abolish counterfeit parts proliferation;
- 4) Risk-based processes that enable Electronic Part traceability that enables tracking of the supply chain back to the Original Manufacturer whether supplied as electronic parts or contained in assemblies;
- 5) Use of suppliers that are the original manufacturer, sources with the express written authority of the original manufacturer or current design activity, including an authorized aftermarket manufacturer or suppliers that obtain parts exclusively from one or more of these sources.
- 6) Reporting and quarantining of counterfeit electronic parts and suspect electronic parts;
- 7) Methodologies to identify Suspect Counterfeit Parts and to determine if a Suspect Counterfeit Part is counterfeit;
- 8) Design, operation, and maintenance of systems to detect and avoid Counterfeit Electronic Parts and Suspect Counterfeit Electronic Parts;

⁵³ JDEC Solid State Technology Association, “JESD243: Counterfeit Electronic Parts: Non-Proliferation for Manufacturers”; SAE Aerospace Standard AS5553 relating to Counterfeit Electrical, Electronic, and Electromechanical Parts; Avoidance, Detection, Mitigation, and Disposition (“AS5553”).

⁵⁴ Defense Federal Acquisition Regulation Supplement Sections 246.870, 252.246-7007, and 252.246-7008 relating to Detection and Avoidance of Counterfeit Electronic Parts (“DFARS”).

- 9) Flow down of counterfeit detection and avoidance requirements to all subcontractors responsible for buying or selling electronic parts or assemblies containing Electronic Parts;
- 10) Process for keeping continually informed of current counterfeiting information and continuously upgrading internal processes;
- 11) Process for screening GIDEP reports; and
- 12) Control of obsolete Electronic parts.

Expansion clawback

15. The Secretary has authority, in consultation with the Secretary of Defense and the Director of National Intelligence, to define the terms “semiconductor manufacturing” and “semiconductor manufacturing capacity.” To ensure effective limits on manufacturing in foreign countries of concern – while balancing the interests of potential eligible CHIPS applicants that may have existing legacy facilities – what types of activities would need to be included under the scope of these terms? How do industry members define the terms in trade usage?

SIA Response: 15 U.S.C. 4652(a)(6)(B) states the term “semiconductor manufacturing” should be defined by the Secretary of Commerce and “includes front-end semiconductor fabrication.” SIA believes Commerce should ensure the definition of “semiconductor manufacturing” should include front-end fabrication (the most common interpretation of the term “manufacturing,” meaning the process of producing finished wafers at a fab). The definition should exclude other stages in the production process, such as assembly, test, and packaging (ATP) operations.

The Secretary should ensure the expansion clawback provisions are implemented in a manner that avoids unnecessary disruption to existing facilities in China while the U.S. works to diversify and bolster its semiconductor supply chain. Today, China remains an important player in manufacturing, ATP, logistics point, and end-device market for the global semiconductor ecosystem across virtually all segments. Many of these facilities support key products and customers around the world, and as such, disruption to their operations would have a significant negative impact on the firms operating these facilities, as well as the broader electronics ecosystem.

16. What considerations are relevant in determining what memory, analog, packaging, and other technologies should be considered equivalent to 28 nm logic chips?

The CHIPS and Science Act sets forth statutory considerations for the Secretary in making this determination.

SIA recommends the Secretary consult and engage with stakeholders on this question, both through this RFI and as part of the application process. SIA also recommends, consistent with the CHIPS and Science Act, the Secretary initiate a public comment period during the biennial update to the exceptions to the definition of “legacy semiconductor” under the expansion clawback process.

SIA welcomes the opportunity to engage in a deeper dialogue as the Secretary develops these updates.

17. Given the complexities in chipmakers determining where their product might eventually reach its end-use, how can the CPO best enforce the requirement that a proposed investment “predominately serve[s] the market” of the foreign country?

Unlike manufacturers of “ready-to-use” assembled products, semiconductor companies do not typically have comprehensive visibility on the geographic market of end use for their products. This is because they do not sell products directly to consumers but to companies such as original equipment manufacturers (OEMs) and other device integrators, and are often sold and re-sold through a long chain of distributors. This makes it difficult, if not impossible, to follow each product to its ultimate user. Accordingly, the market for the output of semiconductor companies is determined by the demand of these large, downstream producers. In this context, serving the market of a given country means meeting demand in a given country for components to be delivered in that country. As a result, location of product shipment rather than location of end use should be the determining measure for market services. Supply chain investments, including in assembly, test, and packaging operations, have been made to align with the location of shipment.

The Merriam Webster definition of “predominant” is “being most frequent or common.” Similarly, Black’s Law Dictionary defines the term as that which is “greater or superior...to others which it is connected or compared.” CPO should interpret the terms in §4652(a)(6)(C)(ii) with flexibility in order to allow operations vital to maintaining healthy supply chains for semiconductors.

Taxpayer protections

18. The CPO has committed to prioritizing companies that are dedicated to making investments in manufacturing, innovation, and workers. Are there types of investments and/or pre-commitments that data suggest have been most effective in promoting inclusive economic growth for workers and communities?

SIA Response: SIA supports the CPO’s commitment to prioritizing companies that are dedicated to making investments in manufacturing, innovation, and workers. SIA recognizes the success of the industry depends on a skilled workforce.

Investments by the U.S. semiconductor industry generate both direct and indirect benefits to workers and communities, such as expanded job growth for community members and increased opportunities for local businesses and suppliers. The semiconductor industry has a strong track record of developing partnerships with local and regional educational institutions, for both primary and secondary education, as part of efforts to promote inclusive economic growth.

Many semiconductor companies have charitable foundations that engage with communities and provide financial contributions toward community resources. Similarly, as part of company Environmental, Social, and Governance (ESG) goals, the semiconductor industry has made widespread commitments to inclusive economic growth. SIA recommends the CPO request information about companies’ efforts and proposed initiatives to support inclusive economic growth. However, the CPO should not require a pre-defined, limited set of specific actions by applicants, as inclusive economic growth can involve a wide range of activities. Academics and think tanks may be able to provide the CPO with more information about data-based approaches to inclusive economic growth by employers.

In general, investments in semiconductor manufacturing are tied to economy-wide job impacts. On average, the U.S. semiconductor industry has a job multiplier effect of 6.7, meaning that one

direct job created in the industry creates an additional 5.7 indirect and induced jobs. This 6.7 job multiplier ranks the semiconductor manufacturing industry second across all industries, tied with aircraft manufacturing and behind computer storage device manufacturing. Some of these indirect and induced jobs may be found in sectors such as education and health services; leisure and hospitality; natural resources and mining; construction; manufacturing; trade, transportation, and utilities; publishing, telecommunications, data processing, and information services; financial activities; professional and business services; government; and other services. As of 2020, the U.S. semiconductor industry directly employed an estimated 277,000 workers, with another 1.5 million workers indirectly employed or induced. This is evidence of the broad-based economic growth and opportunity associated with semiconductor manufacturing projects.

The semiconductor industry has a diverse workforce across race and ethnicity, especially when compared to the overall manufacturing sector and all other U.S. industries. Approximately 48 percent of the semiconductor workforce was non-white in 2019, compared to 36 percent of manufacturing industries and 39 percent of all other industries.⁵⁵ The semiconductor industry actively recruits workers from historically underrepresented groups, and many companies manage strategies to enhance diversity and inclusion.

As the CPO is aware, the CHIPS and Science Act’s Davis-Bacon provision requires the payment of prevailing wages for facilities built with CHIPS funding, supporting the hiring of union labor or other workers at prevailing wages.

19. The CPO intends to preference companies which commit not to engage in stock buybacks with non-CHIPS funds. What terms and length should the CPO seek in such a commitment and should the commitment extend to any forms of capital distribution beyond buybacks? What types of existing buyback programs or programs tailored to prevent dilution from the award of employee stock compensation exist within the industry?

SIA Response: Section 102(g) of the CHIPS and Science Act prohibits recipients of CHIPS funds from using such funds from the CHIPS program for stock buybacks. As stated in the CHIPS strategy document, “private sector recipients [of CHIPS funds] cannot use any public funds on stock buybacks or dividend payments to shareholders.”⁵⁶ Accordingly, a preference for companies who do not engage in stock buybacks with non-CHIPS funds goes far beyond the requirements of the CHIPS Act and interferes with companies’ strategies to compete in capital markets and to manage capital strategies to meet business requirements.

Commerce’s proposal to prohibit all stock buybacks by companies receiving CHIPS grants is inconsistent with the clear intent of Congress. Efforts in the Senate to impose restrictions on companies who received grant dollars from repurchasing equity securities with grant and non-grant dollars twice failed. The first attempt was as an amendment to the NDAA that would have, among other restrictions, prohibited grant recipients from repurchasing equity securities with even non-grant dollars, but this amendment was excluded from those considered for a vote. The second attempt was a Motion to Instruct conferees to include provisions that, among other prohibitions, would ban grantees from re-purchasing stock even with non-grant funds. The Senate rejected that effort 87-6. In the House, the original amendment offered during the conference would have prohibited grant recipients from engaging in stock buybacks, but this

⁵⁵ SIA/Oxford Economics Chipping In, at 14.

⁵⁶ CHIPS strategy document, at 13, emphasis added

language was modified to restrict grant recipients solely from using public funds for this purpose. To extend the prohibition to non-grant dollars would be contrary to Congressional intent, in addition to being an unprecedented restriction on the use of private capital.

Imposing restrictions on companies repurchasing their stock would pose harm to shareholders, many of whom are employees and their families, and the competitive position of U.S. companies. Companies are in the best position to determine when, whether, and how to return value to their shareholders, whether through dividends (a fixed commitment) or stock buybacks (a more flexible tool). Companies have a fiduciary responsibility to act in the best interests of their shareholders. Responsible and disciplined capital deployment and capital return are parts of a healthy and vibrant semiconductor industry. Repurchases specifically are generally part of that responsible capital return to help offset shareholder dilution from employee compensation and to return capital in a more variable and lower risk way than dividends, for example.

CHIPS Act provisions already mandate that companies do not use public funds for buybacks, dividends, or purposes other than for which they are awarded. In exceeding the legislation's scope, Commerce would be intervening in companies' ability to best operate their businesses in the interest of all their stakeholders and compete in capital markets. In general, SIA believes that the practice of using stock buybacks is best left to internal company decisions as they seek to benefit investors, reduce volatility, mitigate uncertainty and price pressures, consider stock acquisitions, reward employee-shareholders and their families, recruit talent through stock compensation, and have greater liquidity for expansion projects like those the CHIPS Act aims to incentivize.⁵⁷

20. Should the CPO consider companies' existing capital allocation strategies in formulating the standards it will apply to its evaluation of stock buybacks and the payment of dividends, and if so, how?

SIA Response: The focus of the CPO should be on how to use CHIPS funds to advance the goals of the CHIPS Act: to strengthen the U.S. economy, national security, technology leadership, and supply chain resilience through investments in the semiconductor ecosystem, especially manufacturing, R&D, and other capital expenditures. Capital allocation involves investing in the business, servicing debt obligations, mergers and acquisitions, and shareholder return, among many considerations. The CPO should evaluate projects based on how they advance the goals of the CHIPS Act, and assessing matters such as a company's "capital allocation strategies" related to stock buybacks and payment of dividends should not be part of the analysis. Instead, the CPO should work with companies to document reasonable tracking and audit procedures that will provide robust and essential taxpayer protection without attempting to invent novel, untested compliance and monitoring frameworks.

Opportunity and Inclusion

21. What are the primary barriers to entry for individuals from underserved communities seeking employment in the industry, including economically disadvantaged individuals, women, people of color, veterans, disabled individuals, people without college degrees, and people in rural communities? Do the barriers differ by job type? By community? By geography?

⁵⁷ U.S. Chamber of Commerce, "[Corporate Liquidity Provision and Share Repurchase Programs](#)," September 2021.

SIA Response: Like many sectors, the semiconductor industry has faced challenges in reflecting and benefiting from the full diversity of our country. Barriers can differ by job type, geography, and community, but often center on the need to provide greater access to vocational and technical training, a long-term commitment to a national science, technology, engineering, and mathematics (STEM) education investment, and concerted focus on the development of a microelectronics pipeline. K-12 and community and technical colleges face challenges of hiring qualified faculty to teach courses that support the skill development needed for semiconductor manufacturing. Access to qualified faculty limits program offerings in low socioeconomic regions.

In general, as the U.S. semiconductor industry grows, there are likely going to be more job openings than available qualified workers. Through partnerships with local universities, community colleges, and technical and vocational programs, the semiconductor industry can support recruitment and training efforts throughout different education levels and skills needs. Ensuring that potential students and workers choose to engage with semiconductor programs is going to be one of the key barriers to overcome in the coming years. Industry, along with Federal, state, and local governments, must create awareness, understanding, and ultimately attract new talent pools who likely would overlook the U.S. semiconductor industry as an employment destination.

There is also a need for funding to expand lab space for technical courses needed to develop semiconductor manufacturing talent nationally. Many of the grants in the last several years limit spending on equipment needed to effectively prepare candidates for semiconductor jobs.

Another barrier to entry for some is a lack of a semiconductor presence in a given geography. While the semiconductor industry has historically developed in clusters, there have been recent efforts to expand the geographies involved in semiconductor manufacturing and the broader supply chain.

Industry leaders are working to overcome this challenge through programs and initiatives to recruit, retain, and promote a more diverse and inclusive workforce. Additionally, the ability to recruit and retain highly educated foreign-born professionals – particularly after they graduate from a U.S. university – is an important complement to domestic sources of talent. Industry examples can be found in SIA/Oxford Economics’s “Chipping In” report, such as scholarships, diversity recruitment programs, Historically Black Colleges and Universities (HBCU) partnership programs, and STEM education programs.⁵⁸

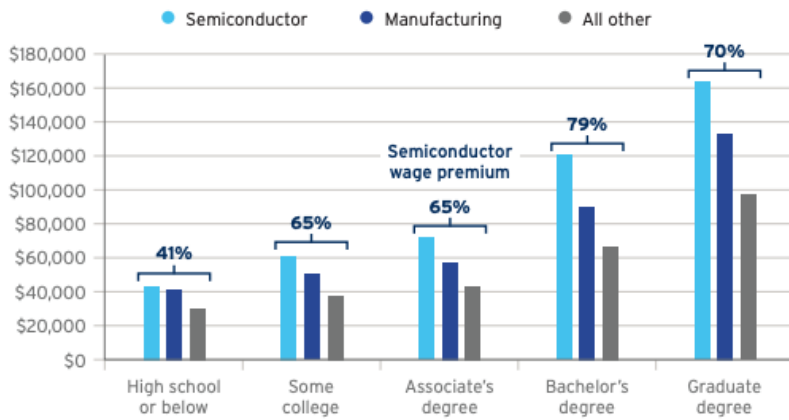
22. What policies have been successful in ensuring that job opportunities are good quality and available to and filled by a diverse pool of workers? Does industry currently offer wrap-around services to employees: childcare, paid leave, transportation, etc.?

SIA Response: From the current workforce, the biggest obstacles to acquiring and retaining talent include competition with other tech companies/sectors, a lack of awareness of the industry, salary and benefits, and finding students with correct training and skills. As such, companies employ a host of recruitment mechanisms, including wraparound services and strong salaries. Although an above-average salary is only one consideration of a good quality job opportunity, the figure below demonstrates that the semiconductor industry, across all

⁵⁸ SIA/Oxford Economics Chipping In

educational levels, pays its workers a wage premium compared to the broader manufacturing sector and all U.S. industries.⁵⁹

FIG. 13: Educational wage premium in the semiconductor industry



Source: ACS 2019, Oxford Economics tabulations

Because the demand for highly skilled talent regularly outstrips the supply of U.S. STEM graduates, the U.S. semiconductor industry also reinvests significantly in their current workforce to maintain and up-level their skills. Industry examples of these activities can be found in SIA/Oxford Economics’s “Chipping In” report, such as educational assistance programs, upskilling tuition reimbursement programs, internship programs, and vocational training programs.

23. What actions can industry take to promote diversity, equity, and inclusion in the projects that receive CHIPS incentives? What actions is industry already taking to promote diversity, equity, and inclusion? In responding, please consider inclusion broadly, such as women, people of color, veterans, disabled individuals, people without college degrees, and people in rural communities.

SIA Response: The semiconductor industry recognizes the value of a diverse and inclusive workforce and is constantly working to diversify its workforce, leveraging support for both underrepresented professionals and students, including women and people of color, pursuing STEM degrees. Companies have deep and longstanding partnerships with two and four year institutions in regions where they operate. Through partnerships with NSF and the Semiconductor Research Corporation (SRC), companies regularly funds research and education programs across the country. Additionally, companies partnerships with HBCUs and Tribal Institutions work to increase student participation in microelectronics fields.

24. What policies have proven effective in providing opportunities for small and underrepresented businesses including minority-owned, women-owned and veteran- owned businesses and rural businesses. Which tactics are most effective in creating opportunities in fab construction? The production supply chain? R&D?

⁵⁹ SIA/Oxford Economics Chipping In, at 16.

SIA Response: There are a variety of efforts that companies may implement that prove effective in creating opportunities in fab construction, the supply chain, R&D, etc. For example, some companies may have a supplier diversity program. Companies may also encourage supplier diversity through engagement with diversity council memberships. Internal corporate awareness of diversity efforts and emphasizing diversity with companies is also a frequent successful effort. For fab construction, in particular, companies can include minority- and women-owned requirements in the contracts with the main contractor.

Some other best practices may include:

- Establish dedicated employee or office to drive initiatives within procurement related to environment, ethics, diversity, etc. that liaises with other internal stakeholders, such as operations, legal, treasury, sales, EHS, etc. on these topics
- Require multiple bids on certain contract types/values in order to widen opportunities for suppliers
- Allow for flexible payment terms
- Collaborate with local associations that promote corporate spending with small, minority, and diverse businesses (e.g., chambers of commerce, business development/enterprise groups, etc.)
- Offer seminars to relevant groups on how to respond to the company's requests for proposal

25. What actions can the CPO take to ensure that the implementation of the CHIPS incentive programs is equitable and inclusive?

The CPO can and should encourage projects that commit to engaging with local educational institutions, from K-12 to higher education. The CPO should support applications that commit to recruiting a talented and diverse workforce at all skill levels, for the near and long term. However, the CPO should not mandate any specific actions regarding equity and inclusion beyond those in the statute.

Other

26. What other information should inform the CPO's implementation of the CHIPS incentive programs?

SIA Response: In addition to the considerations included in the introduction to the SIA RFI response, the CPO should consider the following:

1. Covered state and local incentives_– The CPO should take an expansive approach when determining what meets the statutory requirement of a covered incentive from a state or local entity. A wide range of allowable incentives will support applicants in proposing projects and expansions in a greater diversity of geographies. For example, the Commerce Department should clarify that a property tax incentive received by an applicant through a lease agreement (specifically, a Triple Net Lease where the lessee is responsible for paying the lessor's taxes on the property) qualifies as a covered incentive from a local government. Such inclusion would be particularly important in low-tax states where a property tax exemption may be among the few options offered as targeted tax incentives. While fabs are generally owned, some stages of manufacturing equipment or materials might be performed in a building that was previously a commercial or office building and available by lease.

2. In addition to improving resilience of domestic supply chains for existing electronics products, increased semiconductor manufacturing as a result of the CHIPS incentive program will support the growth of robust domestic supply chains for novel (non-silicon) semiconductor technologies that will enable future electronics products, as well as encouraging sustainability in semiconductor manufacturing through innovation in energy and water consumption, waste reclamation, and carbon emission reductions.

27. What data will be important for the agency to collect to build evidence on the effectiveness of the CHIPS program? What are potential data sources?

SIA Response: CPO should track projects from companies on planned expansion of operations, including new fabs and the expansion of existing fabs, as well as investments by makers of semiconductor manufacturing equipment and semiconductor materials.

By SIA's analysis (Appendix A), companies in the semiconductor ecosystem have already committed \$170 billion to new projects across America, creating an estimated more than 200,000 direct, indirect, or induced⁶⁰ jobs throughout the U.S. economy, including 37,000 new jobs in the semiconductor ecosystem alone at facilities for semiconductor manufacturing, semiconductor manufacturing equipment, and semiconductor materials. This level of investment greatly exceeds the amount of the CHIPS funding, and the passage of the funding for the CHIPS Act will likely result in even more announced projects, resulting in billions of dollars of further private investment and tens of thousands of new jobs. These announcements indicate the CHIPS funding and the ITC are already achieving their intended goal: to leverage federal incentives level the playing field and to attract private sector investment to rebuild the semiconductor ecosystem in the U.S.

Moreover, the U.S. share of semiconductor manufacturing, both in general and within specific technologies, will be an important metric of effectiveness. The U.S. share of global manufacturing capacity was 37 percent in 1990, declined to 12 percent by 2020, and prior to implementation of the CHIPS Act, was expected to further fall to 10 percent by 2030.⁶¹ As facilities go online and U.S. manufacturing capacity grows over the lifetime of the program, it will be valuable to understand what share the U.S. holds in relation to its global peers.

The Bureau of Labor Statistics annually reports job data at the state and county level for NAICS Code 334413, Semiconductor and Related Device Manufacturing. This data will provide information about job creation and annual wage impact.

Another key data metric may include total semiconductor exports and semiconductor exports as a share of total exports, which will provide information on the rate of increase in semiconductor manufacturing year over year. The World Semiconductor Trade Statistics (WSTS)⁶² is the semiconductor industry's standard for semiconductor market data. The WSTS data provides monthly semiconductor sales by value, volume, and average selling price. It allows customers to track monthly trends in semiconductor sales for hundreds of semiconductor sub-products for all

⁶⁰ The semiconductor industry has a job multiplier of 6.7, meaning that nearly 6 jobs are indirectly created for every job added in the semiconductor industry. Semiconductor Industry Association & Oxford Economics, "[Chipping In: The positive impact of the semiconductor industry on the American workforce and how federal industry incentives will increase domestic jobs.](#)" May 2021, at 10 (hereafter "SIA/Oxford Economics Chipping In")

⁶¹ Semiconductor Industry Association & Boston Consulting Group, "[Government Incentives and US Competitiveness in Semiconductor Manufacturing.](#)" September 2020, at 7.

⁶² WSTS.org

major end markets into all major country markets. The semiconductor industry has been running this sales tracking function since 1976, so it has gained significant experience and established a strong track record on tracking industry performance. The data is primary source data provided monthly by semiconductor companies themselves and aggregated so no individual company data is disclosed. SIA can provide more detail on the value of the WSTS data, the specific sales and market data collected through the WSTS program, and how the data collection program works. The WSTS data allow for the comparison of U.S. semiconductor output in relation to global competitors, both broadly and for specific technologies.

The CHIPS Act incentives are designed to drive long term U.S. semiconductor competitiveness. Fluctuations in the economy, changing demand due to unforeseen circumstances whether natural or geopolitical, could have near term impacts on industry growth, production and employment. Any assessment should consider these factors and look to the longer-term view of whether the investments are creating the desired ecosystem, supply chain security, and economic resiliency that are key objectives of the law.

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SIA appreciates the opportunity to provide input to the CPO and looks forward to further engagement to advance the success of the CHIPS incentive program.

Appendix A – Semiconductor Supply Chain Announced Investments

A list of announced projects, as of Nov. 14 2022, is set forth below. This list, compiled by SIA primarily from public information, is not comprehensive. This list is provided purely as a demonstration of the substantial total investments** announced during the period since initial consideration of U.S. government incentives for U.S. chipmaking. This list should not be construed as an endorsement of the project for CHIPS funding, nor as concrete linkage between specific projects and CHIPS funding to the CPO. The list also includes announcements of semiconductor manufacturing facilities, as well as announcements from makers of semiconductor manufacturing equipment and semiconductor manufacturing materials. The projects listed are likely to be currently at different stages of commitment, planning, and construction; some announcements refer to specific projects and others refer to lifetime investment projections at the site.

Semiconductor Facilities

State	Company Name	City/ County	Investment	Investment Type	Employment (Direct)	Source
Arizona	Intel	Chandler (2 fabs)	\$20 billion	New	3000 (2 fabs)	Link
	TSMC	Phoenix	\$12 billion	New	2000	Link
California	Western Digital	Fremont/ San Jose	\$350 million	Expansion	240	
Florida	SkyWater	Osceola County	\$36.5 million	Expansion	220	Link
Idaho	Micron	Boise	\$15 billion (through 2030)	New	2000	Link
Indiana	SkyWater	West Lafayette	\$1.8 billion	New	750	Link
Kansas	Radiation Detection Technologies	Manhattan	\$4 million	Expansion	30	Link
New Mexico	Intel	Rio Rancho	\$3.5 billion	Expansion	700	Link
New York	Micron	Clay	\$20 billion (up to \$100 billion over 20 years)	New	9000 (4 fabs)	Link
	Global Foundries	Malta	\$1 billion	Expansion	1000	Link
North Carolina	Wolfspeed	Chatham County	\$5 billion (over 10 years)	New	1800	Link
Ohio	Intel	New Albany (2 fabs)	\$20 billion (up to \$100 billion over 10 years)	New	3000 (2 fabs)	Link
Oregon	Analog Devices	Beaverton	\$1 billion	Expansion	280	
	Rogue Valley Microdevices	Medford	\$44 million	New	Unknown	Gartner Fab Database

Texas	Samsung	Taylor	\$17 billion	New	2000	Link
	Texas Instruments	Sherman (4 fabs)	\$30 billion (through 2030)	New	3000 (for 4 fabs)	Link
	Texas Instruments	Richardson	\$6 billion	Expansion	800	
	NXP	Austin/TBD	\$2.6 billion	Expansion	800	Link
Utah	Texas Instruments	Lehi	\$3 billion	Expansion	1100	
TBD	Microchip	TBD	\$3 billion	New	650	Link
TOTAL			\$161 billion (up to \$321 billion)		32,370 jobs	

Equipment & Suppliers

State	Company Name	City/ County	Investment	Material	Investment Type	Employment (Direct)	Source
Arizona	Linde	Phoenix	\$600 million	Gas	New	Unknown	Link
	Sunlit Chemical	Phoenix	\$100 million	Chemical	New	Unknown	Link
	Air Liquide	Phoenix	\$60 million	Gas	New	Unknown	Link
	Kanto/ Chemtrade Joint Venture	Casa Grande	\$175-250 million	Chemical	New	Unknown	Link
	Chang Chun Group	Casa Grande	\$400 million	Chemical	New	209	Link
	LCY Chemical	Casa Grande	\$100 million	Chemical	New	57	Link
	Solvay	Casa Grande	\$60 million	Chemical	New	30	Link
	Fujifilm Electronic Materials	Mesa	\$88 million	Chemical	Expansion/ R&D lab	120	Link
	JX Nippon Mining & Metal	Mesa	Unknown	Metals	New	100	Link
	EMD Electronics	Chandler	\$28 million	Equipment	New	Unknown	Link
	Edwards Vacuum	Chandler	Unknown	Vacuum	New	200	Link
	Yield Engineering Systems	Chandler	Unknown	Equipment	New	100	Link
Connecticut	ASML	Wilton	\$200 million	Equipment	Expansion	1000	Link
Georgia	Absolics	Covington	\$600 million	Substrates	New	400	Link
Michigan	Hemlock Semiconductor	Thomas Township	\$375 million	Materials	Expansion	170	Link
	SK Siltron CSS	Bay City	\$300 million	Wafers	Expansion	150	Link

New York	Edwards Vacuum	Genesee County	\$319 million	Vacuum	New	600	Link
	Corning	Monroe County	\$139 million	Substrates	Expansion	270	Link
Oregon	Mitsubishi Gas Chemicals	TBD	\$372 million	Chemicals	Expansion/ New Facility	Unknown	Link
Texas	Global Wafers	Sherman	\$5 billion	Wafers	New	1500	Link
TOTAL			\$9 billion			5,100 jobs	

** Direct employment at facility listed; not inclusive of construction jobs, or jobs created through contractors, suppliers, service providers, and other entities.