Billing Code: 3510-13

DEPARTMENT OF COMMERCE

National Institute of Standards and Technology

[Docket Number: 221004-0210]

Manufacturing USA Semiconductor Institutes

AGENCY: National Institute of Standards and Technology, Department of Commerce.

ACTION: Notice; request for information.

SUMMARY: The National Institute of Standards and Technology (NIST) is seeking public input to inform the design of, and requirements for, potential Manufacturing USA institutes to strengthen the semiconductor and microelectronics innovation ecosystem, which could include design, fabrication, advanced test, assembly, and packaging capability. These Manufacturing USA institutes are envisioned in Title XCIX of the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021 (Creating Helpful Incentives to Produce Semiconductors (CHIPS) for America) to support efforts in research and development as well as education and workforce development, and that Act also provides for complementary initiatives including the National Semiconductor Technology Center, the National Advanced Packaging Manufacturing Program, and the NIST laboratories program supporting measurement science and standards. Responses to this Request for Information (RFI) will inform NIST's development of funding opportunities for federal assistance to establish Manufacturing USA semiconductor institutes.

DATES: Comments must be received by 11:59 PM Eastern time on [INSERT DATE 45 DAYS AFTER FEDERAL REGISTER PUBLICATION]. Written comments in response to the RFI should be submitted according to the instructions in the ADDRESSES and SUPPLEMENTARY INFORMATION sections below. Submissions received after that date may not be considered.

ADDRESSES:

For Comments:

Comments may be submitted by either of the following methods:

- *Electronic submission*: Submit electronic public comments via the Federal eRulemaking Portal.
    1. Go to www.regulations.gov and enter NIST-2022-0002 in the search field,
    2. Click the "Comment Now!" icon, complete the required fields, and
    3. Enter or attach your comments.
- *Email*: Comments in electronic form may also be sent to MfgRFI@nist.gov in any of the following formats: HTML; ASCII; Word; RTF; or PDF.

Please submit comments only and include your name, organization's name (if any), and cite "Manufacturing USA semiconductor institutes" in all correspondence. Comments containing references, studies, research, and other empirical data that are not widely published should include copies of the referenced materials.

All comments responding to this document will be a matter of public record. Relevant comments will generally be available on the Federal eRulemaking Portal at http://www.Regulations.gov and on NIST's website at https://www.nist.gov/oam/manufacturing-usa-semiconductor-institute-request-information-rfi. NIST will not accept comments accompanied by a request that part or all of the material be treated confidentially because of its business proprietary nature or for any other reason. Therefore, do not submit confidential business information or otherwise sensitive, protected, or personal information, such as account numbers, Social Security numbers, or names of other individuals.

For RFI Informational Webinars:

NIST will hold informational webinars explaining how the public can submit comments. Details about these informational webinars, including dates and registration

deadlines, will be announced at https://www.nist.gov/oam/manufacturing-usa-semiconductor-institute-request-information-rfi.

FOR FURTHER INFORMATION CONTACT: For questions about this RFI contact: Kelley Rogers in the Office of Advanced Manufacturing, National Institute of Standards and Technology, telephone number 301-219-8543 or e-mail MfgRFI@nist.gov. Please direct media inquiries to NIST's Office of Public Affairs at (301) 975-2762.

SUPPLEMENTARY INFORMATION:

Background

Semiconductors are fundamental to nearly all modern industrial and national security activities, and they are essential building blocks of critical and emerging technologies, such as artificial intelligence, autonomous systems, next generation communications, and quantum computing. The U.S. semiconductor industry has historically led in many parts of the semiconductor supply chain, such as research and development (R&D), chip design, and manufacturing. Over the past several years, the U.S. position in the global semiconductor industry has faced numerous challenges. In 2019, the United States accounted for 11 percent of global semiconductor fabrication capacity, down from 13 percent in 2015 and continuing a long-term decline from around 37 percent in 1990. Semiconductor packaging also presents a critical supply chain challenge since less than 3% of global packaging capacity is in North America. [1] Much of the overseas semiconductor manufacturing capacity is in Taiwan, South Korea, and, increasingly, China.[2]

The fragility of the current global semiconductor supply chain was put squarely on display in 2020. The industry faced significant disruptions as a result of the coronavirus pandemic, a fire affecting a major supplier in Japan, and a severe winter storm that disabled production in

[1] https://semiengineering.com/expanding-advanced-packaging-production-in-the-u-s/
[2] https://www.semiconductors.org/wp-content/uploads/2020/09/Government-Incentives-and-US-Competitiveness-in-Semiconductor-Manufacturing-Sep-2020.pdf

facilities in Texas for several days.[3] These events, together with other factors, such as pandemic-induced shifts in consumer demand, contributed to a global semiconductor shortage that affected multiple manufacturing sectors that rely on semiconductors as critical components for their finished products. Especially severely hit was the automotive industry, which saw plants idled for months.[4]

The Department of Commerce published a Request for Information (or "RFI") in September of 2021 on the semiconductor supply chain (86 FR 53031, September 24, 2021). More than 150 responses were received from commenters including nearly every major semiconductor producer and representative companies that consume these products across multiple industry sectors. These responses provided new insight into the complex and global semiconductor supply chain.[5] Respondents pointed out a major supply and demand gap that is increasing annually, with very limited inventory on hand for key industries.

To strengthen the U.S. position in semiconductor R&D and manufacturing, Congress authorized a set of programs in Title XCIX of the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021, Pub. L. No. 116-283, as amended by sections 103 and 105 of the CHIPS Act of 2022 (Pub. L. No. 117-167, Division A), codified at 15 U.S.C. 4651 *et seq.* (hereinafter, CHIPS for America Act). This comprehensive set of programs is intended to restore U.S. leadership in semiconductor manufacturing by providing incentives and encouraging investment to expand manufacturing capacity for the most advanced semiconductor designs as well as those of more mature designs that are still in high demand, and would grow the research and innovation ecosystem for semiconductor and microelectronics R&D in the United States, including the investments in the infrastructure necessary to better integrate advances in research into semiconductor manufacturing.

[3] https://www.ept.ca/features/global-chip-shortage-a-timeline-of-unfortunate-events/
[4] https://hbr.org/2021/02/why-were-in-the-midst-of-a-global-semiconductor-shortage
[5] https://www.commerce.gov/news/blog/2022/01/results-semiconductor-supply-chain-request-information

President Biden's American Jobs Plan[6] calls for at least $50 billion to fund this set of programs. As funded by section 102 of the CHIPS Act of 2022:

- $39 billion is available for a program to incentivize investment in facilities and equipment in the United States for the fabrication, assembly, testing, advanced packaging, production, or research and development of semiconductors, materials used to manufacture semiconductors, or semiconductor manufacturing equipment;
- $11 billion is available to support several R&D and infrastructure investments including the establishment of a National Semiconductor Technology Center, investments in advanced packaging, the creation of up to three Manufacturing USA institutes targeting semiconductors, and expansion of NIST's metrology R&D in support of semiconductor and microelectronics R&D.

Under Section 9906(f) of the CHIPS for America Act, the Director of NIST may establish up to three Manufacturing USA Institutes described in section 34(d) of the NIST Act (15 U.S.C. 278s(d)) that are focused on semiconductor manufacturing. In addition, the Secretary of Commerce may award financial assistance to any Manufacturing USA institute for work relating to semiconductor manufacturing. Such institutes may emphasize the following:

(1) Research to support the virtualization and automation of maintenance of semiconductor machinery.

(2) Development of new advanced test, assembly and packaging capabilities.

(3) Developing and deploying educational and skills training curricula needed to support the industry sector and ensure the United States can build and maintain a trusted and predictable talent pipeline.

[6] https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/31/fact-sheet-the-american-jobs-plan/

Request for Information

This RFI outlines the information NIST is seeking from the public to inform the development of up to three Manufacturing USA semiconductor institutes that will strengthen leadership and national resilience of the U.S. semiconductor and microelectronics industry and other industries that rely on microelectronics, through research and development of manufacturing technology, and enhanced education and workforce development.

The following questions cover the major areas about which NIST seeks comment. They are not intended to limit the topics that may be addressed. Responses may include any topic believed to have implications for the development of Manufacturing USA semiconductor institutes, regardless of whether the topic is included in this document. Any one of the topics listed below, on its own, in combination with other topics listed, or in combination with other topics not contained in this notice, could be the basis of a Manufacturing USA semiconductor institute. When addressing the topics below, commenters may address the practices of their organization or a group of organizations with which they are familiar. If desired, commenters may provide information about the type, size, and location of the organization(s). Provision of such information is optional and will not affect NIST's consideration.

NIST is seeking comments on the following questions, and encourages responses from the public, including key stakeholders in the semiconductor and microelectronics ecosystem, for the purpose of informing the design of a funding opportunity for Manufacturing USA semiconductor institutes:

Institute Scope

1. The Manufacturing USA semiconductor institute program is one component of an $11 billion R&D effort that includes the National Advanced Packaging Manufacturing Program, the National Semiconductor Technology Research Center and the NIST laboratories. The entire

R&D program is intended to be interconnected and comprehensive, with no gaps and minimal redundancy, to position the United States for technology and workforce leadership in the semiconductor and microelectronics sector for the long-term prosperity of the nation. Additionally, the Manufacturing USA authorizing statute specifies that new institutes must not substantially duplicate the technology focus of any other Manufacturing USA institute. From your perspective, what role do you envision for new Manufacturing USA semiconductor institutes that will best complement the other R&D investments and remain consistent with the programmatic purposes of Manufacturing USA? Since the Secretary of Commerce may award financial assistance to any existing Manufacturing USA institutes for work relating to semiconductor manufacturing, what role do you envision for existing, federally-sponsored Manufacturing USA institutes with respect to semiconductor manufacturing?

2. The technological breadth of innovation in semiconductors and microelectronics is likely larger than can be served by any single Manufacturing USA institute. Therefore, each Manufacturing USA semiconductor institute should have an appropriate scope to ensure that each institute is impactful and does not duplicate efforts of other programs. Historically, institutes in the current network of existing Manufacturing USA institutes have generally been funded for an initial 5 years at $150 million to $600 million, including federal funding and cost-sharing (co-investment) from non-federal partners. What would be the ideal scope and corresponding financial investment from federal and non-federal partners, for a Manufacturing USA semiconductor institute to achieve the needed impact on competitiveness?
3. Potential technology areas of focus that could be addressed by the Manufacturing USA semiconductor institutes to complement the National Advanced Packaging Manufacturing Program and the National Semiconductor Technology Research Center in Question 1 are listed below. What are your thoughts on the appropriateness of each for the scope of work

for a Manufacturing USA semiconductor institute? What other topics should be included in the scope of an institute?

- **Chip-package architectures and co-design** of integrated circuits and advanced packaging. May include artificial intelligence, security, test methodologies, etc.
- **Technologies to increase the microelectronics manufacturing productivity** of American workers, lower costs and offset the drastic shortfall of skilled workers.
- **Assembly and Test metrologies** to develop new analytical equipment and analysis capabilities based upon standards.
- **Coding and system software** with novel computing paradigms and architectures, including chiplet compatibility with earlier generations.
- **Integration of security into packaging**, interposers and/or substrates.
- **High Density Interposers and substrates,** incorporating new materials and designs.
- **Chiplet-enabled trusted packaging** facilities that obviate the need for trusted foundries.
- **New materials**, such as glass for substrates, or compound semiconductors.
- **Environmental Sustainability** for semiconductor manufacturing.
- **Analog and Gigahertz Technology** materials and metrology, enabling beyond 5G, the Industrial Internet of Things and Industry 4.0.
- **Performance and Process Modeling and Metrology**

4. What criteria should be used to select technology focus areas in delineating the scope for a Manufacturing USA institute focused on semiconductor manufacturing?
5. What technology focus areas that meet the criteria suggested in Question 4 above would you be willing to co-invest in?

Institute Structure and Governance

6. Existing Manufacturing USA institutes were launched and operate in alignment with the design principles published in 2012 as the *National Network for Manufacturing Innovation: A Preliminary Design* (https://www.manufacturingusa.com/reports/national-network-manufacturing-innovation-preliminary-design). Are there any unique considerations for the semiconductor and microelectronics sector that may require modifications to the conventional design for any Manufacturing USA semiconductor institutes under consideration?
7. Semiconductor R&D and manufacturing cover substantial technical breadth. What business models or best practices should be employed by a Manufacturing USA semiconductor institute to support U.S. leadership and effectively manage emerging technologies to support commercialization? What advantages or disadvantages would there be to one "super-sized" Manufacturing USA semiconductor institute that would cover the technology sector broadly? Since Congress authorized the NIST Director to establish up to three institutes, what advantages or disadvantages would there be for multiple Manufacturing USA semiconductor institutes each with a smaller scope focused on a specific technology area? How would one Manufacturing USA semiconductor institute or multiple institutes structure relationships with other significant partners to spur collaborative work?
8. What membership and participation structure for a Manufacturing USA semiconductor institute would be most effective for ensuring participation by industry, academia, and other critical stakeholders, particularly with respect to financial and intellectual property obligations, access, and licensing? Based on your knowledge of current Manufacturing USA institute practices, are the needs of potential semiconductor institutes different than for other institutes?

Strategies for Driving Co-Investment and Engagement

9. The authorizing statute for Manufacturing USA requires at least an equal non-federal co-investment in Manufacturing USA institutes to match the federal investment. From your perspective, what are the most significant considerations to garner support for the required co-investment for a Manufacturing USA semiconductor institute? What is the anticipated impact of the new Investment Tax Credit (ITC) for industry established in the CHIPS Act on the level of investment in the new Manufacturing USA semiconductor institute(s), in facilities, including for manufacturing equipment and construction? How might a Manufacturing USA semiconductor institute be set up to best leverage the Investment Tax Credit?
10. For the required non-federal co-investment for a Manufacturing USA semiconductor institute, with respect to the different types of co-investment (e.g., cash, equipment donations, facilities access, etc.), are there factors unique to the semiconductor industry that would impact how the co-investment could be structured to best support the institute?
11. What arrangements for co-investment proportions and types could help a Manufacturing USA semiconductor institute sustain operations in the absence of continued federal support?
12. A Manufacturing USA semiconductor institute should support domestic competitiveness. How should relationships with foreign entities be structured or constrained to support domestic manufacturing priorities while maximizing the opportunities to leverage international expertise and resources? In what circumstances should the Manufacturing USA Semiconductor institutes and NIST as the federal sponsor, consider membership requests from foreign-owned businesses?
13. How should a new Manufacturing USA semiconductor institute engage other existing Manufacturing USA institutes (https://www.manufacturingusa.com/institutes), including those awarded funds for work related to semiconductor manufacturing, and other manufacturing related programs and networks such as the Manufacturing Extension Partnership (https://www.nist.gov/mep) and the U.S. Department of Energy's Next

Generation Power Electronics National Manufacturing Innovation Institute ("Power America")?

14. How should a Manufacturing USA semiconductor institute interact with State and local economic development entities?
15. How should a Manufacturing USA semiconductor institute coordinate with and inform standards development bodies on the need to modify existing or develop new standards as a result of this initiative?

Education and Workforce Development

16. How could a Manufacturing USA semiconductor institute best support advanced manufacturing workforce development and/or awareness at all educational levels (e.g., for K-12 through post-graduate students)?
17. How could a Manufacturing USA semiconductor institute best engage and leverage the diversity of educational and vocational training organizations (e.g., universities, community colleges, trade schools, etc.)?
18. How could a Manufacturing USA semiconductor institute best ensure that advanced manufacturing workforce development activities address the industry's priorities?
19. How could a Manufacturing USA semiconductor institute best leverage and complement existing education and workforce development programs?
20. What measures could assess Manufacturing USA semiconductor institute performance and impact on education and workforce development?
21. How might a Manufacturing USA semiconductor institute integrate research and development activities and education to best prepare the current and future workforce?
22. How could a Manufacturing USA semiconductor institute help build a steady pipeline of skilled workers? What knowledge, skills and abilities will future workers need, and are there workers with those skills currently employed in other sectors?

23. How could a Manufacturing USA semiconductor institute broaden the talent base (i.e., embrace diversity, equity, inclusion, and accessibility; reach women and minority communities, engage non-traditional workers, engage separating service members, veterans, and families) to modernize the workforce?
24. What type of education and workforce development activities should a Manufacturing USA semiconductor institute support (e.g., curricula, online education, hybrid, entrepreneurship opportunities, credentialing, regional development, train the trainers, internships/apprenticeship, learning labs, etc.) and why?

Metrics and Success

25. What metrics could be used to best evaluate the performance of a Manufacturing USA semiconductor institute in accelerating innovation, and any associated impacts on economic competitiveness and national security? Are there sector-specific metrics for an institute in the semiconductor technology space?
26. What type of metrics could be used to best evaluate the performance and impact of a Manufacturing USA semiconductor institute on education and workforce development in support of U.S. competitiveness?
27. What type of metrics could be used to best evaluate the performance and impact of a Manufacturing USA semiconductor institute in establishing and expanding the U.S. semiconductor manufacturing ecosystem?
28. What constitutes a successful first year for a Manufacturing USA semiconductor institute? What forms of support, and from which partners, are needed to ensure a successful first year?

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[FR Doc. 2022-22221 Filed: 10/12/2022 8:45 am; Publication Date: 10/13/2022]