Testimony of the Semiconductor Industry Association (SIA)

House Permanent Select Committee on Intelligence
Subcommittee on Strategic Technology and Advanced Research

"Microelectronics: What are the Keys, Tools, and Levers for Promoting Security and Innovation in Microelectronics for the Intelligence Community?"

July 20, 2021

The Semiconductor Industry Association (SIA) welcomes the opportunity to provide testimony on the topic, "Microelectronics: What are the Keys, Tools, and Levers for Promoting Security and Innovation in Microelectronics for the Intelligence Community?"

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 electronic technologies – power incredible products and services that have transformed our lives and our economy. SIA represents 98% of the U.S. semiconductor industry by revenue and nearly two-thirds of non-U.S. chip firms. More information about SIA and the industry is available at www.semiconductors.org.

I. Background on Semiconductors and the U.S. Semiconductor Industry

Semiconductors have driven transformative advances in nearly every modern technology, from computers to mobile phones to the Internet itself, and they play a critical role in innovations in automobiles, medical devices, manufacturing, energy production, and other key areas of our economy and society. Chips also will underpin advances in the "must-win" technologies of the future, including artificial intelligence (AI), quantum computing, and advanced wireless networks (5G/6G). Continued U.S. leadership in semiconductor technology and an assured supply chain with a strong domestic base is critical to our future.

The semiconductor industry directly employs 277,000 workers in the United States and indirectly supports 1.85 million jobs.[1] U.S. semiconductor company sales totaled $208 billion in 2020. Semiconductors are America's fourth largest export, amounting to $49 billion in 2020, behind only airplanes, refined oil, and crude oil.[2]

As stated in the recent White House report on the semiconductor supply chain issued in accordance with Executive Order 14017, semiconductors are essential to the U.S. economy and national security:

> The semiconductor-based integrated circuit is the "DNA" of technology and has transformed essentially all segments of the economy, from agriculture and transportation to healthcare, telecommunications, and the Internet. The semiconductor industry is a major engine for U.S. economic growth and job

[1] SIA and Oxford Economics, "*Chipping in: the U.S. Semiconductor Industry Workforce and How Federal Incentives will Increase Domestic Jobs*," May 2021, page 4: https://www.semiconductors.org/wp-content/uploads/2021/05/SIA-Impact_May2021-FINAL-May-19-2021_2.pdf.
[2] SIA, "*2021 Annual SIA Factbook*," May 2021, slide 9, and official U.S. government trade statistics, U.S. International Trade Commission, accessed from the USITC Dataweb, https://dataweb.usitc.gov/.

creation. Semiconductors are used in virtually every technology product and underpin state-of-the-art military systems. [3]

A. Key Factors in U.S. Semiconductor Industry Leadership

U.S. companies have for decades led the world in producing these tiny chips that power modern technologies. Our country's leadership in semiconductors is a big reason America has the world's largest economy and most advanced technologies. This leadership is due to a range of factors, including very high levels of investment in research and development (R&D) by both the U.S. government in the early years of the industry, and by large manufacturers in the later years, including significant capital expenditure (capex) sustained by access to global markets and the ability to leverage a complex global supply chain and the best talent in the world.

- High research intensity – Leadership in semiconductor technology requires massive investments in research and development to develop new architectures and designs, new process technologies, and use new materials. On average, U.S. semiconductor companies invest 18.6 percent of revenue into R&D in 2020, among the highest of any industry sector (second only to the U.S. pharmaceuticals & biotechnology industry in terms of the rate of R&D spending as a percent of sales). In 2020 the U.S. semiconductor industry invested a record $44 billion in R&D, and most of this R&D is conducted in the United States. While global competitors are increasing their R&D investments to compete with the U.S. industry, American firms spend more on R&D as a percent of sales than any other country's semiconductor industry.[4]
- High levels of capital investment – Semiconductor fabrication facilities ("fabs") require very high levels of capital investment. For example, a state-of-the-art logic fab can cost $15-20 billion to build and operate. To remain competitive, companies manufacturing semiconductors must continually invest in new plants and equipment to keep pace with technological changes and more advanced process technology. The ability to produce state-of-the-art semiconductor components can only be maintained through a continual commitment to keeping pace with industry-wide investment rates of roughly 30 percent of sales.[5]
- Access to global markets to provide scale – Access to global markets is essential to the semiconductor industry's success and maintain high levels of investment in research and capital expenditures. Semiconductors are America's fourth-largest export, contributing positively to America's trade balance for the past 20 years, and more than 80 percent of revenues of U.S. semiconductor companies are from sales overseas.[6] The revenue generated from global sales creates a virtuous cycle of innovation, as revenue from global sales sustains the high levels of research investment and capital investment needed to remain competitive.
- Leveraging a complex global supply chain – The U.S. semiconductor industry relies on deep global supply chains to create value, drive innovation, and reduce costs. The need for deep technical know-how and scale to design and manufacture chips has resulted in a highly specialized global value chain in which different regions and countries excel at

[3] A Report by the White House, "Building Resilient Supply Chains, Revitalizing American Manufacturing, and Fostering Broad-Based Growth: 100-Day Reviews under Executive Order 14017" at p. 21, available at https://www.whitehouse.gov/wp-content/uploads/2021/06/100-day-supply-chain-review-report.pdf.

[4] Semiconductor Industry Association (SIA), "*2021 Annual SIA Factbook*," May 2021, slides 20-21.

[5] Semiconductor Industry Association (SIA), "*2021 Annual SIA Factbook*," May 2021, slide 16. For more information and data on U.S. semiconductor industry R&D and capex investment trends, please see Section 3 of the "*2021 Annual SIA Factbook."*

[6] SIA, "*2021 Annual SIA Factbook*," May 2021, slide 9. For more information and data on semiconductor trade please also see the *"2020 SIA State of the Industry Report,"* July 2020: https://www.semiconductors.org/2020-state-of-the-u-s-semiconductor-industry/.

performing different roles according to their comparative advantages. Countries are interdependent in this integrated global value chain, relying on free trade to move materials, equipment, IP, and products around the world to the optimal location for performing each activity.

- Access to top talent – The industry relies on attracting and retaining top talent from around the world, particularly in technical fields such as electrical engineering, materials science, computer science, chemistry, and physics.

But this virtuous cycle starts with sales market share leadership. By maintaining a sales market share leadership, the U.S. semiconductor industry can reinvest a higher amount of revenue back into R&D, which in turn enables it to develop more innovative and cutting-edge products that consumers demand.

B. Importance of Semiconductor Technology to National Security

Semiconductors are critical to our country's ability to collect, store, and analyze intelligence and to communicate securely. Semiconductors enable the communication systems, satellites, advanced imaging equipment, high performance computers, and other applications needed for our country gain and analyze information, communicate securely, and develop the cybersecurity systems needed to protect our own security and critical infrastructure. Semiconductors also underpin the race for emerging technologies like 5G, quantum computing and artificial intelligence that will drive future innovation in national security.

The Pentagon's industrial policy report issued earlier this year highlights the importance of semiconductors to the economy and national security:

> Microelectronics are critical to producing and maintaining existing military systems, for advancing emerging technologies like AI, 5G, and quantum computing, and for sustaining critical infrastructure and indeed, our entire modern economy. Microelectronics are in nearly everything, including the most complex weapons the Department of Defense buys, such as Aegis warships, the F-35 joint strike fighter, soldier systems, and our nuclear weapons and their command-and-control – which together form the backbone of our national defense. [7]

In April 2021, a number of national security experts, including former leaders of the CIA, NSA, and other key agencies, wrote President Biden urging Congress and the Administration to prioritize domestic research, investment, and manufacturing incentives for key technology areas such as semiconductors as a means of revitalizing national and economic security and strengthening U.S. supply chain resilience.[8]

[7] OSD A&S Industrial Policy, "Fiscal Year 2020 Industrial Capabilities: Report to Congress" (Jan. 2021) available at https://www.businessdefense.gov/Portals/51/USA002573-20%20ICR_2020_Web.pdf?ver=o3D76uGwxcg0n0Yxvd5k-Q%3d%3d.

[8] Letter to the President (April 13, 2021) available at https://www.semiconductors.org/wp-content/uploads/2021/04/2021.04.13-National-Security-Letter.pdf

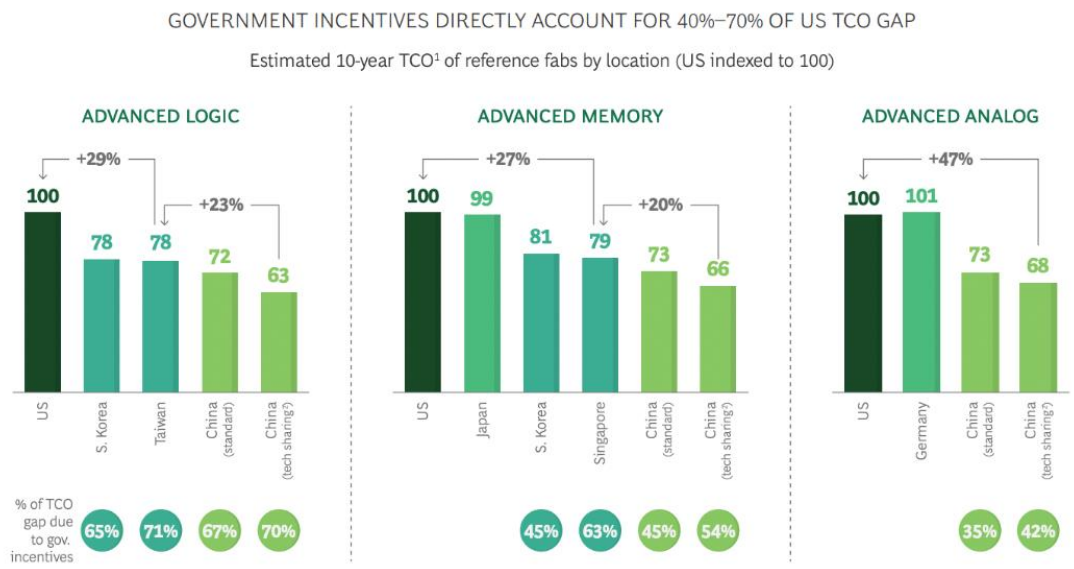
II. Key Challenges Facing U.S. Semiconductor Leadership

A. Global Competitors are Investing Heavily

Multiple governments across the world have been reassessing their positions across the semiconductor value chain and rolling out new national industrial policies and significant investments for semiconductor manufacturing and R&D within their borders. In the past several years, China, Korea, and the EU – all major players in the semiconductor industry – have announced the potential for up to $250 billion in government investments over the next decade dedicated to the semiconductor industry. To date, the U.S. has failed to implement a strategy to address this challenge.

Global competitors around the world offer generous subsidies in the form of grants, tax incentives, construction of infrastructure, and other support for domestic semiconductor investments. As a result, the total cost of ownership (TCO) to build and operate a fab in the U.S. is higher than other countries.

Exhibit 7 - TCO of US-Based Fabs Is 25%–50% Higher than in Other Locations



Source: BCG analysis.

While the U.S. semiconductor industry has long been the global semiconductor leader, consistently accounting for 45% to 50% of global revenues and maintains a stable chip manufacturing footprint, the trend lines are concerning. There are commercial fabs in 18 states, and semiconductors rank as our nation's fourth-largest export. But the US share of semiconductor manufacturing capacity, which was 37% in 1990, has dropped to 12% today. We anticipate this trend will continue downward to 2030 despite an increase in global demand for semiconductors of 50% in that same time frame. Our inability to capture semiconductor manufacturing share while demand is growing rapidly is attributable to significant subsidies provided by every other semiconductor producing nation.

The following is a brief summary of the initiatives offered in several countries to attract investment in the semiconductor industry.

- South Korea: On May 12, 2021, South Korean President Moon Jae-in unveiled a new national semiconductor industrial policy aimed at securing the country's leading position in chips by 2030. Named the "K-Belt Semiconductor Strategy" due to its focus on geographic clusters, the plan includes generous tax credits of up to 50% for R&D and 16% for manufacturing, $886 million USD in long-term loans, $1.3 billion in federal R&D investments, eased regulations, and upgraded infrastructure. SIA estimates these new tax breaks for Korean chip firms could amount to nearly $55-$65 billion in incentives over the next three years. Citing U.S. and Chinese efforts to double-down on their chip industries, President Moon stressed that Korea "needs pre-emptive investments to lead the global supply chain to make this opportunity ours."
- European Union: The European Commission and its member states have been taking concrete steps to strengthen Europe's "strategic autonomy" in semiconductors, including plans to allocate up to 35 billion euros to boost the EU's advanced semiconductor production capabilities. In March 2021, the EU unveiled the "2030 Digital Compass Initiative," which explicitly set a goal of increasing the EU's share of global chip manufacturing to 20% by 2030, up from below 10% today. The initiative highlights the significant gaps in the EU for "state-of-the-art fabrication technologies and in chip design, exposing Europe to a number of vulnerabilities."
- Japan: On June 4, Japan's Ministry of Economy, Trade and Industry (METI) released the Japanese Semiconductor Growth Strategy aimed at revitalizing Japan's lagging semiconductor industry as a "national project" on a par with securing food and energy. The Growth Strategy features the dual focus of further strengthening Japan's current leadership position in semiconductor equipment and materials, as well as attracting leading foreign chipmakers to set up logic foundries in Japan. The Japanese growth strategy also outlines the currently available funding for the semiconductor sector, including the $0.9 billion Post 5G Fund, up to $2.10 billion in subsidies to attract foreign companies to build fabs in Japan, as well as the $26 Million AI Chip Development Fund. Additionally, some in Japan are proposing the government allocate more than just $2 billion to attract an onshore logic foundry, but the debate over the details of the amount is still on-going. For example, Tetsuro Higashi, the President of TIA and former Chairman of Tokyo Electron who has been officially tasked to lead Japan's effort to attract logic foundries to Japan, asked the government to put at least a trillion yen ($9 Billion) this fiscal year and trillions more after that toward chip development.

The most ambitious policies to develop an indigenous semiconductor industry are in China. While the Chinese government has long had an industrial policy to support its nascent chip industry, these efforts accelerated in 2014, as China released its National IC Promotion Guidelines, which laid out ambitious targets for industry revenue, production capacity, and technological advances. A year later, China published the now controversial Made in China 2025 Plan, which sets aspirational goals for China to achieve 70% self-sufficiency in semiconductors by 2025. Central to China's semiconductor industrial policy is the National Integrated Circuits Industry Development Investment Fund (known as the "Big Fund"), established in 2014 with $21 billion in state-backed financing. The Big Fund was renewed in 2019 for a second round of state financing that exceeded $35 billion. To date, China's National IC Fund has invested $39 billion, of which 69.7% has been for front-end manufacturing with the goal to increase China's share of global semiconductor production. In addition, China has announced more than 15 local government IC funds for a total of $25 billion in dedicated to

funding Chinese semiconductor companies. Combined with the National Fund, this amounts to $73 billion which is unmatched in any other country.[9]

With increasing geopolitical tensions, China's efforts to build an indigenous supply chain gained renewed urgency over the last few years, backed at the highest political levels in Beijing. Some aspects of China's semiconductor industrial policies and practices, however, raise concerns. This includes some of China's industrial subsidies (especially below-market equity infusions) that can lead to market distortions, as well as China's IP practices and forced technology transfer measures. If left unchecked, state-owned Chinese firms shielded from market forces, or access to illicitly acquired IP, could pose significant challenges to the health of the U.S. semiconductor industrial base.

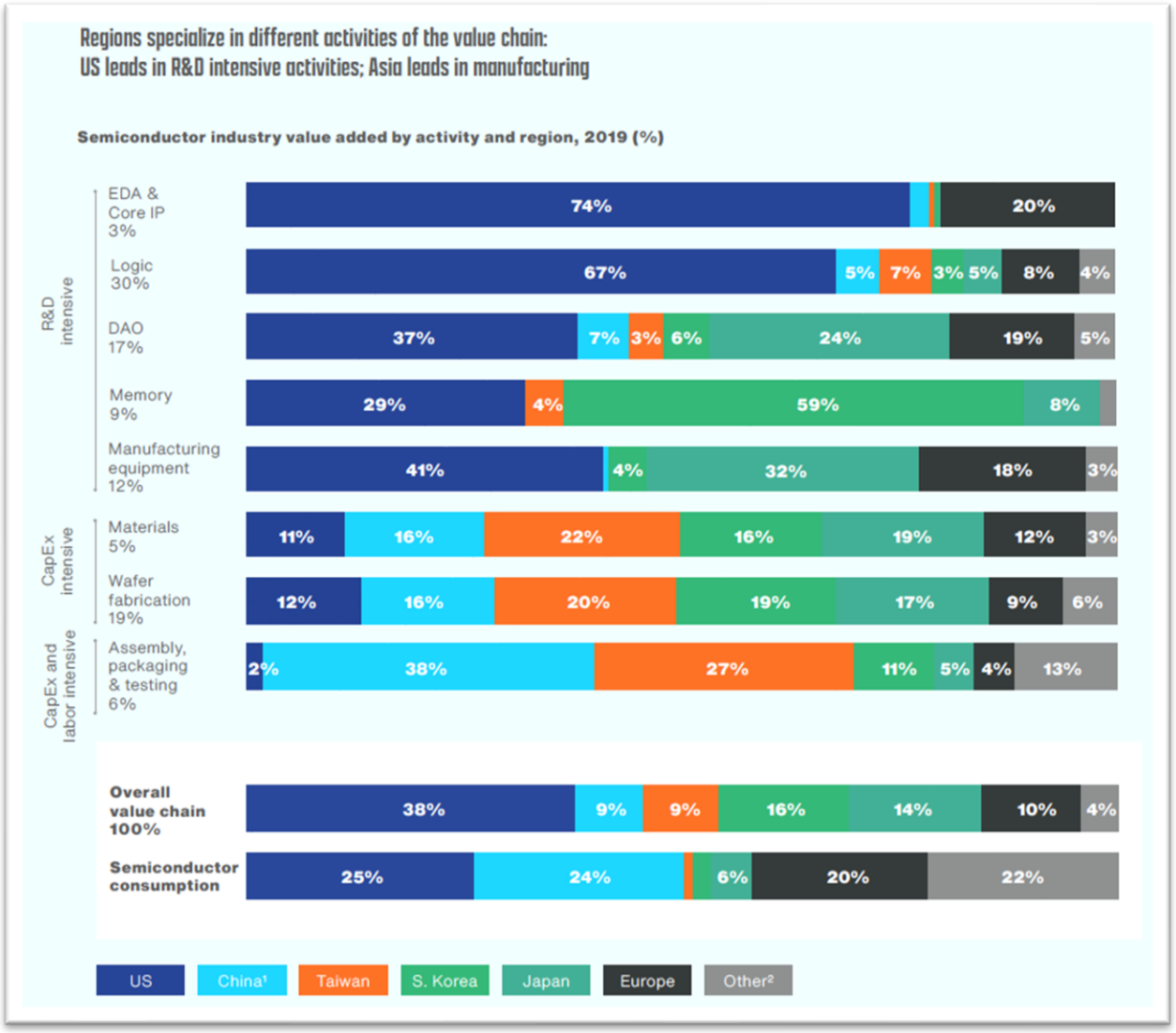
B. Supply Chain Vulnerabilities

While geographic specialization has served the industry well, it also creates vulnerabilities that each region needs to assess in a manner specific to its own economic and security considerations. There are more than 50 points across the supply chain where one region holds more than 65% of the global market share, although the level of risk associated with each of these varies. Manufacturing emerges as a major focal point when it comes to the resilience of the global semiconductor supply chain. About 75% of semiconductor manufacturing capacity, as well as many suppliers of key materials – such as silicon wafers, photoresist, and other specialty chemicals – are concentrated in China and East Asia, a region significantly exposed to high seismic activity and geopolitical tensions. Furthermore, all of the world's most advanced semiconductor manufacturing capacity – in nodes below 10 nanometers – is currently located in South Korea (8%) and Taiwan (92%). These are single points of failure that could be disrupted by natural disasters, infrastructure shutdowns, or international conflicts, and may cause severe interruptions in the supply of chips.[10]

Broadly speaking, the U.S. semiconductor industry maintains market share leadership in the activities that are most intensive in R&D, such as electronic design automation (EDA) and core IP, chip design and manufacturing equipment. Raw materials and manufacturing, both wafer fabrication and assembly, test, and packaging, which are more capital intensive, are largely concentrated in Asia where about 75 percent of the world total semiconductor manufacturing capacity - including all the leading-edge capacity at 7 nanometers and below - reside. This imbalance has highlighted the need for the United States to consider strategic incentives to support more manufacturing domestically. Similarly, in terms of subproduct leadership, the U.S. leads in logic and discrete, analog, and opto semiconductors. However, for memory semiconductors, other countries' industries lead.

[9] For more information on China's semiconductor industry, see the SIA Whitepaper, "Taking Stock of China's Semiconductor Industry" (July 2021) (available at https://www.semiconductors.org/taking-stock-of-chinas-semiconductor-industry/)

[10] For more information on the benefits and vulnerabilities of the global semiconductor supply chain, see "*Strengthening the Global Semiconductor Supply Chain in an Uncertain Era*," April 2021 (available at https://www.semiconductors.org/strengthening-the-global-semiconductor-supply-chain-in-an-uncertain-era/).



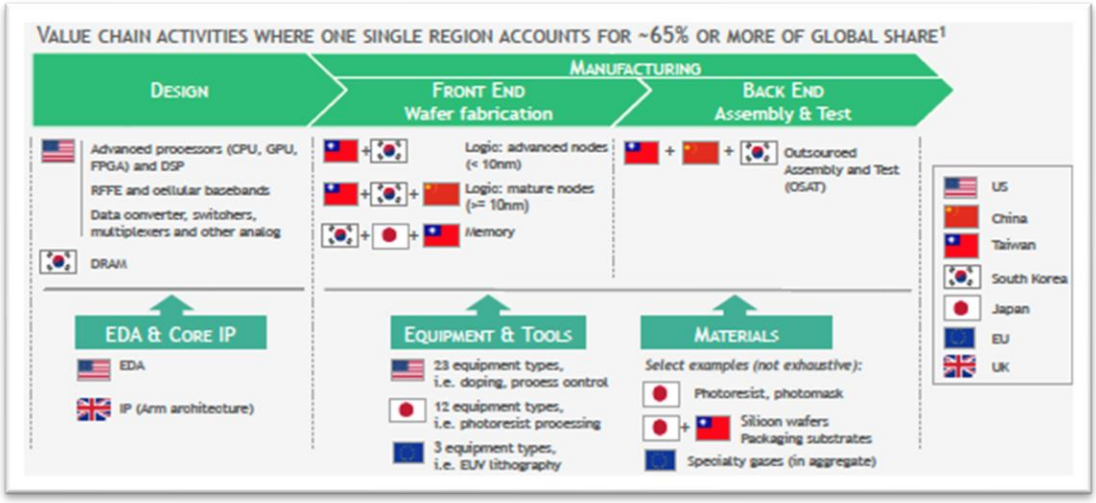
Source: SIA and BCG, "*Strengthening the Global Semiconductor Supply Chain in an Uncertain Era.*"

Besides the risks associated with concentration in certain geographic locations, geopolitical tensions may result in export controls that impair access to critical providers of essential technology, tools, and products that are clustered in certain countries. Such controls could also restrict access to important end markets, potentially resulting in a significant loss of scale and compromising the industry's ability to sustain the current levels of R&D and capital intensity.

The U.S. should work to address gaps and vulnerabilities in the semiconductor supply chain ecosystem. The following chart highlights some of the key areas of concern.[11]

[11] SIA and the Boston Consulting Group (BCG), "*Strengthening the Global Semiconductor Supply Chain in an Uncertain Era*," April 2021, pp. 35-42. https://www.semiconductors.org/wp-content/uploads/2021/05/BCG-x-SIA-Strengthening-the-Global-Semiconductor-Value-Chain-April-2021_1.pdf.

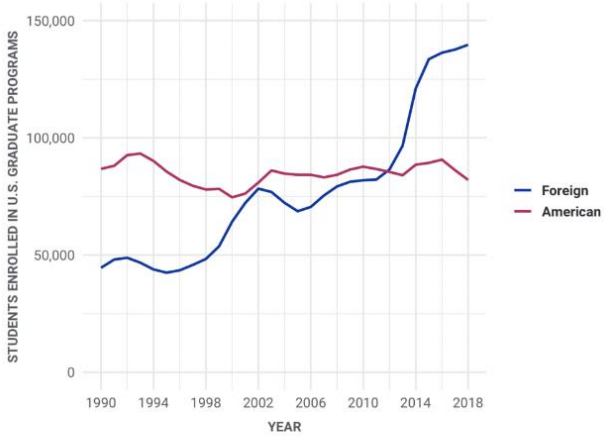
Multiple points of high geographical concentration
across the current semiconductor value chain



Sources: BCG analysis with data from Gartner, SEMI, UBS; SPEEDA.

C. Workforce Challenges

The U.S. semiconductor industry relies on access to top talent to remain competitive. Unfortunately, the U.S. educational system is not producing a sufficient number of students and workers among its citizens with the necessary expertise and skills to meet the industry's demands, particularly in the fields of science, technology, engineering, and math (STEM). While U.S. colleges and universities lead the world, approximately two-thirds of graduate students in the STEM fields at U.S. colleges and universities are foreign born, and U.S. companies may not be able to attract and retain these students.[12]



Source: NSF Survey of Graduate Students and Postdoctorates in Science and Engineering. Data includes students in Electrical, Electronics and Communications Engineering and Computer Science.

[12] For more information on the workforce challenges of the semiconductor industry, see SIA Comments to the National Institute of Standards and Technology on "Current and Future Workforce Needs to Support a Strong Domestic Semiconductor Industry" (August 15, 2018) (available at https://www.semiconductors.org/wp-content/uploads/2018/11/NIST-workforce-RFI-august-2018.pdf). See also CSET, "The Chipmakers: U.S. Strengths and Priorities for the High-End Semiconductor Workforce" (September 2020) (available at https://cset.georgetown.edu/wp-content/uploads/CSET-The-Chipmakers.pdf).

III. Policies Needed to Advance U.S. Semiconductor Leadership

Given the strategic importance of semiconductors to our economy and national security, U.S. leadership in semiconductor research, design, and manufacturing is increasingly acknowledged as a national priority. Congress needs to take action to strengthen U.S. semiconductor competitiveness in the following areas: (1) incentives for semiconductor manufacturing; (2) increased investment in semiconductor research; (3) maintaining access to global markets; and (4) enhancing the semiconductor workforce.

Fortunately, there is growing recognition within Congress and the administration that our country faces dangerous vulnerabilities in the semiconductor supply chain, posing risks to our economy, critical infrastructure, and national security.[13] To address these concerns, the Senate in June 2021 overwhelmingly passed legislation (S.1260) that includes $52 billion in emergency supplemental funding for semiconductor manufacturing and research,[14] and the Administration has expressed support for this legislation.[15] This bill funds the programs authorized in the FY21 defense authorization law (P.L. 116-283), and we are hopeful the House will soon be considering similar legislation.

The Biden Administration has expressed strong support for these bipartisan initiatives. In March 2021 President Biden called for Congress to invest $50 billion on semiconductor manufacturing and research as part of its infrastructure and jobs plan. [16] Similarly, the administration's supply chain report in response to E.O 14017 recommends for Congress to support "at least $50 billion in investment to advance domestic manufacturing for leading edge semiconductors; expand capacity in mature node and memory production to support critical manufacturing, industrial, and defense applications; and promote R&D to ensure the next generation of semiconductor is developed and produced in the United States."[17]

A. Incentives for Semiconductor Manufacturing – CHIPS Act/ FABS Act

Given the strategic importance of the semiconductor industry and the need to make supply chains more resilient, it is crucial for the U.S. to maintain a robust manufacturing ecosystem — from research and design to fabrication and packaging. The U.S. now has only 12 percent of global semiconductor manufacturing capacity, a decline from 37 percent in 1990. The cost of building an advanced semiconductor fabrication facility in the U.S. is not competitive with other countries. The cost differential is directly attributable to significant subsidies provided by global competitors such as China to build their domestic capabilities, and the U.S. lacks comparable incentives. To spur economic growth and strengthen the resilience of the semiconductor supply

[13] White House Supply Chain Report at 25. ("A sudden supply chain shock could have a far-reaching and unforeseen impact in any of these areas [of the economy], not only for specific industries, communities, and workers, but also potentially affecting national security and critical infrastructure.")
[14] https://www.congress.gov/bill/117th-congress/senate-bill/1260/text, section 1002, "Creating Helpful Incentives to Produce Semiconductors (CHIPS) for America Fund." The Senate is also considering legislation, the Facilitating American-Built Semiconductors (FABS) Act (S.2107), to provide a 25 percent investment tax credit for the construction and equipping of new semiconductor fabs.
[15] Statement of Administration Policy (S.1260 – Endless Frontier Act) available at https://www.whitehouse.gov/wp-content/uploads/2021/05/SAP-S.-1260.pdf
[16] President Biden's $50 billion request is at https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/31/fact-sheet-the-american-jobs-plan. The CHIPS Act manufacturing incentives are in P.L. 116-283, Sec. 9902.
[17] White House Report, "Building Resilient Supply Chains, Revitalizing American Manufacturing, and Fostering Broad-Based Growth," June 2021 available at https://www.whitehouse.gov/wp-content/uploads/2021/06/100-day-supply-chain-review-report.pdf

chain to meet our national security and critical infrastructure needs, Congress should enact legislation to provide targeted grants and an investment tax credit to spur the construction of new onshore advanced semiconductor research, design, and manufacturing facilities.

The U.S. has a strategic opportunity to reverse the decades-long trajectory of declining chip manufacturing in America, strengthen national security and make our supply chains more resilient, and make our country one of the most attractive places in the world to produce semiconductors, which are the brains of modern technology. To seize this opportunity the federal government must invest boldly in chip manufacturing incentives and favorable tax policies for semiconductor industry to make the U.S. more cost-competitive with countries that have offered robust government incentives for years. Doing so would expand chip manufacturing in the U.S., strengthen our country's economy and national security, and fortify America's semiconductor supply chains.

The CHIPS for America Act includes a range of federal investments to advance U.S. semiconductor manufacturing, including $39 billion for a new federal grant program that would incentivize new domestic semiconductor manufacturing facilities and $10 billion for a National Semiconductor Technology Center. We are highly supportive of this legislation and these provisions.

Tax policy is also crucial to the incentives equation. SIA has urged Congress and the Administration to utilize smart, targeted tax policy to strengthen the competitiveness of the U.S. semiconductor industry ecosystem and thereby enhance the U.S. economy, technology leadership, national security, and supply chain resilience. SIA has requested action to pass an investment tax credit (ITC) to incentivize manufacturing and advanced research in the U.S. In an important step toward achieving this goal, Senate Finance Committee Chairman Wyden and Ranking Member Crapo have introduced the Facilitating American-Built Semiconductors (FABS) Act (S.2107), bipartisan legislation which would provide a permanent 25 percent investment tax credit (ITC) for expenditures for tangible property for semiconductor manufacturing and research.

The combination of one-time, project-based grants envisioned in the CHIPS Act, along with the permanent, across-the-board ITC envisioned by the FABS Act would create a powerful supplement to each other and certainly combat the incentives of foreign governments and address key vulnerabilities in our economy, national security, and supply chain.

According to the Boston Consulting Group, incentives of this magnitude could result in the U.S. capturing as much as 24 percent of new fab capacity, resulting in as many as 19 new fabs in the U.S. While this funding is not yet final, there is a strong likelihood significant funding will be appropriated to incentivize semiconductor manufacturing in the U.S., with the result being the construction of additional new fabs and/or the expansion of existing fabs.

B. Increased Investment in Semiconductor Research

U.S. semiconductor leadership is critical for America to lead the world in the race for the technologies of the future, such as AI, quantum computing, and 5G/6G. While the U.S. semiconductor industry continues to invest heavily in research needed to remain competitive, our global competitors are investing heavily to challenge U.S. leadership, Unfortunately, federal investments in R&D have failed to keep pace with the rising costs of developing new technology.

To maintain U.S. technology preeminence, Congress and the administration should significantly increase federal investment in semiconductor research. Increased investments in both basic and applied research will help maintain U.S. technology leadership – and the economic and national security benefits resulting from such leadership — and provide the added benefit of training the skilled workforce of scientists and engineers needed to compete in the global marketplace.

The funding in the CHIPS Act passed by the Senate includes significant funding for semiconductor R&D, including the establishment of a National Semiconductor Technology Center (NSTC). The NSTC is intended to maintain U.S. leadership in semiconductor technology and strengthen U.S. semiconductor manufacturing by establishing new capabilities in the U.S. for advanced semiconductor manufacturing, design, and packaging research and prototyping. The NSTC is an important part of a comprehensive strategy to advance semiconductor manufacturing and research needed to advance the U.S. economy and national security. One gap in our innovation ecosystem is the ability to research and prototype advanced semiconductor technologies. Over time, this gap will result in the U.S. losing its leadership position in key technologies of the future – including 5G/6G, quantum computing, artificial intelligence, autonomous vehicles, and robotics – and the economic and national security benefits of this leadership. The NSTC will strengthen the U.S. economy and national security by establishing new leading, U.S.-based research capability for the semiconductor industry – which will provide a unique and lasting competitive advantage due to the high cost and complexity of semiconductor R&D infrastructure.

The U.S. can also incentivize increased semiconductor research through tax policy. The R&D credit in the U.S. is weaker than the research incentives offered in other countries,[18] and unfortunately upcoming changes to the credit will weaken it even more. Currently, the cost of U.S. based research expenses can annually be deducted which is designed to encourage more private sector investment in R&D with the goal of creating a new or improved products, services, processes or techniques. The tax credit is a partial dollar-for-dollar credit focused on incremental increases in year-to-year R&D spending and is primarily a wage-based credit, with 70 percent of R&D qualified expenses, on average, for wages for good paying R&D jobs. However, the 2017 tax law altered this incentive by requiring the entire deduction amount be amortized over a five-year period, thereby reducing the value of the deduction. Once it takes effect, amortization of research will make the U.S. a less attractive venue for research investments by the semiconductor industry and the broader economy.[19] If the amortization requirement takes effect, the U.S. will be the only developed country with such a policy and a less attractive place for critical R&D. This provision should be repealed to strengthen the research and innovation ecosystem in the U.S.

[18] According to an OECD report, the R&D credit in the U.S. ranks 24th out of 34 in a comparison group consisting of all large OECD members, plus Brazil, Russia, India, and China (BRIC). See https://itif.org/publications/2020/09/08/enhanced-tax-incentives-rd-would-make-americans-richer

[19] One report estimates the amortization will cost 20,000 R&D jobs in the first 5 years and another 60,000 in the following 5 years. “Impact of the amortization of certain R&D expenditures on R&D spending in the United States” (October 2019) (available at https://investinamericasfuture.org/ey-impact-of-the-amortization-of-certain-rd-expenditures-on-rd-spending-in-the-united-states/).

C. Access to Global Markets

1. Global Trade

Given the importance of access to global markets and the free flow of commercial goods to the continued leadership of the U.S. semiconductor industry and the health of our industrial base, Congress and the administration should work to promote 21st century trade rules that remove market barriers, eliminate tariffs, protect intellectual property, and enable fair competition. Modernizing trade agreements, strengthening WTO trade rules, updating and renewing trade promotion authority and setting an ambitious trade agenda should be a priority for Congress and the administration.

The U.S. must meet the challenges posed by China's rise through smart and effective policies. First and foremost, as stated above, the U.S. should invest in our own competitiveness and improve our innovation base and human capital to accelerate U.S. technology leadership. At the same time, we believe the right approach to addressing market-distorting Chinese industrial policies is to work closely with our allies to both compel China to change its ways, as well as to develop new global rules and standards that improve market access and ensure fair competition. For example, we welcome efforts by the WTO to create new trade rules regarding the most distortive industrial subsidies (e.g., equity infusions) and develop ways to strengthen penalties for trade secrets theft.

The real, lasting answer to increased semiconductor competition from China is to run faster by investing in our own technological competitiveness and strengthening the resiliency of our domestic and allied-partner supply chains. China is both a competitor in the technology sector and global economic leadership and a geopolitical challenger to U.S. and its allies. At the same time, it is a major player in the global economy and a top customer for U.S. technology companies, including in the semiconductor industry. China is the location of much of the world's electronics supply chain and a high percentage of the products made by the customers of American chip firms are assembled in China, even if higher value research, design, and manufacturing is conducted elsewhere. As a result, proposals to completely "decouple" the two economies would inflict great harm on the U.S. semiconductor industry, our workforce, and the global economy as a whole.[20]

2. Export control

Export controls can be an important tool in advancing U.S. national security and foreign policy objectives, but export controls should be deployed judiciously to ensure they are effective in achieving these goals and avoid harming U.S. industry. Expansive controls covering broad categories of non-sensitive commercial technologies or over-reliance on unilateral controls that fail to ensure coordination with global allies are ineffective and harm the U.S. semiconductor industry. The semiconductor industry is globally competitive and the U.S. industry does not have a monopoly in the design, manufacture, and development of semiconductor technology. Accordingly, unilateral controls can be circumvented and allow access to technology from foreign competitors, thereby depriving U.S. companies of revenue while at the same time failing to limit access to technology. In addition, the ability to sell globally provides the revenue and scale necessary to support the high levels of investment in R&D necessary to maintain

[20] For more background on this virtuous cycle of how semiconductor sales leadership leads to long-term innovation leadership in the industry, please see SIA and BCG, *"How Restricting Trade with China Could End U.S. Semiconductor Leadership,"* March 9, 2020, pp. 8-9: https://www.bcg.com/en-us/publications/2020/restricting-trade-with-china-could-end-united-states-semiconductor-leadership.

technology leadership, and overly broad export controls can limit the global revenue needed to sustain high levels of research investment.

In order to advance our national security while maintaining our industrial competitiveness, export control policies should be:

(1) narrowly targeted to specific items that advance clear national security and foreign policy objectives;
(2) multilateral and coordinated with our allies;
(3) consider impacts on U.S. industry and technology leadership; and
(4) adopted under a process with input from industry and other stakeholders.

Export controls failing to adhere to these principles are likely to harm U.S. competitiveness and the industrial base and be ineffective in achieving national security goals. While targeted and effective export controls are needed to protect sensitive technology, these efforts need to be coupled with investments and policies to promote innovation, technology leadership and competitiveness of the U.S. semiconductor industry. The Biden administration's recent announcement of semiconductor-focused dialogues with Japan and South Korea, as well as the establishment of the Trade and Technology Council with the EU, may serve as a mechanism for achieving a coordinated approach.

D. Workforce Development and High Skilled Immigration

To enhance America's ability to attract and retain the world's best scientists and engineers to push the boundaries of physics, chemistry, and advanced manufacturing, the U.S. must take action to improve our educational system and reform our high-skilled immigration system.

The U.S. must implement a national strategy — backed by appropriate investments and in consultation with education leaders and the private sector — to improve our educational system and increase the number of Americans graduating in STEM fields, including women and underrepresented minorities. Our educational system is poorly aligned with the needs of our industry, and we should take action to improve K-12 education to develop more STEM graduates. For example, bipartisan legislation included in the Senate competitiveness package would provide funding for hands-on education in areas such as robotics. Increased funding for semiconductor research also helps support the pipeline of graduates who can work in our industry.

Additionally, the U.S. must reform its high-skilled immigration system to enable access to, and retention of, the best and brightest in the world. In the near term, Congress and the administration should work to eliminate the existing green card backlog, end discriminatory per country caps on green cards, and exempt advanced STEM degree graduates of U.S. universities from existing green card caps. For example, bipartisan legislation pending in Congress, the Equal Access to Green Cards for Legal Employment (EAGLE) Act of 2021 (H.R. 3648), would phase out the 7 percent per-country limit on employment-based immigrant visas and raise the 7 percent per-country limit on family-sponsored visas to 15 percent.

IV. Conclusion

Maintaining U.S. leadership in semiconductor research, design, and manufacturing is a national priority. To achieve this goal, SIA calls on Congress and the administration to adopt smart policies to incentivize semiconductor manufacturing and increase investments in semiconductor research. We look forward to working with Congress and the administration to achieve these goals.