

**Comments of the  
Semiconductor Industry Association (SIA)  
To the  
National Science Foundation (NSF) and Department of Commerce (DOC)  
On the  
Request for Information (RFI) on the National Network for Microelectronics Education  
NSF-OTAMI-FY24-01  
August 14, 2024**

The Semiconductor Industry Association (SIA)<sup>1</sup> appreciates the opportunity to respond to the Request for Information (RFI)<sup>2</sup> from the National Science Foundation (NSF) and Department of Commerce (DOC) regarding the establishment of a National Network Coordination Hub (the Hub) for the National Network for Microelectronics Education (NNME). SIA applauds NSF and DOC for entering into a memorandum of understanding (MOU) to jointly invest in this new initiative.<sup>3</sup>

The Federal government prioritized the growth and security of the domestic semiconductor supply chain by passing the CHIPS and Science Act of 2022. Since the bill's passage, chip companies spanning the supply chain have invested nearly \$450 billion into the U.S., which are expected to create hundreds of thousands of new jobs in the economy. This includes approximately 56,000 new direct jobs across 25 states, as well as hundreds of thousands of additional jobs with semiconductor suppliers, service providers, and other businesses.<sup>4</sup> These new investments build on the already established economic impact of the industry, which employs roughly 345,000 workers directly in the U.S. and constitutes the sixth largest export industry for the country.<sup>5</sup> Additionally, the semiconductor industry requires significant, and growing, investments to continue advancing innovation. Across U.S. semiconductor firms, roughly 20% of all revenue is funneled back into research and development (R&D).<sup>6</sup>

As global competition for semiconductor manufacturing rises, so does the race for skilled talent. To fulfil the goals of the Chips and Science Act and ensure America has a strong, stable domestic chip supply chain, the federal government and other stakeholders need to take action to solve the growing skills gap. Through these major investments by companies and the federal government, the domestic semiconductor industry is estimated to grow by nearly 115,000 jobs by 2030. At current rates, roughly 67,000 – or 58% of projected new jobs – risk going unfilled. Of the unfilled jobs, more than 60% are expected to involve bachelor's or advanced degrees in engineering, computer science, or other critical STEM fields for the industry.<sup>7</sup> The gravity of this

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<sup>1</sup> SIA has been the voice of the U.S. semiconductor industry for over 45 years. SIA member companies represent more than 99% of the U.S. semiconductor industry by revenue and nearly two-thirds of non-U.S. firms, and are engaged in the research, design, and manufacture of semiconductors. The U.S. is the global leader in the semiconductor industry, and continued U.S. leadership in semiconductor technology drives economic strength, national security, and global competitiveness. More information about SIA and the semiconductor industry is available at [www.semiconductors.org](http://www.semiconductors.org).

<sup>2</sup> National Science Foundation, Request for Information on National Network for Microelectronics Education Program Market Intelligence, July 24, 2024. Available at: <https://sam.gov/opp/8d7e7a3885484323ae6852081adb98e2/view>

<sup>3</sup> National Science Foundation, "U.S. National Science Foundation and Department of Commerce partner to advance semiconductor workforce development," July 24, 2024. Available at: <https://new.nsf.gov/news/nsf-doc-partner-to-advance-semiconductor>

<sup>4</sup> SIA, "The CHIPS Act has already sparked \$450 billion in private investments for U.S. semiconductor production," Dec. 14, 2022. Available at: <https://www.semiconductors.org/the-chips-act-has-already-sparked-200-billion-in-private-investments-for-u-s-semiconductor-production/>

<sup>5</sup> SIA/Oxford Economics, "Chipping Away: Assessing and addressing the labor market gap facing the U.S. semiconductor industry," July 2023. Available at: <https://www.semiconductors.org/chipping-away-assessing-and-addressing-the-labor-market-gap-facing-the-u-s-semiconductor-industry/>

<sup>6</sup> SIA, "2023 State of the U.S. semiconductor industry," July 2023. Available at: <https://www.semiconductors.org/2023-state-of-the-u-s-semiconductor-industry/>

<sup>7</sup> SIA/Oxford Economics, "Chipping Away"

shortfall within the semiconductor industry is put into perspective by the projected workforce gap in the broader economy. The U.S. economy is estimated to create 3.85 million additional jobs by 2030 requiring proficiency in technical fields. At current rates, an estimated 1.4 million jobs across the economy risk going unfilled due to a relative scarcity of skilled technicians, highly educated engineers, and computer scientists. This competition for workers emphasizes the need for semiconductor specific education and training throughout the country.

For the CHIPS and Science Act to achieve the goals of establishing a robust domestic semiconductor ecosystem and driving innovations in key technology industries, the U.S. must prioritize a strong, capable workforce.<sup>8</sup> SIA supports the NSF and DOC's vision for the Hub and NNME and our comments focus on efforts to align existing semiconductor workforce development programs, develop the pipeline for roles across the chip supply chain, increase access and awareness of semiconductor jobs and training, and promote standardization of curricula and measurement of outcomes. Additionally, the Hub should be beneficial and accessible to all U.S. and global semiconductor companies operating within the domestic supply chain to ensure the projects aimed at increasing chip production and innovation within the U.S. have the workers they need.

### **1. Alignment between the Hub, NSTC, and Other Workforce Development Programs**

Since the CHIPS and Science Act was signed into law, industry, government, and academia have worked individually and in partnership to increase the number of qualified workers that can enter roles across the semiconductor supply chain. Collaboration between each of these parties is critical to ensuring efficient workforce development programs that avoid duplication and are effective in education and training. As NSF and DOC establish the Hub and NNME, it is vital for the newly established program to align closely and avoid duplication with the NSTC Workforce Center of Excellence (WCoE) and workforce development activities at other federal agencies, such as the Department of Defense, the Department of Labor, and the Department of Energy, as well as existing programs within NSF and DOC.

According to Natcast, the WCoE will be the “definitive, trusted resource for workforce development for semiconductor companies doing business in America.”<sup>9</sup> Natcast anticipates that the WCoE will include activities such as expanding access to semiconductor training and education, accelerating best practice adoption, and scaling successful workforce development programs. The first WCoE funding opportunity is the “Workforce Partner Alliance,” where Natcast anticipates awarding \$500,000 to \$2 million each for up to 10 programs to establish or scale workforce development efforts.<sup>10</sup>

According to the RFI statement of objectives (SOO), the Hub will also disseminate workforce best practices, expand access to microelectronics jobs, and work with academia and workforce organizations to scale effective curricula. While SIA appreciates the repeated references in the SOO regarding alignment and coordination with the NSTC Workforce Center of Excellence, it appears that many of the Hub activities identified in SOO section 4.1 and regional node activities identified in SOO section 4.2 are similar to expressed plans of the WCoE. SIA recognizes that these activities are not in practice yet and may not overlap completely; however, additional coordination may be needed with Natcast and the Department of Commerce to ensure that the WCoE and the Hub promote complementary and distinct lines of effort. Rather

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<sup>8</sup> SIA, “Semiconductor Workforce Development: A policy blueprint,” April 2024. Available at: <https://www.semiconductors.org/workforceblueprint/>

<sup>9</sup> Natcast, “Workforce Initiatives”. Available at: <https://natcast.org/workforce>

<sup>10</sup> Natcast, “NSTC Workforce Partner Alliance Program”. Available at: <https://natcast.org/workforce/wfpa>

than taking an all-of-the-above approach to possible activities,<sup>11</sup> the Hub and regional nodes should focus on a limited number of key activities where there is an existing gap in the semiconductor workforce development ecosystem. NSF and DOC should work to identify unique activities that the Hub should perform that are complementary to the WCoE and other existing Federal agency programs.

SIA encourages NSF and DOC to establish clear guidance that allows potential participants to better understand the differences in each program, their coordinated functions, and explicit desired outcomes. SIA believes these guidelines will also ensure the agencies, whose shared goal is to fulfill the workforce needs of the U.S., avoid redundant efforts and confusion among potential participating entities.

## **2. Focus on Gaps in Roles and Skills Across a Diverse Supply Chain**

The semiconductor supply chain consists of several highly complex steps, such as R&D, chip design, and front-end and back-end manufacturing. To perform each of these functions, companies employ a broad range of individuals that each require specific skills and education, ranging from engineers and scientists who drive chip design and innovation in manufacturing processes, to technicians and engineers who operate and maintain equipment on fab floors. Therefore, it is critical the Hub supports all types of semiconductor roles which require specialized skills and knowledge in software and hardware, to ensure the program is improving the workforce for the *entire* semiconductor ecosystem. As innovation advances and requirements for chip performance continue to increase at a rapid pace, America needs to increase the number of skilled workers throughout the supply chain.

While the Hub should focus on roles throughout the supply chain, it should also primarily aim to fill gaps in workforce development programs. There are many successful workforce development programs in different subsets of the supply chain at the federal, regional, and local level and these should be scaled as appropriate. The Hub should scale these programs and fund new programs only in coordination with industry to confirm their effectiveness in filling gaps and avoiding duplication with current areas of success. To ensure these gaps are understood and addressed appropriately, the Hub should consult industry throughout the process of funding an existing or new program.

The Hub and corresponding regional nodes should ensure they are covering roles focused on semiconductor research, development, and production. Understanding the full breadth of requirements will allow the Hub to prepare and execute the regional nodes and how they best can support the domestic industry. For example, as existing fabs are expanded and new ones are built, the industry will need an influx of skilled technicians that are appropriately stationed throughout the country. Semiconductor fabrication is a complex, technically advanced manufacturing process requiring industrial operations specialists, engineering technicians, equipment operators, and others to operate and maintain sophisticated machinery, handle specialized materials, and conduct other operations. Additionally, several types of engineers are required across the supply chain, such as electrical engineers, electronics engineers, design engineers, electronic design automation (EDA) applications engineers, EDA R&D engineers, fab engineers, infrastructure technology engineers, and innovation engineers. In establishing the Hub and regional nodes, NSF should take into the consideration the broad range of skills important to the domestic industry and ensure that regional nodes are appropriately placed and prepared to advance the workforce demands for a region.

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<sup>11</sup> The statement of objectives identifies over 30 unique activities between the Hub and the regional nodes.

NSF should also consider increasing resources and support for the pipeline of STEM educators and trainers. In doing so, NSF should support recruitment and training of new educators and upskilling of current educators in K-12 and community college with expertise needed to teach relevant curricula. Additionally, the Hub should provide funding opportunities for educational institutions to build infrastructure and hire teachers needed to deliver relevant curricula to students. NSF should also take into consideration supporting community colleges, technical schools, and institutions of higher education (IHEs) to liaise between industry and K-12 and provide training for K-12 educators on curricula. NSF should also develop an online database of training, curricula and industry information for educators. Establishing a strong pipeline for STEM educators and trainers addresses a long-term need for a sustainable workforce.

### **3. Increase Awareness of Chip Industry and Access to Training**

The semiconductor industry suffers from a lack of awareness among students about the long-term jobs available to them in the field causing some to forgo entering a STEM field of study. This lack of awareness also leads most students who graduate with a STEM degree to choose occupations outside the industry. Further, attention should also be paid to creating excitement about the jobs available, but also the rewarding careers individuals can build in the industry. Across the industry, we should help students see themselves benefiting from a commitment to the necessary upfront education and training over time. With companies heavily invested and domestic facilities beginning production in the coming years, the semiconductor industry provides prospective workers the opportunity to build a long, successful career. This expected growth of the industry in America needs to be communicated to students and individuals so they can understand and seize the multidecade career opportunity before them. SIA believes the Hub should commit resources toward an industry awareness campaign, coordinated with the WCoE. Specifically, the Hub should support programs intended to:

- Ensure awareness of career and technical education (CTE) pathways that lead to industry opportunities among K-12 students, parents, teachers and counselors
- Increase awareness of workforce needs, career opportunities, and working environments in semiconductor manufacturing among K-12 administrators, parents, teachers, counselors, CTE professionals, and students
- Create industry alignment on curricula and KSAs to ensure a consistent message delivered through speaking engagements, teacher professional development programs, and advisory committee meetings
- Fund summer experiences that can be leveraged for high school students or educators interested in learning about technician or maintenance careers in the semiconductor industry – these experiences should be a collaboration between community college, IHEs and industry
- Promote a marketing campaign through social media platforms
- Catalog platforms being used by K-12 districts, community colleges, and IHEs and create email campaigns for students and parents of students in pursue relevant pathways or degree programs (e.g., SchoolLinks, Handshake, etc.)

The issue of awareness of the semiconductor industry significantly impacts individuals who are underrepresented in STEM professions. To increase the overall employee talent pool, the Hub should promote opportunities for underrepresented groups to build on their education and enter STEM industries in need of workers. These opportunities may come in the form of partnerships between industry, academia, government entities, and other organizations. Specifically, the Hub should support programs intended to:

- Connect underserved communities with educational, training and career opportunities relevant to semiconductors
- Connect underserved K-12 districts with industry or non-profit organizations who can provide career awareness, professional skills education, job-seeking support and post-secondary enrollment/admissions process support to students and parents within those districts
- Promote experiential learning opportunities in industry open to recent graduates, adult-learners, and transitioning service members
- Remove barriers for students and/or adult learners to participate in internship or apprenticeship opportunities in industry
- Provide funding to support participants from underrepresented backgrounds in internship or apprenticeships programs
- Create of an online database that aggregates open positions in the semiconductor industry nationwide and provides a direct link company career site/application

#### **4. Standardization of Curricula and Measurement of Outcomes**

The CHIPS Industrial Advisory Committee highlighted the lack of standardization as a key impediment to effective semiconductor workforce development in manufacturing and design: “[M]icroelectronics education and training, while well-intentioned, creative and largely effective locally, exist primarily in a very large number of silos (disciplinary, education level, industry segment and/or geographical) with little standardization, almost no sharing of curriculum, and pockets of proprietary information and training that limit the industry’s ability to grow the diverse, multidisciplinary, highly skilled workforce needed.”<sup>12</sup> To address this problem, the IAC stated: “All post-secondary educational institutions which receive funding through CHIPS R&D programs should be incentivized to participate in and contribute to an inclusive and highly collaborative national network for microelectronics education that promotes sharing of curricular content and workforce development program models, adoption of best practices, and standard frameworks, for maximum collective benefit.” A successful education and workforce development ecosystem for training workers for microelectronics employment should facilitate curricula standardization. Specifically, the Hub should support programs intended to:

- Facilitate standardization of curricula within geographic regions for programs relevant to semiconductor manufacturing based on industry input; standardize and publish KSAs for semiconductor advanced manufacturing roles
- Publish KSAs developed by industry and standard curricula publicly, which should be updated on a regular cadence to ensure any changes in industry are quickly fanned out to educational institutions
- Connect K-12, community colleges, IHEs, and industry to build and implement CTE high school pathways that will articulate to a certificate and/or degree. Credentials offered within a pathway should be relevant to advanced manufacturing, stackable, and have multiple on-ramps and off-ramps.
- Leverage structure and work completed through existing consortia to develop best practices and disseminate across regions
- Ensure participation of K-12 school administrators/leadership in order to scale across districts

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<sup>12</sup> CHIPS Industrial Advisory Committee, “R&D Workforce Working Group Update and Recommendations,” Feb. 7, 2023. Available at: <https://www.nist.gov/system/files/documents/2023/02/08/Feb%207%20IAC%20Meeting%20Workforce%20Presentation%20Final.pdf>

## **Conclusion**

The CHIPS Industrial Advisory Committee recently recommended that the Hub coordinate with the WCoE on developing an inventory of workforce development programs, industry marketing collateral, and a curricular repository.<sup>13</sup> The Hub should coordinate with the WCoE to focus on these existing gaps in order to support development of a robust, skilled workforce that is required for America to build a strong domestic semiconductor ecosystem.

SIA is pleased that NSF and DOC plan to move forward with the Hub and NNME to ensure that industry has the workers it needs to meet the economic and national security needs of the country. In order to succeed, SIA believes that the Hub must intensely focus on coordination and alignment with the NSTC WCoE, the spectrum of skills and roles across the chip supply chain, generating a greater awareness and access to industry jobs and training opportunities, and standardization of curricula and measurement of outcomes.

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SIA appreciates the opportunity to submit comments on this RFI, and we look forward to continued collaboration with NSF and DOC to support the advancement of semiconductor workforce development efforts.

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<sup>13</sup> CHIPS Industrial Advisory Committee, "R&D Workforce Working Group Findings and Recommendations," Aug. 1, 2024. Available at: [https://www.nist.gov/system/files/documents/2024/08/04/R%26D%20Workforce%20WG%20Presentation\\_%202024.08.01.pdf](https://www.nist.gov/system/files/documents/2024/08/04/R%26D%20Workforce%20WG%20Presentation_%202024.08.01.pdf)