



Strategic Plan for the Manufacturing USA Program



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About This Document

This document is the strategic plan for the Manufacturing USA Program, as required by the program’s authorizing statute.* This strategic plan addresses the role of the Manufacturing USA institutes in developing advanced manufacturing technology; fostering resilient, domestic supply chains; and building a diverse and equitable manufacturing workforce.

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* Consolidated and Further Continuing Appropriations Act, 2015, (Pub. L. 113-235, Title VII – Revitalize American Manufacturing Innovation Act of 2014, codified at 15 U.S.C. § 278s(h)(2)(C)). [http://uscode.house.gov/view.xhtml?req=\(title:15%20section:278s%20edition:prelim\)](http://uscode.house.gov/view.xhtml?req=(title:15%20section:278s%20edition:prelim))

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Manufacturing USA Program Overview

The Manufacturing USA Program catalyzes public and private investments in precompetitive advanced manufacturing technology to 1) develop new manufacturing technologies for transition to private industry; 2) educate, train, and connect the manufacturing workforce to jobs that rely on advanced manufacturing methods; and 3) improve the capability, resilience, and security of the domestic manufacturing ecosystem and supply chains to achieve and sustain U.S. global competitiveness.

Manufacturing USA's mission is accomplished through a uniquely structured interagency and public-private partnership network. Participating Federal agencies and Manufacturing USA institutes coordinate to collectively advance the goals and objectives of the Manufacturing USA Program.

The Manufacturing USA institutes

Each institute is a public-private partnership comprised of companies, academia, state and local governments, and Federal agencies that co-invest in developing advanced manufacturing technologies and capabilities. Each institute has a unique technology focus area and can provide the state-of-the-art facilities needed for collaborative and precompetitive research and development (R&D). Their focuses include important areas such as improving cybersecurity in manufacturing across the supply chain, developing advanced lightweight materials manufacturing, enabling efficient flexible new technologies in biopharmaceutical production, and many others. To promote and propagate the new technologies, the institutes also provide for workforce education and training in their unique technology area. The institutes promote the creation of resilient advanced manufacturing ecosystem and supply chains through strategic, innovative, and collaborative R&D. There are currently seventeen Manufacturing USA institutes sponsored by the Department of Commerce (DOC), Department of Defense (DoD), and the Department of Energy (DOE). The Department of Commerce has released a notice of funding opportunity for a new institute focused on digital twins for the semiconductor industry as part of its CHIPS R&D program¹ and a notice of intent for an institute on Artificial Intelligence for Resilient Manufacturing.²

The Manufacturing USA Network

The authorizing legislation³ requires DOC to establish and convene a network of all the Manufacturing USA institutes. The DOC's National Institute of Standards and Technology (NIST) is the only research laboratory in the U.S. Government specifically focused on enhancing industrial competitiveness; its robust research portfolio is concentrated on the technical challenges associated with advanced manufacturing. In addition to its research portfolio in advanced manufacturing, NIST has connections to and assists small and medium manufacturers (SMMs) through its widely recognized Hollings Manufacturing Extension Program (MEP). In addition, NIST is chartered to assist the Federal government in technology transfer issues.

¹ <https://www.nist.gov/chips/research-development-programs/chips-manufacturing-usa-institute>

² <https://www.nist.gov/oam/loi-ai-resilient-manufacturing-institute>

³ Revitalize American Manufacturing and Innovation Act of 2014, (Pub. L. 113-235, codified in relevant part at 15 U.S.C. § 278s(c)).
[http://uscode.house.gov/view.xhtml?req=\(title:15%20section:278s%20edition:prelim\)](http://uscode.house.gov/view.xhtml?req=(title:15%20section:278s%20edition:prelim))

The Manufacturing USA network's connected and coordinated activities enhance the program's impacts and further strengthen America's global competitiveness and security through the cooperation, collaboration, and leadership of the institutes, Federal sponsors, and agencies. Supported by their agency sponsors and assisted by the participating Federal agencies, each institute forms a network among institute members and partners with the same technology focus. The Manufacturing USA Program unites all of the institutes into a network of interconnected and collaborative networks across industry sectors nationwide.

The Advanced Manufacturing National Program Office

Headquartered at NIST, the Advanced Manufacturing National Program Office (AMNPO) oversees and coordinates the activities of the Manufacturing USA Program, working with Federal departments and agencies whose missions contribute to or are affected by advanced manufacturing.

Interagency Collaboration

Manufacturing USA Program comprises nine Federal partner agencies: DOC, DoD, and DOE (as sponsoring agencies); and DOL, ED, HHS/FDA, NASA, NSF, and USDA (as participating agencies). Together, the interagency team shares information and approaches to address manufacturing challenges and identify opportunities for collaboration. AMNPO is responsible for coordinating and collaborating with the Federal agencies to conduct program activities.



Figure 1. Manufacturing USA partner agencies.

Public-Private Partnership

Manufacturing USA unites the current seventeen institutes with the nine sponsoring and participating Federal agencies to help ensure a whole-of-government approach in tackling the nation's important manufacturing challenges. The Manufacturing USA institutes are public-private partnerships focused on critical and emerging advanced manufacturing technology areas to accelerate technology development and commercialization, workforce development, and economic security and resilience. The sponsoring Federal agencies have individually provided initial funding and program management of the current institutes (Figure 1). These three sponsoring agencies launched their institutes through competitive Federal assistance agreement awards. After an initial funding period of 5-7 years, Federal support may be continued after a rigorous evaluation with follow-on agreements. Each institute is responsible for a minimum of 1:1 match of non-Federal resources to Federal base program support.⁴ Since each institute is established by a lead government agency, institute technology focus areas and models vary based on the mission and needs of that agency:

- The institute sponsored by DOC NIST Office of Advanced Manufacturing (OAM) focuses on economic competitiveness via manufacturing technology development and workforce development. NIST sponsors the National Institute for Innovation in Manufacturing Biopharmaceuticals (NIIMBL) and has recently announced plans for two additional institutes, a CHIPS Manufacturing USA Institute on Digital Twins for Semiconductor Manufacturing and an institute on Artificial Intelligence for Resilient Manufacturing.

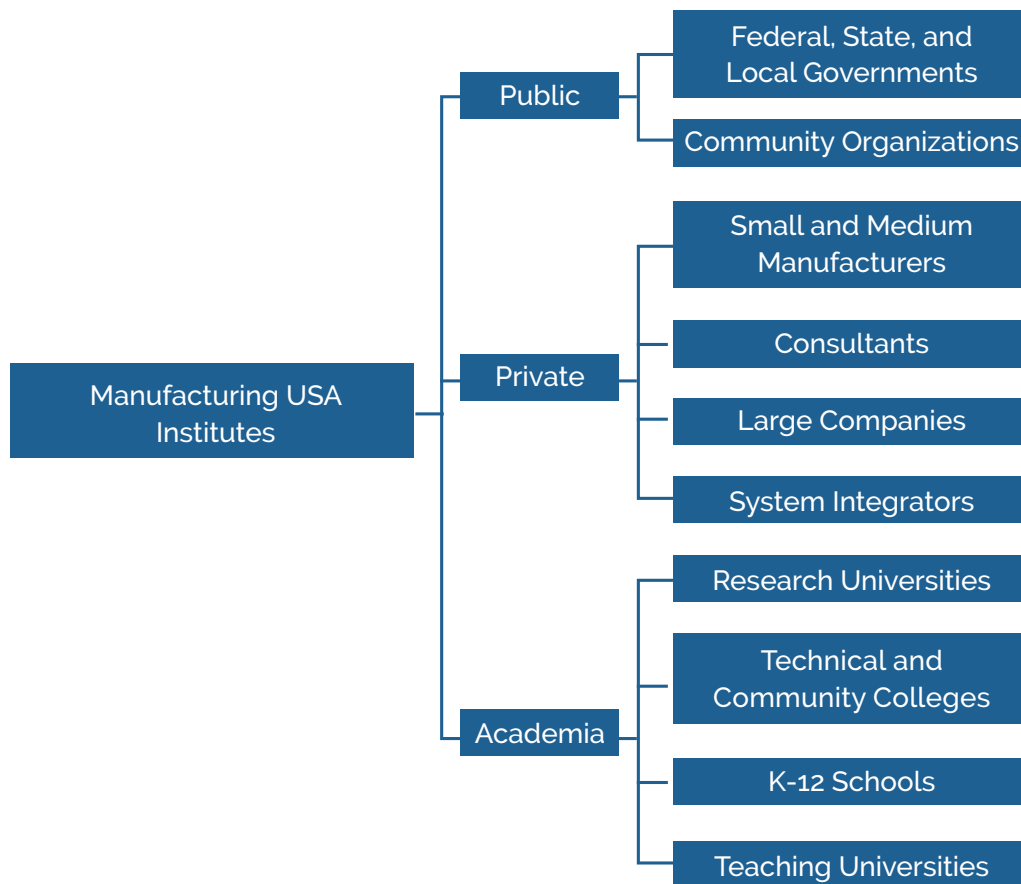


Figure 2. Manufacturing USA institute members and stakeholders.

⁴Revitalize American Manufacturing and Innovation Act of 2014, (Pub. L. 113-235, codified in relevant part at 15 U.S.C. § 278s(e)(7)). [http://uscode.house.gov/view.xhtml?req=\(title:15%20section:278s%20edition:prelim\)](http://uscode.house.gov/view.xhtml?req=(title:15%20section:278s%20edition:prelim))

- The nine institutes sponsored by DoD within the Office of the Secretary of Defense Manufacturing Technology Program (ManTech) focus on manufacturing technologies needed for national security with potential commercial applications. They seek to revitalize the U.S. domestic manufacturing capability to enhance the nation’s strategic competitiveness while enabling the military of tomorrow.
- The seven institutes sponsored by DOE within the Office of Energy Efficiency & Renewable Energy (EERE) focus on improving the energy and resource efficiency of manufacturers across industrial sectors and advancing industrial decarbonization technologies.⁵

The institutes’ flexible operational models and highly collaborative approach to applied R&D catalyze important new relationships across government, industry, and academia. Members leverage the institutes’ unique project and networking opportunities to collectively solve manufacturing challenges and educate the workforce needed to advance new technologies. These unique institute-led ecosystems also serve as invaluable resources for the Federal government to tackle agency-specific challenges.

Through collaborative precompetitive development and transition of promising technologies, Manufacturing USA institutes create sustainable innovation ecosystems for advanced manufacturing by:

- Conducting precompetitive applied research and development projects to reduce the cost, time, and technical uncertainty associated with new manufacturing technologies and to improve existing technologies, processes, and products.
- Developing and implementing education, training, awareness, and programs for all stages of workforce development.
- Developing new technologies, innovative methodologies, and improved practices for securing, expanding, and increasing the resilience of domestic manufacturing supply chains.
- Engaging with diverse stakeholders, including small and medium-sized manufacturers (SMMs), woman-owned and minority-owned manufacturing enterprises, as well as larger manufacturing firms.
- Developing or encouraging shared state-of-the-art facilities and infrastructure to promote the development of new technologies and manufacturing processes.

A goal of the Manufacturing USA Program is to build on years of best practices and to ensure collaboration among the institutes and the Federal government. Each institute is designed to deliver on the specific mission of its sponsoring agency, while uniting under the umbrella of the Manufacturing USA network to fulfill a common vision and support shared national goals within this strategy. Existing and future institutes will continue to leverage the public-private partnership model to deliver on the important national strategic goals of the Manufacturing USA Program and the agency partners, providing a foundation for the implementation solutions proposed later to improve cooperation among the institutes and agencies. The Manufacturing USA Program will reach its full impact when the Program not only conducts R&D on all new, innovative, and emerging manufacturing technologies, but also transitions and scales up these technologies into commercialization.

⁵On May 16, 2023, DOE announced the selection of Arizona State University to lead the seventh Clean Energy Manufacturing Innovation Institute. EPIX will mobilize a coalition of private companies, National Labs, universities, labor unions, and community partners and will allocate up to \$70 million in Federal funding over the next five years for research, development, and demonstration (RD&D) projects to electrify process heating and decarbonize the industrial sector.

Table 1. Established Manufacturing USA Institutes

Institute	Technology Focus Area	Agency	Headquarter Location	Date Estab.
America Makes The National Additive Manufacturing Innovation Institute	Additive manufacturing	DoD	Youngstown, OH	Aug 2012
MxD Manufacturing Times Digital	Digital manufacturing and design/ Cybersecurity in Manufacturing	DoD	Chicago, IL	Feb 2014
LIFT Lightweight Innovations For Tomorrow	Lightweight materials manufacturing	DoD	Detroit, MI	Feb 2014
PowerAmerica Next Generation Power Electronics Manufacturing Innovation Institute	Wide-bandgap power electronics manufacturing	DOE	Raleigh, NC	Jan 2015
IACMI Institute for Advanced Composites Manufacturing Innovation	Fiber-reinforced polymer composites manufacturing	DOE	Knoxville, TN	Jun 2015
AIM Photonics American Institute for Manufacturing Integrated Photonics	Integrated photonics manufacturing	DoD	Rochester, NY Albany, NY	Jul 2015
NextFlex America's Flexible Hybrid Electronics Manufacturing Institute	Thin flexible electronics devices and sensors manufacturing	DoD	San Jose, CA	Aug 2015
AFFOA Advanced Functional Fabrics of America Institute	Sophisticated, integrated, and networked fibers, yarns, and fabric manufacturing	DoD	Cambridge, MA	Apr 2016
CESMII Clean Energy Smart Manufacturing Innovation Institute	Smart manufacturing, sensing, control, modeling, analytics and platform technologies	DOE	Los Angeles, CA	Dec 2016
ARMI BioFabUSA Advanced Regenerative Manufacturing Institute	Engineered tissues and tissue-related manufacturing	DoD	Manchester, NH	Dec 2016
ARM INSTITUTE Advanced Robotics for Manufacturing Institute	Transformative artificial intelligence and robotic technologies for manufacturing	DoD	Pittsburgh, PA	Jan 2017

Table 1. Established Manufacturing USA Institutes (continued)

Institute	Technology Focus Area	Agency	Headquarter Location	Date Estab.
NIIMBL National Institute for Innovation in Manufacturing Biopharmaceuticals	Biopharmaceutical manufacturing	DOC	Newark, DE	Mar 2017
RAPID Rapid Advancement in Process Intensification Deployment Institute	Modular chemical-process intensification for manufacturing	DOE	New York, NY	Mar 2017
REMADE Reducing Embodied-energy And Decreasing Emissions	Sustainable manufacturing	DOE	Rochester, NY	May 2017
CyManII Cybersecurity Manufacturing Innovation Institute	Cybersecure and energy efficient manufacturing	DOE	San Antonio, TX	Sep 2020
BioMADE Bioindustrial Manufacturing and Design Ecosystem	Sustainable and reliable bioindustrial manufacturing technologies	DoD	St. Paul, MN	Oct 2020
EPIX The Electrified Process for Industry without Carbon	Electrified process heating	DOE	Tempe, AZ	May 2023

Manufacturing USA Program Strategy

The United States is seeing a historic boom in domestic manufacturing. In recent years, the U.S. has attracted over \$500 billion in private investment to American manufacturing and the industries of the future. Real spending on factory construction doubled in the last two years, and during a period last year contributed more to gross domestic product growth than any six months on record.⁶

The Manufacturing USA institutes are an important part of that work. They help facilitate U.S. leadership in advanced manufacturing and build a strong workforce. The institutes work through public-private partnerships and are involved in a range of cutting-edge technologies from robotics to additive manufacturing to biomanufacturing. Guided by this Strategic Plan, the AMNPO works with the Federal agency partners to coordinate the network of institutes to achieve the following vision and mission.

Vision

The vision for the Manufacturing USA program is U.S. global leadership in advanced manufacturing through the development and transition of innovative technologies into scalable, cost-effective, and high-performing domestic manufacturing capabilities.

Mission

To support this vision, the mission of the Manufacturing USA Program is to connect people, ideas, and technology to solve industry-relevant advanced manufacturing challenges, thereby enhancing industrial competitiveness.

The focus of the Manufacturing USA Program, which includes nine Federal agencies and a growing network of manufacturing innovation institutes, is to strengthen U.S. economic prosperity, resilience, and national security by transitioning innovative technologies into practice. The Manufacturing USA institutes are public-private partnerships focused on accelerating the development and commercialization of critical emerging advanced manufacturing technologies and training domestic workers in these new technologies. The Program is part of the Federal government's overall innovation portfolio, which includes basic and applied R&D support, investment incentives, and programs and policies related to taxes, trade, and regulations.

This Program helps to grow the economy, create and preserve high-quality jobs, promote supply chain resilience, enhance environmental sustainability, address climate change, ensure national security, and improve healthcare.⁷ Due to increased importance and reliance on digital technologies in manufacturing, each institute and the network, as a whole, must pay particular attention to cybersecurity issues needed to protect safety and security of our manufacturing ecosystem and supply chains.

⁶ <https://www.whitehouse.gov/briefing-room/presidential-actions/2023/10/05/a-proclamation-on-national-manufacturing-day-2023/>

⁷ *National Strategy for Advanced Manufacturing*, Executive Office of the President, National Science and Technology Council, Committee on Technology, Subcommittee on Advanced Manufacturing (October 7, 2022).
<https://www.commerce.gov/news/blog/2022/10/announcing-national-strategy-us-leadership-advanced-manufacturing>

Goals and Objectives

Based on the vision and mission of the Manufacturing USA Program, the Federal agency partners and institutes work toward four goals that flow from the purposes stated in the authorizing legislation⁸ and are consistent with each sponsoring agency's mission:

Goal 1: Increase the competitiveness of U.S. manufacturing

Goal 2: Create and facilitate the transition of innovative technologies into scalable, cost-effective, and high-performing domestic manufacturing capabilities

Goal 3: Accelerate the development of an advanced manufacturing workforce

Goal 4: Promote a network of institutes that build long-term support for and within their communities

These four program goals are interrelated elements of a robust strategy for supporting manufacturing innovation by reducing the time required to transition early-stage research to commercial development and, ultimately, deployment in U.S. manufacturing environments. The goals guide the network of agency partners and institutes to advance U.S. domestic manufacturing capability while leveraging the economic and national security benefits from other Federal and private sector investments in fundamental research. The initiatives identified under the Goals and Objectives are aligned with suggested recommendations from the 2022 White House Leadership Summit.⁹

To develop this Strategic Plan, the program goals, and objectives from the 2016 and 2019 Strategic Plans¹⁰ were reviewed by the strategic planning interagency team. Strategic objectives under each goal were refined and Goal 4 was updated to incorporate lessons learned, enhance impact of the Program, and meet current national priorities. The four program goals and thirteen strategic objectives are presented in Table 2. In the following section, each strategic objective is explained, with recommended outcomes, approaches, and actions to be achieved over the next three years. The suggested actions will be accomplished through mechanisms described in the “Coordination and Reports” section, as well as through new mechanisms described in the “Implementation of the Strategic Plan” section. The outcomes are designed to be concrete and measurable. As programmatic efforts are implemented to support these outcomes, concomitant metrics will be developed for each outcome to measure program success.

⁸ Revitalize American Manufacturing and Innovation Act of 2014, (Pub. L. 113-235, codified in relevant part at 15 U.S.C. § 278s(b)(2)). [http://uscode.house.gov/view.xhtml?req=\(title:15 section:278s edition:prelim\)](http://uscode.house.gov/view.xhtml?req=(title:15 section:278s edition:prelim))

⁹ *Readout of the First White House Leadership Summit with Manufacturing USA Innovation Institute Network Directors*, The White House (October 24, 2022). <https://www.whitehouse.gov/briefing-room/statements-releases/2022/10/24/readout-of-the-first-white-house-leadership-summit-with-manufacturing-usa-innovation-institute-network-directors/>

¹⁰ *National Network for Manufacturing Innovation (NNMI) Program Strategic Plan*, Executive Office of the President, National Science and Technology Council, Advanced Manufacturing National Program Office (February 2016). <https://www.manufacturingusa.com/reports/national-network-manufacturing-innovation-nnmi-program-strategic-plan>, and *Manufacturing USA Strategic Plan*, Advanced Manufacturing National Program Office (November 2019). <https://www.manufacturingusa.com/reports/manufacturing-usa-strategic-plan>

Table 2. Manufacturing USA Strategic Goals and Objectives

Goal 1: Increase the competitiveness of U.S. manufacturing

Objective 1.1: Promote development and maturation of technologies that reduce costs and increase productivity of domestic manufacturing.	Objective 1.2: Promote a diverse advanced manufacturing ecosystem.	Objective 1.3: Establish an applied research and development innovation portfolio.	Objective 1.4: Provide leadership to support national advanced manufacturing priorities.
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Expected Outcome: Increased competitiveness of U.S. manufacturing by promoting a diverse manufacturing ecosystem and an enhanced portfolio of technology programs.

Goal 2: Create and facilitate the transition of innovative technologies into scalable, cost-effective, and high-performing manufacturing capabilities

Objective 2.1: Provide U.S. manufacturers with validated advanced manufacturing technologies, materials, and equipment.	Objective 2.2: Facilitate sharing of technical knowledge and best practices to address advanced manufacturing challenges.	Objective 2.3: Encourage multi-institute collaborations to accelerate the development and adoption of manufacturing technologies.
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Expected Outcome: Enhancement of Manufacturing USA Program's success through transition of institute technologies to industry.

Goal 3: Accelerate the development of an advanced manufacturing workforce

Objective 3.1: Support development and integration of advanced manufacturing credentialing and certification to meet industry employment needs.	Objective 3.2: Expand work-based learning, registered apprenticeships, industry credentials, dual enrollment, career advising, distance learning, and other innovations in career and technical programs.	Objective 3.3: Promote manufacturing careers and provide culturally responsive outreach to and engagement with students, especially to diverse, underrepresented populations.
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Expected Outcome: Increased local and regional cooperation among institutes, industry, educational institutions, and all other organizations interested or active in career and technical programs to raise participation of underrepresented populations in institute education and workforce development activities.

Goal 4: Promote a network of institutes that build long-term support for and within their communities

Objective 4.1: Encourage membership structures that promote shared risk and shared investment in institute activities.	Objective 4.2: Support the development of institute sustainment models that ensure continuity of operations.	Objective 4.3: Support cross-network collaboration and sharing of best practices, infrastructure, and activities.
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Expected Outcome: Growth in non-core Federal and non-Federal program funding for institute activities and cross-network collaborations for continuity of operation and long-term sustainment and impact.

Goal 1: Increase the competitiveness of U.S. manufacturing

Increasing manufacturing production capability will strengthen U.S. manufacturers' global competitiveness. This requires fostering and maintaining U.S. leadership in advanced manufacturing research, innovation, technology development, and deployment to industry. The four strategic objectives that support this Goal focus on positioning the Program to build a resilient ecosystem and strategic technical portfolios needed to collaboratively advance innovation and increase productivity. The recommended outcomes, approaches, and actions below must be implemented with emphasis on stakeholder diversity, especially those in underserved and underrepresented communities. By focusing on the approaches outlined for each objective below, it is expected that institute membership, the diversity of membership, and network-wide active participation will increase. This will help support participating manufacturers to become more globally competitive by adopting new technologies that will boost productivity and reduce production costs.

Expected Outcome: Increased competitiveness of U.S. manufacturing by promoting a diverse manufacturing ecosystem and an enhanced portfolio of technology programs.

Objective 1.1: Promote development and maturation of technologies that reduce costs and increase productivity of domestic manufacturing. A robust and resilient manufacturing ecosystem must include a diverse and healthy base of small, medium, and large producers. Advanced manufacturing technologies can address barriers to domestic production and address critical supply chain challenges. For example, the June 2021 White House report on “Building Resilient Supply Chains, Revitalizing American Manufacturing, and Fostering Broad-Based Growth,” identified the need for increased public investment in R&D and commercialization to increase competitiveness in critical sectors.¹¹ Advancements in next generation battery innovation can reduce exposure to supply chain risks and reduce the environmental impacts of production. Advancements in pharmaceutical manufacturing can improve quality control, increase flexibility of production lines, and raise plant productivity. Similarly, innovations in semiconductor chip designs and advanced manufacturing technologies can reduce potential future supply chain shocks.

Manufacturing USA institutes already play a critical role in advancing productivity-enhancing technologies. A project at the DOE-sponsored Institute for Advanced Composites Manufacturing Innovation (IACMI) is reducing the cost of wind turbine blades by developing new manufacturing processes and materials that are more efficient, cost-effective, and environmentally sustainable. NIIMBL has supported the development of “flow-through methods” in pharmaceutical manufacturing, which reduce the use of natural resources and energy and lower costs.

Existing and new Manufacturing USA institutes will build on these strengths. Since 2021, the private sector has committed \$644 billion in U.S. manufacturing investment, including hundreds of billions of dollars in foreign direct investment (FDI).¹² Real U.S. private investment in manufacturing structures has doubled since January 2021, above S&P global projections. As of Spring 2024, these investments were at their highest level on record.¹³ Manufacturing USA institutes are well positioned to capitalize on this investment in U.S. manufacturing to advance technologies that improve the economics of domestic production.

Approach: *Engage diverse industrial, academic, and government participants and stakeholders to enhance productivity and reduce costs of domestic production.*

¹¹ *Building Resilient Supply Chains, Revitalizing American Manufacturing, and Fostering Broad-Based Growth*, pps. 12-14, The White House (June 2021). <https://www.whitehouse.gov/wp-content/uploads/2021/06/100-day-supply-chain-review-report.pdf>

¹² https://www.whitehouse.gov/invest/?utm_source=invest.gov

¹³ Source: S&P global projections, BEA.

Action: AMNPO, with support from its Federal partners, will host several events for the Manufacturing USA network to engage with stakeholders and share challenges and opportunities to improve production processes or eliminate barriers to domestic production.

Objective 1.2: Promote a diverse advanced manufacturing ecosystem. Strengthening market-driven, advanced manufacturing innovation ecosystems that can quickly adapt to new challenges enhances domestic production capabilities, and, in turn, maintains U.S. global manufacturing competitiveness. The manufacturing ecosystem is a complex collection of educational, research, and industrial enterprises that contribute to the success of manufacturing systems. The ecosystem also includes local and regional enterprises that can provide a connection to the local communities. While the ecosystem of advanced manufacturing has been slowly growing, this growth has been generally concentrated in certain localities with historical strength in advanced technologies. Further growth of the manufacturing ecosystem requires participation by diverse communities, organizations, stakeholders, and individuals. To be the most competitive country in the world, communities all across the United States must be included in the advanced manufacturing ecosystem, especially those that have been historically left behind. While each Manufacturing USA institute focuses on a unique technology and is geographically located in a specific region, the Program will reach out to other regions and more diverse populations.

Approach: Engage diverse industrial, academic, and government participants and stakeholders in under-represented localities and groups to join and collaborate with Manufacturing USA Institutes.

Action: AMNPO and its Federal partners will support at least two events annually for the Manufacturing USA network to engage with historically Black colleges and universities; Tribal Colleges or Universities; minority-serving institutions; minority business enterprises; and/or rural-serving institutions of higher education, that represent communities underrepresented in advanced manufacturing.

Objective 1.3: Establish an applied research and development innovation portfolio. Manufacturing USA institutes focus on specific, critical, and emerging technology issues to promote economic development and global competitiveness. While the Manufacturing USA Program currently consists of seventeen institutes, many opportunities exist for strategically expanding the technology portfolio of the Program. Federal agencies should evaluate the manufacturing technology priorities listed in the 2022 Advanced Manufacturing National Strategic Plan,¹⁴ which drew on input from a wide range of stakeholders, to plan for the establishment of new institutes in technology areas not currently covered by the Program. The same list of priorities and the list of emerging technologies,¹⁵ along with input from the institute member organizations and agency sponsors, should be also used by the institutes to expand the technical portfolio of the institute projects.

Approach: Establish new institutes, when appropriate, in technology sectors aligned with national priorities in advanced manufacturing. Through institute project calls, engage U.S. industry in R&D directions needed to develop and transition innovative advanced manufacturing technologies.

Action: AMNPO and sponsoring agencies will develop coordinated best practices for defining potential new institutes and/or for modifying an institute's technical scope.

¹⁴ *National Strategy for Advanced Manufacturing*, Executive Office of the President, National Science and Technology Council, Committee on Technology, Subcommittee on Advanced Manufacturing (October 7, 2022).

<https://www.commerce.gov/news/blog/2022/10/announcing-national-strategy-us-leadership-advanced-manufacturing>

¹⁵ <https://www.whitehouse.gov/wp-content/uploads/2024/02/Critical-and-Emerging-Technologies-List-2024-Update.pdf>

Objective 1.4: Provide leadership to support national advanced manufacturing priorities. Manufacturing USA institutes serve as leaders in their technology areas to pursue priorities for implementing advanced manufacturing innovations, in coordination with their ecosystem partners. Collaboration among institutes and input from all stakeholders results in a more granular advanced manufacturing policy to secure the competitiveness of each technology. By sponsoring and convening activities such as technical road mapping, technology forums, and training curricula, Manufacturing USA facilitates consensus in the shared needs of the industrial ecosystems to drive innovation beyond an individual institute’s reach. Institutes also provide leadership in the development of technology-based manufacturing ecosystems through connections for their start-up members with business acceleration, financing, and scale-up technical assistance. The Manufacturing USA Program guides the development of innovative facility, testbeds, and other approaches to enable the institutes to scale-up their technologies and link to later-stage business services.

Approach: *Sponsoring agencies will work with institutes to ensure sufficient flexibility and resources to lead and support national efforts to meet sector needs.*

Action: *AMNPO will offer public service grants to institutes to expand the reach of individual institute activities to broader national ecosystems. AMNPO and Federal partners will provide opportunities for the institutes to inform national advanced manufacturing priorities; for example, through annual presentations to discuss technologies of interest with the National Science and Technology Council Subcommittee on Advanced Manufacturing.*

Goal 2: Create and facilitate the transition of innovative technologies into scalable, cost-effective, and high-performing manufacturing capabilities

Advanced manufacturing technologies that show promise in research laboratories often face technical and economic barriers toward scale-up and implementation in production environments. Many promising manufacturing innovations developed in universities and small- and medium-sized manufacturers (SMMs) suffer this fate, which is detrimental to U.S. manufacturing productivity. The Manufacturing USA Program lowers these barriers and accelerates the delivery of productivity-improving innovations to manufacturing companies and reduces market failures caused by insufficient availability of resources needed to bring innovations into production. The scale-up amplification of newly developed manufacturing capabilities is a key benefit of having a connected network of institutes.

The CHIPS and Science Act, requires each agency head to “establish policies to promote the domestic production of technologies developed by the Manufacturing USA Network.”¹⁶ Therefore, AMNPO, in coordination with sponsoring agencies, will encourage transition and commercialization of new technologies developed with Federal R&D investments into production in the U.S.

Expected Outcome: Evidence of the Manufacturing USA Program’s impact through successful transition of institute technologies to industry.

¹⁶ CHIPS and Science ACT, Section 10263, codified at 42 USC 18972.

Objective 2.1: Provide U.S. manufacturers with validated advanced manufacturing technologies, materials, and equipment. Although the U.S. innovation ecosystem is fueled by a strong entrepreneurial culture that rewards innovation, it often lacks the resources needed to mature these innovations and effectively transition them to production. Manufacturing USA institutes address this challenge by providing U.S. manufacturers of all sizes with access through institute memberships (and sometimes fee-based services) to resources, technical expertise, and a network of support.

Many manufacturers, particularly SMMs, lack the capability to undertake the technological and financial risks associated with new technology development, scale-up, and adoption. Manufacturing USA institutes identify promising breakthroughs that align with compelling industry needs and advance those technologies to the point of broad accessibility. They support development of testbeds and demonstration facilities that provide opportunities for potential users to assess the suitability of new technologies. These facilities and services, including affordable state-of-the-art prototyping capabilities, allow domestic manufacturers to conduct limited-scale production runs to evaluate new manufacturing processes or prototypes prior to committing to full-scale production. Manufacturing USA institutes also provide fee-based access to technical consulting services, equipment, training, and opportunities to collaborate and conduct business with other institute members and technology and service providers.

Historically, Manufacturing USA institutes have focused on bridging the “valley of death,” mainly through applied, precompetitive research in technology readiness levels (TRLs) or manufacturing readiness levels (MRLs) 4-7. TRLs are used to estimate the maturity of technologies, especially for acquisition purposes. MRLs are criteria used to assess the readiness of a product or system for full-scale production. Each readiness scale can be useful for assessing the development level of a new manufacturing technology, depending on the specific technology and application. As chartered, institutes can, and do, work with later technology maturity levels. Manufacturing USA institutes will consider expanding activities in higher levels (i.e., TRLs 7-9 or MRLs 7-10, commonly referred to as “scale-up” and composed of activities such as technology qualification, pilot production, manufacturing deployment, and commercialization).

Approach: Provide manufacturers of all sizes in the network, particularly SMMs, innovators, and entrepreneurs, with increased access to knowledge, services, testbeds, and facilities to enable evaluation and adoption of new manufacturing technologies.

Action: AMNPO will work with sponsoring agencies to develop and share best practices that help institutes provide manufacturers, including start-ups and SMMs, access to specialized facilities, equipment, and other institute resources, including expanding focus on later-stage technology development.

Objective 2.2: Facilitate sharing of technical knowledge and best practices to address advanced manufacturing challenges. Manufacturing USA institute members include large, small, and medium-sized organizations, that benefit from shared undertakings and resources. Many of SMMs participate in the MEP programs through the regional MEP centers and comprise an integral part of the domestic manufacturing supply chains. The technical knowledge developed by the Manufacturing USA institutes is shared with the SMMs to assist in the transition and commercialization of the network’s technologies.

The institutes can create value nationwide through communicating emerging government and industry technology priorities, spotlighting institute-led activities, products, and services, and addressing common technical challenges. Collaborations with the MEP centers create program-level solutions for institute challenges, such as sustainable business models and foreign engagement.

Approach: Identify, codify, and disseminate knowledge of institute technical activities within the program and outside the program to broader domestic manufacturing stakeholders.

Action: AMNPO will work with the MEP National Network to develop points of contact and tangible and sustained engagement between institutes and MEP centers to support knowledge transfer needed to expand manufacturing capabilities and domestic supply chains for advanced manufacturing technologies.

Objective 2.3: Encourage multi-institute collaborations to accelerate the development and adoption of manufacturing technologies. Each institute specializes in a unique subset of manufacturing technologies, ranging from biopharmaceuticals to robotics to cybersecurity, each with their own supply chain system. However, product development often requires the application of multiple technologies and would necessitate collaboration between the institutes. Robust cross-institute collaborations could also stimulate collaborative regional innovation ecosystems, as each technology focus might be regional. Furthermore, cross-collaboration might lead to the development of new domestic supply chains, technical tools, and services, thereby enhancing economic and national security.

Approach: Encourage cross-institute collaborations in technology development, education and workforce development, and supply chain stimulation.

Action: AMNPO will provide funding opportunities through its public service grant authority for institutes to conduct multi-institute projects that promote domestic production of institute-developed advanced manufacturing technologies.

Goal 3: Accelerate the development of an advanced manufacturing workforce

Adoption of new manufacturing technologies requires a skilled workforce at all educational and training levels, including skilled technicians, production workers, engineers, scientists, and laboratory personnel. U.S.-based innovation has the potential to create millions of sustainable high-wage manufacturing jobs, many of which do not require a four-year post-secondary degree but could include industry-recognized certificates. Additionally, current workers require training to keep pace with the expanding set of new skills needed for high-quality jobs. Achieving U.S. innovation and manufacturing potential requires tapping the potential of all American workers and innovators across the country. To harness these talents, employers, educators, and government must embrace proven models for training, attracting, and promoting workers. To expand opportunities for place-based economic development and participation of underrepresented populations, collaborations should be established with such organizations as local and city government entities, labor/workforce development organizations, Federal economic development award recipients, nonprofits, and broader community partners. The following objectives are consistent with the national priorities stated in the National Strategy for Advanced Manufacturing and those promoted by the White House Advanced Manufacturing Workforce Sprint.¹⁷

While each institute has its own technology portfolio, all institutes share a goal of fueling advanced manufacturing job creation, strengthening career and technical education pathways, leveraging innovative learning tools, upskilling incumbent workers, and increasing supply-side responsiveness to emerging workforce demand. The same interests are shared by agencies across the Federal government.

¹⁷ <https://www.whitehouse.gov/briefing-room/statements-releases/2023/10/06/fact-sheet-to-launch-investing-in-america-tour-the-biden-%E2%81%A0harris-administration-kicks-off-sprint-to-catalyze-workforce-development-efforts-for-advanced-manufacturing-jobs-and-careers/>

Expected Outcome: Increased local and regional cooperation among institutes, industry, educational institutions, affinity groups, community organizations, and other partner organizations in career and technical programs that can help increase participation of underrepresented populations in institute education and workforce development activities.

Objective 3.1: Support development and integration of advanced manufacturing credentialing and certification to meet industry employment needs. To create a set of evolving credentials that accurately represent the manufacturing labor market, Manufacturing USA institutes work with the relevant industries to translate emerging advanced technologies into occupational requirements. The institutes work with education and training providers to guide the development of new instructional methods, educational delivery systems, modules, courses, and programs of study. Building on established relationships with industry, the institutes have platforms to identify useful existing certifications or to develop new ones. A huge and varied set of certifications has been created by many different organizations, ranging from academic institutions to not-for-profits to for-profit training organizations. The institute EWD and membership directors have significant and critical insights as to what skills industry considers useful with regards to certifications. Manufacturing USA institutes promote awareness of high-quality curricula, learning materials, and market-relevant credentials to support alignment with attractive employment opportunities in the manufacturing sector. The institutes are well positioned to assist educators and training providers to further develop curricula and educational materials. Aligning industry workforce needs with skill development programs will continue to foster the changing skill sets and competencies that are essential for high-quality jobs in a globally competitive advanced manufacturing workforce.

Collaboration with national organizations, including professional organizations and trade groups, is important to support the development and validation of credentials, including for occupations for which certifications and degrees are not already available. Alignment of education and training with employer needs and credentials, however, is just one piece of the overall strategy. The goal is alignment of EWD with employer needs, and certification can serve as one of the ways to achieve that goal.

Approach: *Adapt existing workforce frameworks to identify, develop, and align credentials and certifications for the advanced manufacturing workforce.*

Action: *The White House and DOL will convene Manufacturing USA institutes and Federal partners to identify priorities, effective mechanisms, and sufficient resources needed for industry-supported advanced manufacturing credentials and certifications.*

Objective 3.2: Expand work-based learning, registered apprenticeships, industry credentials, dual enrollment, career advising, distance learning, and other innovations in career and technical programs. Institutes support education and workforce development at all levels and provide guidance on the skills and knowledge needed to meet the needs of occupations in the new technologies. Workforce education and training benefit from a coherent and standard sequence of secondary to postsecondary courses. The practical nature of and skills needed for occupations in advanced manufacturing require learning approaches that integrate conceptual learning with hands-on experiences. It is crucial to connect students to work-based learning opportunities such as registered apprenticeships, pre-apprenticeship programs, cooperative education (Co-op), internships, and residency-type capstone projects. Such programs must be aligned to facilitate students' seamless transitions through different levels of study. The institutes increasingly monitor the quality of their secondary and postsecondary career and technical education programs to ensure that they are based on realistic expectations of future skill demands.

Approach: Develop and facilitate opportunities for work-based learning, apprenticeships, certification programs, cooperative education, and other ways to engage the future workforce at all educational and career levels.

Action: AMNPO, working with its Federal partners and the Manufacturing USA institutes, will convene quarterly meetings to develop and gather best practices, implement roadmaps to coordinate the efforts of the education and workforce development working, and establish teams to expand the deployment of successful institute-sponsored educational and training programs.

Objective 3.3: Promote manufacturing careers and provide culturally responsive outreach to and engagement with students, especially to diverse, underrepresented populations. Expanding the manufacturing workforce capacity requires a positive and compelling narrative around manufacturing careers and a broad demographic base from which employers can draw. Nurturing the interest of young students, including those who are underrepresented (women, persons with disabilities, and persons of color) or located in underserved communities, in science, technology, engineering, and mathematics (STEM) is an important first step toward developing an advanced manufacturing workforce to meet U.S. needs.

Today's manufacturing, and particularly the advanced manufacturing environment, is completely different from that of the past century. Advanced manufacturing encompasses new technologies, robotics, automation, sensors, computer software, data analytics, and in some cases, the use of artificial intelligence. The new technologies used in the advanced manufacturing environments are also designed to provide a much safer environment for the workers.

Manufacturing USA Institutes support STEM education with internships and work-based learning, afterschool programs, and other approaches focused on training workers with skills needed to apply new technologies in manufacturing environments. Communication plans for network and institute activities should include expanded outreach efforts, such as encouraging and targeting participation among underserved communities and populations in events such as Manufacturing Day and in network education and workforce programming.

Approach: Support equitable workforce development in advanced manufacturing,¹⁸ including working with the Departments of Labor and Education, with emphasis on broadening participation from groups that are underrepresented in the advanced manufacturing workforce.

Action: AMNPO, in collaboration with MEP, will pilot a recognition program to raise awareness of advanced manufacturing careers by highlighting the extraordinary accomplishments of select individuals from the Manufacturing USA network who exemplify the diversity of the advanced manufacturing workforce.

Goal 4: Promote a network of institutes that build long-term support for and within their communities

A strong, connected, collaborative network of institutes deeply embedded in their local communities promotes local and regional economic benefit with broad national impact. High levels of ongoing engagement from industrial, academic, and government partners are the foundation of a healthy institute ecosystem. While the Manufacturing USA Program currently consists of seventeen unique institutes, with the two new institutes

¹⁸ Fact Sheet: Biden-Harris Administration Highlights New Commitments Toward Equitable Workforce Development in Advanced Manufacturing (January 24, 2024), <https://www.whitehouse.gov/briefing-room/statements-releases/2024/01/23/fact-sheet-biden-harris-administration-highlights-new-commitments-toward-equitable-workforce-development-in-advanced-manufacturing/>

planned in the coming year, there is still a need to expand the technical coverage of the Program to broaden its impact across different industrial sectors. AMNPO, the agency partners, and the institutes continuously identify existing and emerging technologies where advanced manufacturing innovation is needed, new institutes could be created, and new projects should be initiated, while looking for key partnerships to link to local communities. Continued impact of the institutes on economic prosperity and national security requires continuity of institute operation through an effective sustainment model. Federal sponsors and the institutes monitor performance through metrics developed both at the institute and program levels to measure impact and identify challenges and opportunities.

The strategic objectives under Goal 4 position the Manufacturing USA Program to deliver value to partners within each institute while strengthening the broader network as a national asset. The approaches outlined by each objective are expected to also grow non-Federal program funding for institute activities to ensure long-term sustainability and develop adequate assessments for continuity of institute operations.

Expected Outcome: Growth in non-core Federal and non-Federal program funding for institute activities and cross-network collaborations for continuity of operation and long-term sustainment and impact.

Objective 4.1: Encourage membership structures that promote shared risk and shared investment in institute activities. Manufacturing USA offers clear value to members across stakeholder groups with different core missions, financial resources, business operations, and expectations. The Program creates an opportunity for domestic stakeholders to pool their risk—with cost shared by the Federal government—to advance manufacturing so the next generation of products and systems continue to be made in the U.S.

Institutes continually identify and recruit key stakeholders across the industry, including suppliers, end-users, and promising start-up companies, and build and maintain strong representation among all member groups to properly inform priorities. The institutes also engage academic institutions, from major research organizations to local community colleges, likely to benefit from and contribute to technical and workforce development activities. Relationships with Federal, state, and local governments, national laboratories, professional associations, labor unions, economic development organizations, and venture capitalists must also be considered in setting membership structures. To strengthen financial success and long-term sustainability of the Manufacturing USA Program, it is necessary to grow membership engagement. Expanded membership and member engagement increases Manufacturing USA's impact on the U.S. economy. To that end, it is the responsibility of AMNPO, sponsoring agencies and the institutes to continuously evaluate the institute membership structure and the value provided to the members and assess what would make institute programs appeal to other potential members.

Approach: Evaluate and improve the institute membership value proposition to recruit, retain, and grow institute membership to further financial success and long-term sustainability of the institutes.

Action: AMNPO and sponsoring agencies will review the current institute membership models and the member value proposition and recommend strategies to increase value for institute members to support growth.

Objective 4.2: Support the development of institute sustainment models that ensure continuity of operations. It is important for the Manufacturing USA Program to ensure long-term financial sustainability of the institutes. Each institute has been working with its lead funding agency on planning for continued partnership.

Creating sustainable ecosystems requires an understanding of the value proposition for institute partners, including an understanding of stakeholder needs and how their participation contributes to the overall mission

of the institute. These exchanges of value between the institutes and their stakeholders define the value cycle that sustains the partnership over time.

The Manufacturing USA Program supports institute sustainment in many ways, such as increasing awareness of strategic partners associated with manufacturing and sharing best practices for operationalizing business models. Additional efforts include communications through the Manufacturing USA brand and ManufacturingUSA.com, national awareness campaigns, and Congressional briefings. Links to other sources of funding are also promoted through the network of agency partners and relationships with non-profit foundations and professional organizations with significant stakeholder reach. All institutes work with their sponsoring agencies to develop long-term strategic partnership plans, although any given institute may have a plan with distinct features that meet its unique mission, technology, and membership structure. AMNPO assists institutes and agencies in this process by facilitating sharing of best practices from earlier institute sustainment planning efforts and may share funding opportunities from non-sponsoring agencies with the network.

Approach: *AMNPO, sponsoring agencies, and institutes will develop and articulate the value of institute membership and build sustainable funding models, to ensure minimal impact on operations should Federal funding lapse.*

Action: *Each sponsoring agency will assist their institutes in developing long-term operational strategies that maintain value to the nation and agencies' missions. Working with AMNPO, sponsoring agencies will share their periodic renewal processes and outcomes of renewal evaluations for their sponsored institutes.*

Objective 4.3: Support cross-network collaboration and sharing of best practices, infrastructure, and activities. Manufacturing USA institutes have varied membership structures where value is created by balancing the needs and interests of members and Federal sponsors. The requirement for non-Federal co-investment to match Federal base funding adds a layer of complexity that must be managed when navigating cross-network collaboration. Despite those strategic and operational realities, increasing cooperation across the network will better leverage the technological capabilities and resources of the institutes. Institutes and Federal partners benefit from sharing best practices in successful communication and outreach efforts, return on investment in infrastructure, secure data sharing, and physical and cybersecurity practices. While each institute serves the unique needs of its technical community, the sharing of best practices facilitates the continued growth of strong ecosystems. Institutes also learn about opportunities to work with non-sponsoring agencies and how to draw on their expertise and resources.

The CHIPS and Science Act directed the DOC/NIST to establish a Council of Manufacturing USA Institute directors to foster collaboration among the Institutes and to assist AMNPO in carrying out its functions.¹⁹ In fulfilling this mandate, AMNPO convened the Manufacturing USA Council in 2023. The Council is establishing its functions and selecting cross-institute collaborations to expand the effectiveness of the institute network. Institutes learn from each other, collaborate, and benefit from being in a comprehensive advanced manufacturing network. An important focus for the Council will be to develop a unified approach to achieve network effectiveness and sustainability.

Approach: *Share experiences, knowledge, best practices, resources, and infrastructure models across the program, and coordinate activities of the institutes through cross-network collaboration.*

Action: *AMNPO will assist the Manufacturing USA Council to foster collaboration between Manufacturing USA institutes, to share best practices, and develop plans for cross-network activities that strengthen the network.*

¹⁹ 15 U.S.C. § 278s(h)(7).

Value of the Network

The Manufacturing USA network of institutes serves as a national asset to drive impact across the private, public, and academic sectors. In Fiscal Year 2022, the Manufacturing USA institutes collectively worked with over 2,500 member organizations (63% are manufacturers and 73% of those are small and medium-sized manufacturers) to collaborate on more than 700 major technology and workforce applied R&D projects. The institutes also engaged more than 106,000 students, teachers, and workers in advanced manufacturing skills training. State, industry, and non-core Federal funds contributed \$307 million to these activities, representing a nearly three to one investment match to the core Federal funds.

The network model leverages advanced manufacturing technologies to develop innovative, cost-effective products and processes. Co-development and shared investment accelerate technology advancement and transfer. Collectively, the network of institutes delivers greater return on investments for members than they could achieve on their own, especially for SMMs, academia, and non-profit members.

The innovation ecosystems created through the network also help build advanced capabilities in the domestic supply chain and revitalize manufacturing across the country. The regional ecosystems created by the institutes build infrastructure and manufacturing hubs needed for stronger communities. This results in increased workforce development opportunities, new and improved jobs, and increased economic opportunities.

While interagency coordination remains a core tenet of the Manufacturing USA model, the institutes serve as the network's central mechanisms for convening and coordinating across public-private spheres. Institutes offers unique value to the Federal, state, and local government, industry, academia, and other stakeholders because of their close ties with their sponsoring agencies and the Manufacturing USA network. In turn, the Manufacturing USA network serves as a valuable resource for the institutes as they help to catalyze the nation around advanced manufacturing challenges.

Value to the Federal Government

Through its whole-of-government approach, the Manufacturing USA network provides mechanisms to match other agency funding opportunities to institutes. From DoD's Manufacturing Engineering Education Program to NSF grants and NIST public service awards, the connections made across the Manufacturing USA network enable agencies and institutes to partner with their members and work together to better meet national needs and drive advanced manufacturing innovation in the U.S.

Agencies can provide targeted government-directed project funding to the institutes to solve their challenges. Because the institutes serve as subject matter experts within their technical fields, the Federal agencies often rely on the institutes to provide an industry perspective to help inform strategy and policy decisions.

The institutes offer both sponsoring and non-sponsoring Federal agencies access to roadmapping activities with industry, pilot manufacturing facilities, and responsive project contracting. From an acquisition perspective,

precompetitive Federal assistance agreements can be utilized to conduct technology-related projects, provide access to cost share, and ensure competition. From an operations and sustainment perspective, institutes can be a source for low-cost R&D and rapid production of complex advanced manufacturing technology.

The Manufacturing USA institutes can also pivot quickly to meet emerging needs in times of crisis or transition. For example, the institutes announced steps to expand workforce development to support the growing need for skilled workers driven by historic levels of manufacturing investment through the Bipartisan Infrastructure Law, the Inflation Reduction Act, and the CHIPS and Science Act of 2022.²⁰ During the COVID-19 pandemic, the institutes demonstrated leadership early on, leveraging millions of dollars in funding through the Coronavirus Aid, Relief, and Economic Security (CARES) Act²¹ for high-impact R&D projects. The American Rescue Plan (ARP) Act of 2021,²² also provided funding for testbeds.

Areas of focus for the institutes include:

- **Facilitate rapid transition of technical advances to industry** by sponsoring government-directed projects that advance concepts through prototype development and rapid flexible contracting.
- **Test and apply new manufacturing processes** to lower the risks of technology transition.
- **Help scale advanced manufacturing** by identifying domestic sources for components and materials, and by advancing technologies from the prototype stage to limited-scale production.
- **Facilitate access to the advanced manufacturing ecosystem** by engaging with leaders in industry and academia to expand training programs.

Examples include:

- **Launching New Partnership with DARPA (AIM Photonics):** The Defense Advanced Research Projects Agency's (DARPA) awarded AIM Photonics \$19M to advance integrated photonics under DARPA's Lasers for Universal Microscale Optical Systems (LUMOS) program. The LUMOS program will work with AIM Photonics to enable efficient on-chip optical gain in highly capable integrated photonics platforms. This will allow complex, end-to-end photonic functionality on a single crystal silicon substrate for state-of-the-art optical microsystems.
- **Furthering Federal Partnerships (BioFabUSA):** Alongside the Food and Drug Administration's (FDA) Center for Biologics Evaluation and Research, BioFabUSA established a public-private partnership to ensure alignment between industry and regulators as the tissue engineering industry grows. This partnership has two foci: (1) the development of scalable, modular, automated, and closed process development and Good Manufacturing Practice-compliant manufacturing; and (2) the development of measurement assurance for in-line and near-line sensor systems to facilitate application of process analytical technology and quality-by-design principles to scalable, modular, automated, and closed manufacturing of engineered tissues.

²⁰ Fact Sheet: Biden-Harris Administration Highlights New Commitments Toward Equitable Workforce Development in Advanced Manufacturing (January 24, 2024), <https://www.whitehouse.gov/briefing-room/statements-releases/2024/01/23/fact-sheet-biden-harris-administration-highlights-new-commitments-toward-equitable-workforce-development-in-advanced-manufacturing/>

²¹ Coronavirus Aid, Relief, and Economic Security (CARES) Act, (Pub. L. 116-136, Division B). <https://www.congress.gov/116/plaws/publ136/PLAW-116publ136.pdf>

²² American Rescue Plan Act (ARP) of 2021, (Publ. L. 117-2, Section 7501). <https://www.congress.gov/117/plaws/publ2/PLAW-117publ2.pdf>

Value to Regional Ecosystems

The institutes are innovation clusters comprised of many partners with a shared technology focus. Because these clusters contain the elements necessary for product realization, including research, design, prototyping, and production, they leverage each other's successes and develop close local and regional ties. Clusters formed around advanced manufacturing facilities succeed because they can accelerate product to market using a co-located supply chain. This synergy also provides meaningful opportunities to expand the local workforce. The institutes help communities and regional clusters:

- **Gain returns from advanced manufacturing** by generating the highest community economic multiplier for jobs and GDP and bringing manufacturing project grants into the institutes' communities.
- **Grow a qualified workforce** through institutes' public-private partnerships and programs with community colleges and universities, providing exciting and rewarding career pathways for students.
- **Attract direct investment** from companies who participate in institute pilot facilities and projects, with small businesses becoming key suppliers as spin-off companies.
- **Increase national prominence** as a leader in next-generation technologies and recipient of Federal grant opportunities associated with being an innovation cluster.

Examples include:

- **Transitioning Technology to the Warfighter (LIFT):** In collaboration with Ricardo Defense, a LIFT project successfully won an \$89M U.S. Army contract to retrofit High Mobility Multipurpose Wheeled Vehicle (HMMWV or 'Humvee') fleets with a combination system which adds antilock braking and electronic stability control to mitigate rollovers commonly associated with specific military vehicles. LIFT funded and managed the initial project, completed in 2017, leading to the successful retrofitting of 10 Michigan National Guard vehicles with the optimized system and making the kit available for purchase by military units worldwide. In FY 2021, Ricardo Defense announced its award for another Army contract to provide up to 9,480 critical safety improvement retrofit kits over the next three years. The initial project team included support from GKN, Michigan Technological University, and the University of Michigan Transportation Research Institute.
- **Developing New Additive Manufacturing Training Curriculum (America Makes):** A Manufacturing Engineering Education Program was successfully launched at America Makes after three years of development and a \$1.9M investment. The project focused on creating new training content in advanced manufacturing specific to enabling technologies, included a credential landscape audit and an educational landscape assessment across several regions. The program was developed after assessing the needs of underserved and veteran populations through national and regional workshops with workforce, community, and economic organizations. In addition, the credential audit examined over 68 national industry-recognized credentials and 2,000 competencies to align, map, and identify gaps across the industry. The resulting education program features 33 new blended eLearning courses and two new instructor-led trainings. This new eLearning content has already impacted more than 8,000 learners in academia and in nearly 500 companies.

Value to Industry

The development and commercialization of next-generation advanced manufacturing capabilities requires collaboration among industry, academia, and government. A modern “industrial commons” is essential, where shared R&D facilities and relevant manufacturing experience enables U.S. companies of all sizes and means to develop products for commercial or national security needs. The Manufacturing USA institutes provide companies the ability to transition precompetitive R&D into future product opportunities via innovations in materials and manufacturing R&D, product design and development, production capacity, visibility into new markets, and workforce training and education. The institutes provide the manufacturing industry with:

- **Access to high-value collaboration** through technology roadmapping, manufacturing pilot lines, extensive lab testing and prototyping, and programs and mechanisms to build a skilled workforce.
- **Support to establish new capabilities and markets** by facilitating connections between small businesses and large manufacturers, access to IP generated by the institutes, and commercialization of technology from Federal labs and academia.
- **Supply chain multiplier opportunities** through collaboration and opportunities with new partners, small business incubators, and networking with industry, academia, and the Federal government.
- **Increased performance and returns and reduced risk** through pooled R&D funds, Federally cost-shared R&D projects, and development of cutting-edge technology and a well-trained, skilled workforce.

Examples include:

- **Automated Blade Finishing Trials Demonstrate Throughput Boost of 30% (IACMI):** An automated blade finishing project at IACMI successfully completed full-scale trials in a wind turbine factory that lower costs, improves worker safety, and has the capability to transform wind technology manufacturing. Launched in 2020, the partnership facilitated by IACMI among GE Renewable Energy, LM Wind Power and GE Research, and DOE’s National Renewable Energy Laboratory (NREL) enabled innovative solutions with meaningful impact on domestic wind blade manufacturing. Blade finishing includes trimming excess material after molding and grinding blade surface to meet quality requirements. The IACMI project leveraged knowledge of advanced composite processing along with sensing, robotics, and automation to develop low-cost solutions with potential to increase throughput by 30% and improve health and safety in factories. Industrializing these R&D concepts aligns well with increasing deployment and reducing costs of wind power once implemented in a production environment. The program is supported by funding from DOE’s Advanced Manufacturing Office and Colorado’s Office of Economic Development and International Trade.
- **Automating Supply Chain Alerting (MxD):** The COVID-19 pandemic exposed fragile aspects of supply chains that can cause widespread disruptions, driving a need to secure U.S. manufacturing supply chains by improving the current structure and increasing resiliency. In response, MxD partnered with Software AG Government Solutions in April 2021 to develop Supply Chain Risk Alerting to the DoD. Seeking new ways to minimize manufacturing production impacts during a crisis, Software AG will provide a rapid hybrid integration solution to deliver a supply chain risk alert framework to policy leaders and supply chain leaders so they can efficiently assess a wide range of value chain designs and optimize supply chain resiliency and agility during an emergency.

Value to Academia

Institute networking provides unique opportunities for universities, community colleges, and other educational institutions to engage with and understand the needs of industry and government. Targeted and collaborative manufacturing research benefits participating institutions, faculty, and students by providing industrial context for research and opportunities for hands-on training, access to internships, cooperative training, and increased connections to industry jobs for students. The institutes provide:

- **Meaningful collaboration** with industry, academia, and government and opportunities to partner in design and execution of innovative apprenticeship and educational programs and to gain access to roadmaps for future technology.
- **Increased opportunities for academic members to license** their institute-sponsored research.
- **Improved skills and enhanced employability for students** who benefit from first-hand experience and opportunities to develop new technologies with industry.
- **Solutions to manufacturing problems** through innovation, applied research, and integration with ecosystems to positively impact regional and national economies.

Examples include:

- **Successful Smart Manufacturing Workforce Model (CESMII):** The project team of El Camino Community College (ECCC), California State University Northridge (CSUN), UC Los Angeles (UCLA), and UC Berkeley (UCB) leveraged existing education and workforce training systems to deliver the workforce needed for the adoption of smart manufacturing (SM). Their work resulted in: launching a SM certificate program at CSUN in Advanced Professional Development – Smart Manufacturing that is comprised of four 36-hour courses and an 18-hour project; incorporation of SM modeling and process control into existing UCLA chemical engineering classes that resulted in six journal publications; commitment from five California high school districts and colleges to adopt a new SM Career Pathway Program; and ECCC training of its incumbent workforce that resulted in engaging 53 manufacturers, training 2,017 employees and training-the-trainers with 17 colleges.
- **Improving Biomanufacturing for Cell and Gene Therapy Applications (NIIMBL):** The University of Massachusetts Medical School, Johns Hopkins University, Rensselaer Polytechnic Institute, and their collaborators developed an integrated and optimized process to reduce the cost and complexity of manufacturing lentiviral vector (LV) products such as cell and gene therapies, while simultaneously aiding in the national response to COVID-19. This project de-risked technology development and provided the industry with a blueprint for enhanced LV operations upstream and downstream. Through the project, Johns Hopkins University played a vital role in COVID-19 response by using the same biomanufacturing platform established for lentiviral vectors to pivot to producing SARS-CoV-2 spike proteins within two weeks. The ability to make crucial proteins in-house saved significant time and assured the availability of quality materials. Additional project participants included: Massachusetts Life Sciences Center, Artemis Biosystems, Inc., and Repligen Corporation.

Coordination and Reports

Robust coordination between Federal agencies and the Manufacturing USA Network is critical to improve operations and increase the impact of the Manufacturing USA Program. Coordination occurs among all the Federal agencies participating in the Program; among the agencies sponsoring institutes; between the Federal agencies and the institutes; and among the institutes themselves through the following activities:

The Interagency Working Team

The Manufacturing USA Interagency Working Team, comprised of representatives from participating Federal agencies in Manufacturing USA, meets to discuss and coordinate activities. The interagency team also discusses higher-level policy issues and actions that might affect the Manufacturing USA Network.

Sponsoring Agency Leadership Meetings

A team of leaders from across the Federal agencies that sponsor institutes (DoD, DOE, and DOC) meets biweekly to coordinate activities across the institutes, disseminate and discuss Manufacturing USA Network plans and information, and share best practices. This group may also be called on, in an ad hoc basis, to establish working groups with targeted objectives, such as how institutes can be leveraged to address a specific national need.

Education and Workforce Development Team

The Manufacturing USA Education and Workforce Development Team facilitates workforce development, communication, and collaboration across the network for all institutes, workforce development leads, and agency partners. This group encourages cross-network projects and shares best practices in expanding knowledge and awareness; developing new competency and skill curricula; engaging academia, industry, and economic development stakeholders regionally and nationally; and scaling and diffusing education and workforce development activities to maximize impact.

Communications Team

Manufacturing USA institute communication leads share information and ideas for effective outreach and communications with a variety of audiences. In addition, the institute and sponsoring agencies work closely to plan and implement targeted public activities, such as national outreach initiatives. The team also leverages shared resources and approaches to improve awareness and perceptions on advanced manufacturing.

Institute Coordination

Current institutes identify unique best practices by comparing membership models, industry sectors, and target stakeholders. New institutes can scale-up and mature more quickly by leveraging lessons from more established institutes. Participating agencies are able to expand engagement with institutes by identifying unique delivery opportunities. Encouraging this internal communication will continue both in regular, formal interactions discussed below, and in informal or ad hoc situations.

Network Meetings

Staff from Manufacturing USA institutes and participating agencies connect at least once a year at national meetings to share best practices, generate new ideas and collaborations, and identify cross-institute priorities. Annual meetings often include pre-meeting and parallel working sessions for specific interest groups, such as an executive session for institute directors and senior Federal leaders and the Education and Workforce Development team. These meetings have proven to be productive for information sharing and idea generation, as well as facilitating dialogue on program direction.

Manufacturing USA Council

The council facilitates cooperation and collaboration among the institutes. Among the council's stated responsibilities are the following:

- Promote collaboration and cooperation among the Institutes in support of the goals of the Manufacturing USA Program.
- Work with the AMNPO in supporting the Manufacturing USA Network.
- Facilitate communications and engagement among the institutes.
- Encourage institute activities that leverage the technical diversity and strengths of the network to collaborate on cross-cutting activities, and encourage cooperation in solving technological challenges.
- Develop strategies for expanding the manufacturing ecosystem, including encouraging participation of underserved communities and groups.
- Facilitate the institutes' collaboration with other established manufacturing-related government programs, such as the Manufacturing Extension Partnership (MEP) program and the Economic Development Administration (EDA).

External Assessments

The Manufacturing USA Program has greatly benefited from external assessments of the Program over the past several years. Feedback on the Program that highlights successes and recommends improvements has been used to evolve the network and make it more effective. A collection of findings from previous assessments are summarized below in the section entitled Progress Made Since the 2019 Strategic Plan. Best practices identified through independent assessments have provided valuable guidance for both new and maturing institutes. Independent assessments include independent workshops and studies convened by the National Academies of Sciences, Engineering, and Medicine.

The Government Accountability Office (GAO) is required to assess the Manufacturing USA Program at least once every three years.²³ Manufacturing USA will continue to benefit from assessment and feedback from unbiased, respected, and expert observers. A summary of these assessments and references are detailed in the External Assessments subsection in Progress Made Since the 2019 Strategic Plan, below.

Metrics

One of the common themes of the external assessments of Manufacturing USA Program has been the recommendation for better metrics to assess how Program goals and objectives are being met. Manufacturing USA institutes are in various stages of maturity and have a broad set of priorities driven by the sponsoring agency and may have evolved since the Program's inception. Thus, care is taken to ensure that metrics tracked provide meaningful and usable information for the network and are not burdensome on the institutes and the Manufacturing USA network. Institutes funded through Manufacturing USA's authorizing legislation submit annual reports assessing their performance.

Compiling a meaningful annual report requires collaboration with other agencies in the Program, such as DoD and DOE, who themselves are subject to different authorities and requirements. Within these annual reports, there are 10 quantitative performance metrics, complemented by an additional 27 education and workforce metrics, that track progress toward the Program's goals based primarily on the legislative program's purposes.²⁴

²³ Revitalize American Manufacturing and Innovation Act of 2014, (Pub. L. 113-235, codified in relevant part at 15 U.S.C. § 278s(i)(3), as amended). [http://uscode.house.gov/view.xhtml?req=\(title:15 section:278s edition:prelim\)](http://uscode.house.gov/view.xhtml?req=(title:15 section:278s edition:prelim))

²⁴ Revitalize American Manufacturing and Innovation Act of 2014, (Pub. L. 113-235, codified in relevant part at 15 U.S.C. § 278s(b)(2)). [http://uscode.house.gov/view.xhtml?req=\(title:15 section:278s edition:prelim\)](http://uscode.house.gov/view.xhtml?req=(title:15 section:278s edition:prelim))

In addition to the Manufacturing USA Program metrics reported in the annual reports, each lead sponsoring agency collects and evaluates additional metrics relating to the agency's unique mission requirements. To address the recommendation for improved metrics and performance goals across the network, interagency coordination has resulted in the development of a set of draft performance goals. These performance goals would be applied broadly by the network and will be piloted in the future.

In addition to the aggregated Program metrics described above, institutes funded through the Manufacturing USA authority are required to submit an annual summary of their performance with respect to the Program's statutory purposes. Summary and assessment of these reports are included in the Annual Report to Congress.

Assessment of Institutes by Sponsoring Agencies

Sponsoring agencies also implement assessment processes associated with renewing assistance agreements for each of their Manufacturing USA institutes.

In 2019, agencies sponsoring institutes under the Manufacturing USA authority were given authorization to renew funding for sponsored institutes beyond their initial award period, subject to a rigorous merit review.²⁵ Following this authorization, DOC and DOE each established their review process and evaluation criteria. In 2021, NIST developed its own performance standards to evaluate the renewal of DOC-sponsored Manufacturing USA institutes using a rigorous merit review process by an independent, external evaluation panel.²⁶ The process and standards were piloted with DOC-sponsored institute NIIMBL, leading to a renewal in their funding.

In a 2019 Congressionally requested plan for sustained investment in its institutes,²⁷ DoD determined that continued investment in its institutes would be contingent upon periodic evaluation of performance and progress towards charting principles.²⁸ Using evaluation criteria based upon established peer review of Federally funded R&D centers, DoD has a five-year rotating schedule of assessments, evaluating two institutes each year. The DoD-chartered Joint Defense Manufacturing Council conducts these assessments and has completed seven to date. Similarly, DOE published a Manufacturing USA Institute Renewal Process Framework in 2022.²⁹ The framework outlines the steps DOE will take to consider award renewals for its institutes and establishes the criteria and input sources to be used.

International Benchmarking

In a benchmarking study by AMNPO, manufacturing R&D programs in Australia, Belgium, Brazil, Canada, China, France, Germany, Japan, Singapore, South Korea, Taiwan, and United Kingdom were reviewed and evaluated. A wide range of topics were explored, including but not limited to, foreign institute membership models, education and workforce development programs, technology transfer mechanisms, and membership business support programs. This benchmarking study also included analysis of key performance indicators across international programs, such as the number of patents, licensing revenue, project revenue, and the total number of trained personnel. The international benchmarking also included reciprocal visits to some of the countries. The results of these evaluations are currently being assessed to compile a list of best practices that could be beneficial for adapt and evolve both existing and new institutes in the Manufacturing USA Program.

²⁵ Revitalize American Manufacturing and Innovation Act of 2014, (Pub. L. 113-235, codified in relevant part at 15 U.S.C. § 278s(e)(2)(B)(i), as amended). [http://uscode.house.gov/view.xhtml?req=\(title:15%20section:278s%20edition:prelim\)](http://uscode.house.gov/view.xhtml?req=(title:15%20section:278s%20edition:prelim))

²⁶ *Manufacturing USA Institute Evaluation: Renewal Process and Performance Standards*, Office of Advanced Manufacturing, National Institute of Standards and Technology, Department of Commerce (July 15, 2021). <https://www.manufacturingusa.com/reports/manufacturing-usa-institute-evaluation-renewal-process-and-performance-standards>

²⁷ S. Rept 116-103 – 116th Congress (2019-2020): Department of Defense Appropriations Bill, 2020, (September 12, 2019). <https://www.congress.gov/congressional-report/116th-congress/senate-report/103/1>

²⁸ *Long-Term Strategy Plan for DoD Manufacturing Innovation Institutes*, Office of the Director, Manufacturing Technology, Department of Defense (August 2020).

²⁹ *Clean Energy Manufacturing Innovation Institute Renewal Process Framework*, Department of Energy (June 3, 2022). <https://www.energy.gov/sites/default/files/2022-06/Clean%20Energy%20Manufacturing%20Institute%20Renewal%20Process%20Framework.pdf>

International Takeaways (Examples: China and Germany)

Manufacturing USA is distinct from other international manufacturing programs.

Throughout the last decade, Germany and China have expanded the number of manufacturing innovation institutes for their respective program, and these institutes have provided significant resources to support their nation's manufacturing ecosystem. While the U.S. has sought to respond to the rapid growth of China's programs and its non-market policies and practices, and has drawn important insights from Germany's program, the Manufacturing USA Program remains distinct from either of these important international programs, including its significantly smaller scale of support.



China's "Made in China 2025" is a ten-year industrial plan targeting ten strategic advanced technology manufacturing industries for promotion and development. The program was officially funded through an initial \$300 billion investment from 2016-2020, though the true value of total funding is unknown and likely much larger due to the non-transparent nature of support provided under the program. The program includes, among other initiatives, a network of Manufacturing Innovation Centers (MICs).¹ Unlike the Manufacturing USA Program, China's goal is to become dominant by 2025 in specific targeted advanced manufacturing industries,

including aerospace, computer chips, robotics, pharmaceuticals, and electric vehicles.² In each of these ten industries, China seeks to capture global market share, not just dominance in the China market, as part of a broader strategy to use state resources to alter the global competitive landscape. China's MICs were initiated in 2015, and have consistently received support from the central government, provinces, autonomous regions, and municipality governments. The first MIC opened in 2016 and the network quickly grew to 21 centers by early 2022, with a total of 40 centers targeted by 2025. To become a global leader in semiconductors, China established additional cutting-edge semiconductor-focused MICs in 2021. In addition, the program has established two new institutes focused on consumer household products for global markets incorporating artificial intelligence (AI) and voice recognition. The program has progressed rapidly, and in contrast to Manufacturing USA, Made in China 2025 reflects China's state-led, non-market approach to its economy through, for example, non-market policies and practices such as support for state-owned enterprises and its objectives to ensure the dominance of domestic companies over foreign competition.³



Germany's Fraunhofer Society is one of the most established innovation networks, with 76 research institutes geographically distributed across the nation. Established in 1949, the network promotes applied research and transfer of research from laboratory to market. The 76 institutes conduct independent research projects, carry out projects assigned to it by the German federal and state governments, and undertake contract research which represents approximately 86% of its €3 billion total business volume.³ The network has a very rich IP portfolio, with 7620 total patents (a rate of >2 patents filed per day in 2021), 3090 of which have been commercialized across 100 countries, generating average annual revenues of €114 million.⁴

¹ *Made in China 2025: Global Ambitions Built on Local Protections*, U.S. Chamber of Commerce, p. 63 (March 16, 2017). https://www.uschamber.com/sites/default/files/final_made_in_china_2025_report_full.pdf

² *Office of the U.S. Trade Representative, Findings of the Investigation into China's Acts, Policies, and Practices related to Technology Transfer, Intellectual Property, and Innovation under Section 301 of the Trade Act of 1974* (Mar. 22, 2018), <https://ustr.gov/sites/default/files/Section%20301%20FINAL.Pdf>

³ *2022 Report to Congress on China's WTO Compliance*, United States Trade Representative, p. 22 (February 2023). <https://ustr.gov/sites/default/files/2023-02/2022%20USTR%20Report%20to%20Congress%20on%20China's%20WTO%20Compliance%20-%20Final.pdf>

⁴ *Annual Report 2021: Knowledge and prosperity: Impact and innovation driven by pioneering research*, Fraunhofer Society, p. 11 (January, 2022). <https://www.fraunhofer.de/s/ePaper/Annual-Report/2021/epaper/Fraunhofer-annual-report-2021.pdf>

Communications

The Advanced Manufacturing National Program Office communicates to stakeholders through multiple media and non-traditional channels to broaden awareness of and engagement with the U.S. manufacturing industry. Communication efforts target manufacturers of all sizes who benefit from technology and workforce development, as well as workers, educators, and students who benefit from education and workforce development opportunities. A national educational awareness campaign involves network-wide collaboration to craft and share stories that illustrate the impacts that institutes and their members have across key areas, including advanced manufacturing technology leadership, strategic supply chain development, pandemic response, and advanced manufacturing education and workforce development. These efforts also resulted in the Emmy®-awarded short documentary, *Rethinking Manufacturing*.³⁰

Through the <https://www.manufacturingusa.com/> website and social media (LinkedIn and Twitter/X), Manufacturing USA engages the national manufacturing ecosystem, promotes the role of the network of institutes in leading U.S. advanced manufacturing, shares news and successes from the institutes, informs potential new members about how to participate in institute activities, and updates the manufacturing industry on the opportunities available through Manufacturing USA. These collective communication efforts complement the activities of the institutes and agencies within the network. Each institute also has its own extensive strategies and communication channels to promote its work and the benefits of membership, as well as to engage with current and potential members.

³⁰ Brunner, Garcia, Gerskovic and Stewart Receive Emmy® Awards for Video, “Rethinking Manufacturing”, National Institute of Standards and Technology, Department of Commerce (August 14, 2020).
<https://www.nist.gov/about-us/nist-awards/brunner-garcia-gerskovic-and-stewart-receive-emmyr-awards-video-rethinking>

Progress Made Since the 2019 Strategic Plan

Manufacturing USA relies on internal and external assessments to evaluate progress in meeting goals and objectives outlined in earlier strategic plans. These assessments are described below.

Overview of 2019 Strategic Plan

The 2019 Manufacturing USA Strategic Plan was produced in collaboration with a strategic planning interagency team. It outlined the four primary goals of the Program: 1) Increase the competitiveness of U.S. manufacturing; 2) Facilitate the transition of innovative technologies into scalable, cost-effective, and high-performing domestic manufacturing capabilities; 3) Accelerate the development of an advanced manufacturing workforce; and 4) Support business models that help institutes to become stable and sustainable. The 2019 strategic plan was written before the COVID-19 pandemic, and only 14 Manufacturing USA institutes had been established at the time the plan was written. Since then, DOE has sponsored CyManII and EPIX, and DoD has sponsored BioMADE. Significant progress has been made toward the goals outlined in the 2019 Strategic Plan, as summarized in the published annual reports, summarized below.

Annual Reports

Manufacturing USA is mandated to provide an Annual Report to Congress.³¹ The Program has also produced other detailed reports highlighting success stories in technology advancement projects and workforce development, and the building of innovation ecosystems and supply chains. The Program has also reported on institute responses to the COVID-19 pandemic. These reports clearly show that the Manufacturing USA Program has been growing in terms of membership and range of activities. Furthermore, the institutes have been producing valuable innovative technologies, many of which have been implemented by member organizations. However, opportunities remain, including for example, additional institutes that focus on identified emerging technologies, increased technology transition and scale up, further outreach to local stakeholders, increasing the diversity of institute membership, and inclusion of underrepresented groups in the workforce development programs. The previous sections of this plan described how these issues will be addressed going forward.

Summaries of recent reports are as follows:

- *The Report to Congress: Fiscal Year 2019*³² reported on the 14 institutes in operation at that time and their aggregate performance metrics. Twelve quantitative measures in four program categories were consistent from previous years. The Program expanded its education and workforce metrics, incorporating lessons learned from piloting these metrics with the nine DOC and DoD institutes. The introduction of 10 new education and workforce measures increased the number of program performance measures to 22.
- *The Report to Congress: Fiscal Year 2020*³³ built upon the new performance metrics and included a section on the quick response of the institutes to the COVID-19 pandemic. Many of these efforts involved institutes working as early as March 2020 to quickly mobilize and address the critical lack of personal protective equipment throughout the nation. In addition, the report covered inaugural, NIST-

³¹ Revitalize American Manufacturing and Innovation Act of 2014, (Pub. L. 113-235, codified in relevant part at 15 U.S.C. § 278s(i)(2)). [http://uscode.house.gov/view.xhtml?req=\(title:15 section:278s edition:prelim](http://uscode.house.gov/view.xhtml?req=(title:15 section:278s edition:prelim)

³² *Report to Congress: Fiscal Year 2019*, Advanced Manufacturing National Program Office, National Institute of Standards and Technology, Department of Commerce (January 12, 2021). <https://www.manufacturingusa.com/reports/report-congress-fiscal-year-2019>

³³ *Manufacturing USA Report to Congress: Fiscal Year 2020*, Advanced Manufacturing National Program Office, National Institute of Standards and Technology, Department of Commerce (August 2021). <https://www.manufacturingusa.com/reports/mfg-usa-report-congress-fiscal-year-2020>

funded projects authorized under the CARES Act that were awarded to the institutes to address other pandemic needs and prepare for future pandemics.

- *The Report to Congress: Fiscal Year 2021*³⁴ reported that the Manufacturing USA network collaborated across agencies and institutes to share research progress and discuss lessons learned from the COVID-19 pandemic. Under the American Rescue Plan appropriations, NIST-sponsored grant competitions funded projects to Manufacturing USA institutes to focus on domestic research, development, and testbeds to prevent, prepare for, and respond to coronavirus. The institutes continued addressing the need for more skilled workers trained in advanced manufacturing technology. The pandemic prompted the institutes to augment their on-line tools to increase the accessibility of innovative advanced manufacturing education and training, which reached more diverse groups and communities.
- *The 2021 Manufacturing USA Rapid Response to COVID-19*³⁵ report summarized how nine Manufacturing USA institutes worked with 91+ partners across 24 states and Puerto Rico on 36 manufacturing innovation projects to combat COVID-19.
- *The Report to Congress: Fiscal Year 2022*³⁶ described how the institutes worked with more than 2,500 member organizations on more than 670 applied research and development technology projects of high priority to industry. Manufacturers constituted 63% of those member organizations, with nearly three-quarters of those being small and medium-sized. In FY 2022, the institutes attracted \$307 million from state, Federal, and private funds in addition to \$109 million in base Federal funding. This 2.8 to 1 investment match exceeded the Program design of a 1-to-1 match, demonstrating how Federal investment effectively catalyzes investment in industrial innovation. Additionally, 106,000 workers, students, and educators participated in institute and partner-led advanced manufacturing education and workforce programs, an increase of 25% over the prior year.

External Assessments

In December 2021, GAO released their third assessment report on Manufacturing USA: *Advanced Manufacturing: Innovation Institutes Report Technology Progress and Members Report Satisfaction with Their Involvement*.³⁷ GAO found that the majority of institute projects moved from Technology Readiness Level (TRL) 4 to 6, developing technology from lab demonstration to a prototype system implemented in a simulated production environment. Importantly, the report indicated that small manufacturers, who are institute members, were generally engaged and satisfied with their participation. Finally, the GAO indicated that while sponsoring agencies had implemented prior recommendations on interagency collaboration and the development of sustainment criteria, additional network-wide performance metrics still need to be developed.

³⁴ *Manufacturing USA Report to Congress: Fiscal Year 2021*, Advanced Manufacturing National Program Office, National Institute of Standards and Technology, Department of Commerce (October 2022).

https://www.manufacturingusa.com/sites/manufacturingusa.com/files/2022-10/FY21_MFG%20USA%20Report%20to%20Congress.pdf

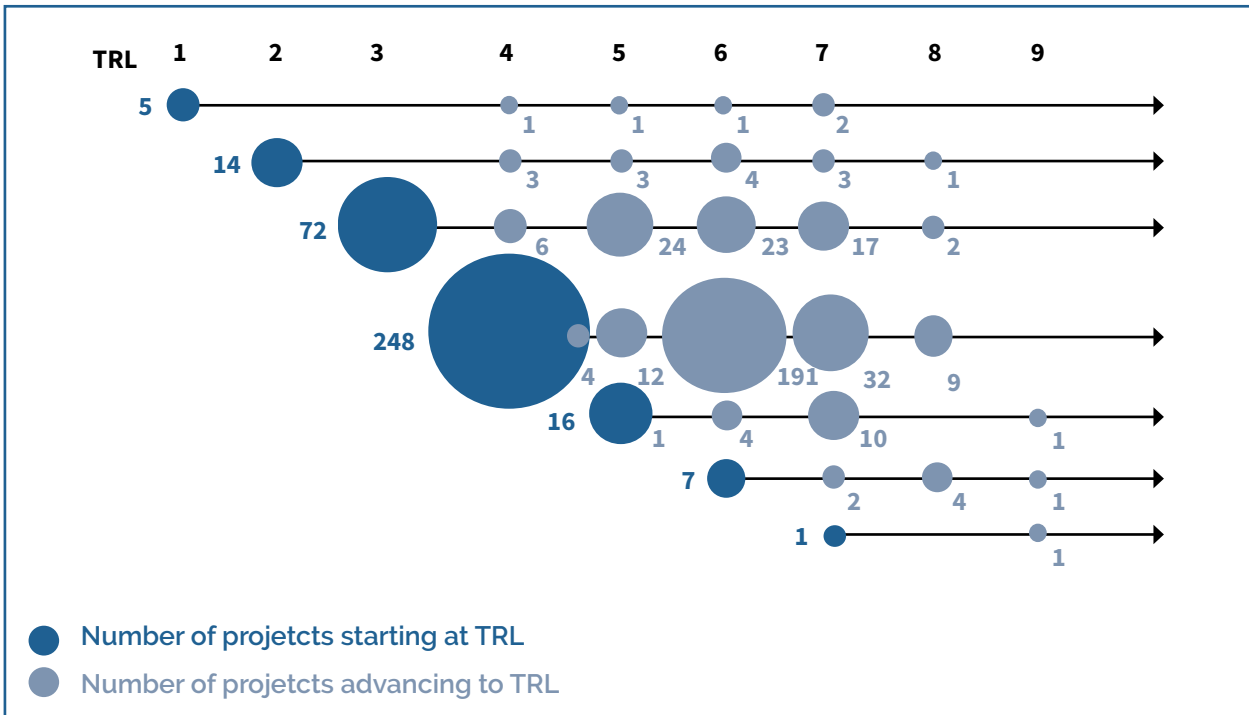
³⁵ *Manufacturing USA Rapid Response to COVID-19 Report*, Advanced Manufacturing National Program Office, National Institute of Standards and Technology, Department of Commerce (March 24, 2021).

<https://www.manufacturingusa.com/reports/manufacturing-usa-rapid-response-covid-19-report>

³⁶ *Manufacturing USA Report to Congress: Fiscal Year 2022*, Advanced Manufacturing National Program Office, National Institute of Standards and Technology, Department of Commerce (January 2024). <https://www.manufacturingusa.com/reports/2023-manufacturing-usa-annual-report>

³⁷ *Advanced Manufacturing: Innovation Institutes Report Technology Progress and Members Report Satisfaction with Their Involvement*, GAO-22-103979 (December 16, 2021).

<https://www.manufacturingusa.com/reports/advanced-manufacturing-innovation-institutes-report-technology-progress-and-members-report>



Source: GAO analysis of data provided by Manufacturing USA institutes. GAO-22-103979

Figure 3. Advancement of technology readiness level (TRL) for completed manufacturing USA institute projects, as of March 2021.

Implementation of the Strategic Plan

Over the next three years, the strategy detailed in this document will be implemented through collaboration mechanisms established for the Manufacturing USA Program. The strength of the Manufacturing USA Program is driven by the work of the institutes and the Program's network of public-private partnerships. The Manufacturing USA Program will utilize mechanisms including institute and interagency working teams, annual meetings, roadmapping, outreach and communication tools, and benchmarking to meet the Program goals and objectives. In addition to the Action items identified for each Objective, new initiatives as described below will be implemented over the next three years to enhance the Program.

Manufacturing USA White House Leadership Summit

On October 24, 2022, the Assistant to the President and Director of the National Economic Council, along with the Deputy NEC Director and Deputy OMB Director, convened the sixteen directors of the Manufacturing USA Institutes at the White House for the first time since the network's founding in 2012. Deputy and Under Secretaries from DOD, DOE, DOC, DOL, and USDA, along with representatives from six additional agencies, joined this leadership summit to discuss the critical role the Manufacturing USA network plays in advancing the American Industrial Strategy. Three themes emerged from the summit:

- Strengthening interagency and cross-institute coordination to leverage existing education and workforce development and technical programs as whole-of-government efforts to meet national priorities for advanced manufacturing.
- Strengthening network evaluation mechanisms so the Program has more effective data about what works well and what does not.
- Fostering the evolution of Manufacturing USA to be a critical asset for the Modern American Industrial Strategy.

This strategic plan implements the themes and recommendations from the White House Leadership Summit.³⁸ These initiatives, as well as all Federal agency activities listed in this strategic plan, require ongoing recognition of the importance of advanced manufacturing to national competitiveness and remain subject to budgetary and resource constraints and other approvals.

Metrics and Evaluation

An interagency working group will be chartered to evaluate and improve the Program's metrics to better assess progress towards program goals and quantify the impact of the Program and network. This group will start with the recently drafted performance goals and identify suitable measures for consideration. Each metric will be evaluated to ensure that the benefit derived from measurement is greater than the resources needed to capture and report. Other key areas for consideration include measuring impact across various technology areas; determining when targets are appropriate; evaluating trends; determining specific strengths, weaknesses, opportunities, and threats faced by institutes; and incorporating potential micro- and macro-economic measures. In the first year, analysis of funding agency performance measures and requirements of existing

³⁸ *Readout of the First White House Leadership Summit with Manufacturing USA Innovation Institute Network Directors*, The White House (October 24, 2022). <https://www.whitehouse.gov/briefing-room/statements-releases/2022/10/24/readout-of-the-first-white-house-leadership-summit-with-manufacturing-usa-innovation-institute-network-directors/>.

support agreements will be completed and opportunities for expanding measurement of program impact will be identified. In the second year, piloting of new metrics will begin. A revised set of metrics for the Program is expected to be completed by 2027.

Network Technology Collaboration

While most manufacturing challenges require multidisciplinary approaches, cross-institute technology collaboration can be difficult due to differences in membership terms, IP policies, and funding vehicles. An interagency working group with robust participation by the institutes will develop multiple pathways for cross-institute technical projects, including alternate procurement options such as Other Transactions for Prototyping.³⁹ In 2021, using the Other Transaction Authority, the DoD awarded two cross-institute projects involving three institutes.

The Manufacturing USA Education and Workforce Development (EWD) group focuses on sharing best practices for EWD projects across multiple institutes. Cross-institute EWD projects are less complex but can also involve multiple stakeholder groups, including Federal agencies, industry, universities, community colleges, local workforce investment boards, and economic development agencies. Existing cross-institute EWD projects have demonstrated the feasibility of expanding EWD activities across technology areas. The interagency group will work to identify priorities for expanding cross-institute programs and identifying Federal investment programs suitable for multiple institutes.

Public Service Grants and Pilot Programs

Subject to appropriations, the Secretary of Commerce may award grants for public service activities that promote cross-institute collaboration and pilot programs at Manufacturing USA institutes to address specific purposes of the Program.⁴⁰ Under this authority, NIST awarded over \$50 million in grants for pandemic response and preparedness.⁴¹ Such authority can serve as a useful tool for cross-institute collaboration in the areas of workforce development, R&D, technology transfer, manufacturing cluster development, outreach to small and medium-sized manufacturers, or other activities the Secretary of Commerce determines to be in the national interest and which are unlikely to receive private sector financial support.⁴² One area of opportunity discussed at the White House Leadership Summit focused on increasing the impact of Manufacturing USA institutes workforce development programs in areas such as sector-based partnerships. Appropriated funding in the 2023 Omnibus legislation will give the network a mechanism to pilot projects that address this opportunity.

Network Expansion in Critical Technology Areas

Expansion of the number of Institutes within the Manufacturing USA network will be pursued through multiple pathways. When funding is authorized and appropriated, Federal agencies will solicit proposals for establishing new institutes consistent with their program needs and mission. DOC has received FY 2023 appropriations to host a competition for a new Manufacturing USA institute that does not substantially duplicate the technology

³⁹ Authority of the Department of Defense to carry out certain prototype projects, (Pub. L. 114-92, codified in 10 U.S.C. § 2371b, renumbered to 10 USC 4022). [https://uscode.house.gov/view.xhtml?req=\(title:10%20section:4022%20edition:prelim\)](https://uscode.house.gov/view.xhtml?req=(title:10%20section:4022%20edition:prelim))

⁴⁰ The Secretary may award a grant on a competitive basis to Manufacturing USA institutes that are not receiving financial assistance under 15 U.S.C. § 278s(e) to carry out workforce development, outreach to small- and medium-sized manufacturers, and other activities that (1) are determined by the Secretary to be in the national interest; and (2) are unlikely to receive private sector financial support. (Pub. L. 113-235, codified in relevant part at 15 U.S.C. 278s(f)). [https://uscode.house.gov/view.xhtml?req=\(title:15%20section:278s%20edition:prelim\)](https://uscode.house.gov/view.xhtml?req=(title:15%20section:278s%20edition:prelim))

⁴¹ *Commerce Department Awards \$54 Million in American Rescue Act Grants to Increase Access to Advanced Manufacturing Opportunities*, National Institute of Standards and Technology, Department of Commerce (February 28, 2022). <https://www.nist.gov/news-events/news/2022/02/commerce-department-awards-54-million-american-rescue-act-grants-increase>

⁴² Revitalize American Manufacturing and Innovation Act of 2014 (Pub. L. 113-235, codified in relevant part at 15 U.S.C. § 278s(f)). [https://uscode.house.gov/view.xhtml?req=\(title:15%20section:278s%20edition:prelim\)](https://uscode.house.gov/view.xhtml?req=(title:15%20section:278s%20edition:prelim))

focus of other Manufacturing USA institutes.⁴³ In the past, DOC solicitations did not specify a specific technology focus, but instead referred proposers to a broad collection of critical technology areas. The agency evaluated institute proposals based upon impact to national economic competitiveness as captured in the Program's authorizing legislation.⁴⁴

The 2022 National Strategy for Advanced Manufacturing identified a listing of national priority technology topics, that includes:⁴⁵

- Decarbonization of Manufacturing Processes
- Clean Energy Manufacturing Technologies
- Sustainable Manufacturing and Recycling
- Nanomanufacturing of Semiconductors and Electronics
- Semiconductor Materials, Design, and Fabrication
- Semiconductor Packaging and Heterogeneous Design
- Biomanufacturing
- Agriculture, Forest, and Food Processing
- Biomass Processing and Conversion
- Pharmaceuticals and Healthcare Products
- Advance High-Performance Materials Design and Processing Capabilities
- Additive Manufacturing
- Critical Materials
- In-Space Manufacturing
- Digital Manufacturing
- Artificial Intelligence (AI) in Manufacturing
- Human-Centered Technology Adoption
- Cyber Security in Manufacturing

Many of these technology topics are partially covered by the current institutes and other major Federal funding mechanisms. Topics related to semiconductor manufacturing will be addressed with funds appropriated through the CHIPS and Science Act, which provided appropriations in FY2022 through FY2026⁴⁶ for NIST to establish up to three Manufacturing USA institutes focused on semiconductor manufacturing.⁴⁷ Plans are in place to solicit institute proposals for a new CHIPS Manufacturing USA institute focused on digital twins for the semiconductor industry⁴⁸ and another institute on AI for Resilient Manufacturing.⁴⁹

⁴³ Revitalize American Manufacturing and Innovation Act of 2014 (Pub. L. 113-235, codified in relevant part at 15 U.S.C. § 278s(e)(4)(A)). [https://uscode.house.gov/view.xhtml?req=\(title:15%20section:278s%20edition:prelim\)](https://uscode.house.gov/view.xhtml?req=(title:15%20section:278s%20edition:prelim))

⁴⁴ Revitalize American Manufacturing and Innovation Act of 2014 (Pub. L. 113-235, codified in relevant part at 15 U.S.C. § 278s(e)(4)(C)). [https://uscode.house.gov/view.xhtml?req=\(title:15%20section:278s%20edition:prelim\)](https://uscode.house.gov/view.xhtml?req=(title:15%20section:278s%20edition:prelim))

⁴⁵ *National Strategy for Advanced Manufacturing*, Executive Office of the President, National Science and Technology Council, Committee on Technology, Subcommittee on Advanced Manufacturing (October 7, 2022). <https://www.commerce.gov/news/blog/2022/10/announcing-national-strategy-us-leadership-advanced-manufacturing>

⁴⁶ Section 102(a)(2) of the CHIPS Act of 2022, (Pub. L. 117-167, Division A), codified at 15 U.S.C. 4651 et seq., <https://www.congress.gov/117/bills/hr4346/BILLS-117hr4346enr.pdf>

⁴⁷ William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021, (Pub. L. 116-283, codified in relevant part at 15 U.S.C. 4656(f)). [http://uscode.house.gov/view.xhtml?req=\(title:15%20section:4656%20edition:prelim\)](http://uscode.house.gov/view.xhtml?req=(title:15%20section:4656%20edition:prelim))

⁴⁸ <https://www.commerce.gov/news/press-releases/2024/05/chips-america-announces-285-million-funding-opportunity-digital-twin>

⁴⁹ <https://www.nist.gov/oam/noi-ai-resilient-manufacturing-institute>

Many of the topics listed above fall under the mission of several agencies. Further expansion of the network by sponsoring agencies occurs when mission-essential technology maturation requirements align with the Manufacturing USA vision and mission. These principles are also aligned with the National Strategy on Microelectronics Research.⁵⁰ This pathway for expanding the network proceeds when agency funding is identified, and a competitive solicitation for new institutes is developed with a narrow technology focus area.

Technology Transition and Commercialization

New, science-based manufacturing technologies that are infused into domestic production of new and improved products will help grow the manufacturing sector, create new high-quality jobs, and strengthen the competitiveness of the United States. As articulated in Executive Order (*July 28, 2023*) “*Federal Research and Development in Support of Domestic Manufacturing and United States Jobs*,”⁵¹ new technologies and innovative products resulting from Federally funded R&D, once commercialized, should be produced in the United States by American workers to the maximum extent possible. The 2022 National Strategy for Advanced Manufacturing outlines three goals to grow the economy and strengthen national security. The goals outline several objectives and national technology priorities that address technology development and transition, education and workforce development, and supply chain resiliency. The national strategic plan provides an integrated roadmap to support domestic production and increase the number of high-quality, high-paying jobs. Achievement of the technology priorities is linked with advances in science and technology that underpin technology development and transition to manufacturing.

The new technologies developed under Federal R&D investments, especially those in advanced manufacturing, should be transitioned to higher TRL/MRL levels to drive positive economic impact and job creation. The CHIPS and Science Act, “requires an Agency head to establish policies to promote the domestic production of technologies developed by the Manufacturing USA Network.”⁵² Therefore, AMNPO, in coordination with sponsoring agencies, will encourage transition and commercialization of new technologies developed with Federal R&D investments into domestic production. This initiative is aligned with recommendations from the 2022 White House Leadership Summit.⁵³

⁵⁰ <https://www.whitehouse.gov/wp-content/uploads/2024/03/National-Strategy-on-Microelectronics-Research-March-2024.pdf>

⁵¹ <https://www.whitehouse.gov/briefing-room/presidential-actions/2023/07/28/executive-order-on-federal-research-and-development-in-support-of-domestic-manufacturing-and-united-states-jobs/>

⁵² CHIPS and Science ACT, Section 10263, codified at 42 USC 18972.

⁵³ *Readout of the First White House Leadership Summit with Manufacturing USA Innovation Institute Network Directors*, The White House (October 24, 2022). <https://www.whitehouse.gov/briefing-room/statements-releases/2022/10/24/readout-of-the-first-white-house-leadership-summit-with-manufacturing-usa-innovation-institute-network-directors/>

Appendix A. Federal Agencies Participating in Manufacturing USA

Department of Commerce

The Department of Commerce's mission is to create the conditions for economic growth and opportunity for all communities. Through its 13 bureaus, the Department works to drive U.S. economic competitiveness, strengthen the domestic industry, and spur the growth of quality jobs in all communities across the country. The Department serves as the voice of business in the Federal Government and the Department touches and serves every American every day.

The DOC 2022-2026 Strategic Plan⁵⁴ describes the Department's five strategic goals to 1) Drive U.S. Innovation and Global Competitiveness, 2) Foster Inclusive Capitalism and Equitable Economic Growth, 3) Address the Climate Crisis Through Mitigation, Adaptation, and Resilience Efforts, 4) Expand Opportunity and Discovery Through Data, and 5) Provide 21st Century Service with 21st Century Capabilities.

The Department increases regional and national capacity for innovative manufacturing through partnerships with state and local governments, academic institutions, and the private sector. Through its convening power, regional economic development programs, and statistical and economic analysis, it empowers industry-driven solutions to the shortage of in-demand skills.

The DOC's National Institute of Standards and Technology is the only research laboratory in the U.S. Government specifically focused on enhancing industrial competitiveness; its robust research portfolio is concentrated on the technical challenges associated with advanced manufacturing.

The Department supports the work of Manufacturing USA by establishing networking opportunities for the manufacturing institutes. DOC also hosts the AMNPO at NIST, an interagency team with participation from Federal agencies that oversees the planning, management, and coordination of Manufacturing USA.

Department of Defense

The U.S. Department of Defense provides a staffed, trained, and equipped military force needed to deter aggression and protect the security of our nation. To transition DoD science and technology advances into production, the Department must have access to a robust and responsive U.S. industrial base equipped with advanced manufacturing technologies that deliver critical products and systems affordably and rapidly. To help develop the technology and manufacturing ecosystems needed to support the Department's mission, the DoD established nine Manufacturing Innovation Institutes (DoD MIIs) through the Office of the Secretary of Defense Manufacturing Technology Program. Unlike the other manufacturing institutes, the DoD-sponsored institutes have the additional mission to develop innovative technologies that will ultimately support DoD capabilities.

The DoD MIIs address commercial and defense manufacturing needs via public-private partnerships with active participation and support from the military departments and defense agencies. The institutes' flexible business models and focus on highly collaborative R&D catalyze important new organizational relationships across government, industry, and academia. Under the leadership of the Under Secretary of Defense for Research

⁵⁴ U.S. Department of Commerce Strategic Plan | 2022 – 2026, Department of Commerce.
<https://www.commerce.gov/sites/default/files/2022-03/DOC-Strategic-Plan-2022%E2%80%932026.pdf>

and Engineering, DoD continues to foster long-term engagement with its institutes to support the DoD critical technology areas.⁵⁵ Already, the institutes have shown progress in support of cybersecurity for manufacturing, microelectronics, biotechnology, hypersonics, and autonomy, among other technology priorities. These innovations support the National Defense Strategy⁵⁶ as the Department seeks to build enduring advantages for the future Joint Force through getting the technology we need more quickly.

The DoD intends to continue strategic partnerships with their institutes to further enable the development of defense-critical technologies into affordable, domestic defense products. Continued engagement helps to maintain and enhance manufacturing innovation ecosystems. By fostering Department engagement, these public-private partnerships help ensure domestic and defense manufacturing needs can be met while protecting IP and providing overmatching technology to the warfighter. The DoD institutes further the Department's vision for a national technology innovation base and help ensure that key advanced technologies that are invented in the U.S. are manufactured in the U.S.

Department of Education

The mission of the U.S. Department of Education is to promote student achievement and preparation for global competitiveness by fostering educational excellence and ensuring equal access. The Department administers the \$1.4 billion Carl D. Perkins Career and Technical Education Act, the purpose of which is to develop more fully the academic and career and technical and employability skills of secondary education students and postsecondary education students who elect to enroll in career and technical education programs. The Department also administers the \$729 million Adult Education and Family Literacy Act (AEFLA), which awards funds to states to support basic skills, high school equivalency, and English language instruction for adults who do not have a high school credential or who are not proficient in English. The Department strongly promotes the use of AEFLA funds for integrated education and training, an evidence-based strategy that combines occupational training with basic skills or English language instruction, teaching academics in the context of careers.

The Department has been active in helping develop Manufacturing USA from its formation. The Department's leadership collaborates closely with its counterparts at the U.S. Departments of Commerce, Labor, Transportation, Agriculture, Energy, and other Federal agencies to advance the President's Investing in American agenda to prepare and connect more Americans with the good jobs in advanced manufacturing and other industries that are being created by the Bipartisan Infrastructure Law, the CHIPS and Science Act, the Inflation Reduction Act, and associated private investments.

Department of Energy

The mission of the Department of Energy (DOE) is to ensure America's security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions.

The manufacturing technologies programs within the DOE Office of Energy Efficiency and Renewable Energy (EERE) are dedicated to improving the energy and material efficiency, productivity, security, sustainability, and competitiveness of manufacturers across the industrial sector. Manufacturing accounts for approximately 30% of total U.S. emissions and energy consumption, costing \$125–\$150 billion annually. Reducing energy costs can have a significant impact on improving the efficiency, security, and sustainability of operations directly improves manufacturing competitiveness, specifically improving energy affordability for manufacturers. Technology advances are also needed to make our supply chains for clean energy technologies more resilient to

⁵⁵ *USD(R&E) Technology Vision for an Era of Competition*, Department of Defense (February 1, 2022).
https://www.cto.mil/wp-content/uploads/2022/02/usdre_strategic_vision_critical_tech_areas.pdf

⁵⁶ *Fact Sheet: 2022 National Defense Strategy*, Department of Defense (March 28, 2022).
<https://media.defense.gov/2022/Mar/28/2002964702/-1/-1/1/NDS-FACT-SHEET.Pdf>

secure our clean energy future. Reducing emissions from manufacturing and securing our clean energy supply chains are essential to ensuring we reach the nation's climate goals. DOE recognizes that the impacts of energy production and consumption have been inequitably distributed and seeks to ensure historically disadvantaged communities experience the benefits of DOE's programs.

EERE brings together manufacturers, not-for-profit entities, research organizations, and institutions of higher education to identify challenges; catalyze innovations; and develop cutting-edge material, process, and information technologies needed for an efficient and competitive domestic manufacturing sector. EERE seeks to drive energy productivity improvements in the U.S. manufacturing sector, efficiently utilize abundant and available domestic energy resources, and support the manufacture of energy products with benefits extending across the economy.

DOE uses a range of partnership mechanisms, including Manufacturing USA institutes and Energy Innovation Hubs, to catalyze the development of advanced manufacturing technologies. As of the end of FY 2022, DOE had established six Manufacturing USA institutes and an open funding opportunity to establish a seventh. Each DOE Manufacturing USA institute is designed to accelerate U.S. advanced manufacturing by catalyzing the development of new technologies, national infrastructure, educational competencies, production processes, and products via shared contributions from the public and private sectors and institutions of higher education. These partnerships create an innovation ecosystem that accelerates technology development and facilitates the transition of innovative advanced manufacturing technologies to industry. Developing these national capabilities enables future global leadership in advanced manufacturing.

Department of Health and Human Services

The mission of HHS is to enhance and protect the health and well-being of all Americans. The Department achieves this mission by providing effective health and human services and fostering advances in medicine, public health, and social services. The HHS considers robust manufacturing to be critical to public health security and resilience in the U.S.

The Food and Drug Administration (FDA), an operating division within the HHS, is responsible for protecting public health by ensuring the safety, efficacy, and security of human and veterinary drugs, biological products, medical devices, our nation's food supply, cosmetics, and products that emit radiation. The FDA continues to support the development of new tools, standards, and approaches to evaluate the advanced manufacturing of FDA-regulated products. During the 2020 COVID-19 pandemic response, FDA collaborated with Manufacturing USA institutes, especially America Makes, to facilitate the use of advanced manufacturing, where possible, for pandemic response and improvements to future responses. The FDA also has several Working Groups that monitor the technology landscape and work closely with Manufacturing USA institutes. Promising technologies potentially implemented in 5 to 10 years are explored by the FDA Emerging Sciences and Technology Working Group. Technologies that are ready for implementation and adoption are considered by the FDA Advanced Manufacturing Technologies Working Group. Furthermore, the FDA awards projects through the FDA's Broad Agency Announcement to support emerging and enabling technologies for advanced manufacturing. Several of the FDA product Centers also have programs to facilitate and foster the review and use of advanced technologies in medical products.

The HHS Biomedical Advanced Research and Development Authority (BARDA) engages regularly with Manufacturing organizations through its DRIVE Broad Agency Announcement for funding proposals as well as through outreach efforts. BARDA has allocated \$6.5 billion in CARES Act funding to various critical manufacturing and development projects for the pandemic response, including advanced manufacturing activities that will improve supply chain resilience and manufacturing efficiency. The National Institute for Occupational Safety

and Health (NIOSH), part of the Centers for Disease Control and Prevention, provides leadership to prevent work-related illness, injury, disability, and death by gathering information, conducting scientific research, and translating the knowledge gained into products and services. Recent NIOSH activities which support advanced manufacturing include field and laboratory study of the use of nano and advanced materials in industry, to include three-dimensional (3D) printing. These studies have been used to produce guidance for manufacturers on the safe and responsible use of these technologies.

Department of Labor

The U.S. Department of Labor's Employment and Training Administration (ETA) is the principal workforce development agency in the Federal government. ETA's mission is to contribute to the more efficient functioning of the U.S. labor market by providing high-quality job training, employment, labor market information, and income maintenance services, primarily through state and local workforce development systems. The ETA supports sustainable economic growth through leadership and a national investment portfolio that develops workforce skills necessary to support the jobs of today and is positioned to support the jobs of tomorrow, to the benefit of American job seekers and job creators. This portfolio includes significant investments in employment and workforce development solutions.

ETA oversees a diverse portfolio of programs and services provided by the public workforce system, a network of Federal, state, and local government-funded agencies and programs. The public workforce system delivers quality job opportunities and assistance in acquiring skills and credentials to workers and connects businesses with skilled workers to meet their workforce needs. The Department of Labor's 2022-2026 Strategic Plan⁵⁷ includes ETA's strategies for preparing America's workers for the jobs of the 21st century by investing in high-quality workforce training programs and expanding access to underserved communities. Partnerships at the Federal, state, and regional levels connect employers, labor organizations, educational institutions, the public workforce system, and economic development partners to address the workforce needs of industry sectors, such as advanced manufacturing. These partnerships ensure that job creators have the talent they need to grow and thrive and provide job seekers the opportunity to develop in-demand skills through work-based learning and Registered Apprenticeships and to earn industry-recognized credentials.

ETA supports and is part of the Manufacturing USA Interagency Working Team and the Manufacturing USA Education and Workforce Subcommittee. The agency continues to engage in partnerships, share tools and resources, and identify strategies that can be leveraged to support the Manufacturing USA institutes.

National Aeronautics and Space Administration

The National Aeronautics and Space Administration is the United States government agency responsible for aeronautics, space exploration, space technology, space, and Earth science. NASA contributes to our nation's economic competitiveness, fueling growth in American industry and supporting quality, high-paying jobs across the country. NASA emphasizes leadership in climate change, as a leading provider of Earth systems science and data. NASA also inspires young explorers, scientists, and technologists who will lead our nation's skilled STEM workforce.

The Space Technology Mission Directorate (STMD) is the NASA organization most closely related to Manufacturing USA. STMD invests in transformational technologies that help offset future mission risk, reduce cost, advance capabilities that enable NASA's missions, and support space industry growth and high-quality job creation.

⁵⁷ U.S. Department of Labor Evidence-Building Plan Fiscal Year 2022-2026, Department of Labor.
<https://www.dol.gov/sites/dolgov/files/evidence/evidence-building-plan-fy2022-2026.pdf>

STMD identifies and promotes research and technology development, demonstrates applicability, and supports the infusion of these technologies into NASA’s exploration and science missions as well as commercial space activities.

Advanced manufacturing research and development within STMD is focused on several areas, including in-space manufacturing, additive manufacturing, advanced materials, polymer matrix composites, metals processing and joining, digital transformation, and other technology development areas critical to achieving NASA’s missions. Research and development are conducted through a combination of in-house activities at NASA centers, competitively funded research with universities and industry, and collaborations with other agencies. The rapid infusion of advanced manufacturing technologies into mission applications is a major emphasis of NASA’s technology investment strategy.

U.S. National Science Foundation

The U.S. National Science Foundation (NSF) works to promote the progress of science and maintain our nation’s scientific leadership and global competitiveness. It supports basic research and education in all fields of fundamental science and engineering, other than medical sciences, to create knowledge that transforms the future. NSF’s 2022-2026 Strategic Plan⁵⁸ identifies advanced manufacturing as one of six emerging industries where scientific and engineering advancements are critical. As noted in the plan, advanced manufacturing research contributes to other key areas such as biotechnology, synthetic biology, sustainability, AI, robotics, sensing technologies, data science, and computational modeling, and will serve to propel almost every sector of the U.S. economy, from health to IT to transportation.

NSF supports fundamental advanced manufacturing research, education, and workforce training through awards from almost all of its Directorates and Offices. The most targeted support is provided through the Advanced Manufacturing Program, and through the Future Manufacturing solicitation, first published in 2020. NSF also promotes advanced manufacturing innovation through a variety of translational research programs, including the Small Business Innovation Research (SBIR), Small Business Technology Transfer (STTR), and Grant Opportunities for Academic Liaison with Industry (GOALI) programs, and by partnering with industry, states, and other agencies.

Advanced manufacturing is also supported through the Engineering Research Centers (ERC), Industry-University Cooperative Research Centers (IUCRC), and Advanced Technological Education (ATE) programs. With an emphasis on two-year colleges, the ATE program focuses on the education of technicians for the high-technology fields that drive the nation’s economy. NSF strives to encourage the full participation of all Americans in STEM and to remove barriers to their doing so.

All NSF programs welcome the submission of proposals to collaborate with Manufacturing USA institutes on cutting-edge research and educational projects⁵⁹, and it is expected that the incorporation of the resources, expertise, and experience of the institutes and their member companies will increase the competitiveness of such proposals in merit review.

⁵⁸ *Leading the World in Discovery and Innovation, STEM Talent Development and the Delivery of Benefits from Research - NSF Strategic Plan for Fiscal Years (FY) 2022 - 2026*, National Science Foundation, (March 28, 2022). <https://www.nsf.gov/pubs/2022/nsf22068/nsf22068.pdf>

⁵⁹ <https://new.nsf.gov/funding/opportunities/aligning-fundamental-research-education-advanced>

U.S. Department of Agriculture

The U.S. Department of Agriculture (USDA) provides leadership on food, agriculture, natural resources, rural development, nutrition, and related issues based on public policy, the best available science, and effective management. USDA's 2022-2026 Strategic Plan⁶⁰ prioritizes innovation that will meet the needs of stakeholders to support technological progress, production efficiencies, and advance climate-smart technologies for the agriculture and forestry industries. Advances in technology, automation, and remote sensing are a cross-cutting, macro movement in science impacting agriculture and rural communities. These technologies can provide economic opportunity through innovation, increase the productivity of the food, agriculture, and forestry sectors, enable new markets, and create new jobs.

USDA focuses on collaborative science that aligns work in fundamental and applied research funded through extramural and intramural research programs and recognizes that manufacturing is part of value-added innovations that have an important role in maximizing the benefits of a sustainable rural economy. Of specific interest is the expansion of the bioeconomy, which has the potential for the sustainable harvest and use of substantial renewable biomass in the U.S. to support existing food, feed, and fiber markets while creating new jobs. The bioeconomy is supported by innovation in biomanufacturing, biotechnology, and bioproduct development. Innovation in scaling up biomanufacturing can improve technology to more efficiently and sustainably process biological materials to produce high value bioproducts. Biotechnology can create new or improved biomaterials, and engineer forestry and agriculture crops to adapt to vulnerabilities from climate change to sustain the production of food and non-food products.

USDA is focusing on creating better market opportunities for producers and consumers at home and abroad. This would include utilizing additive manufacturing (e.g., 3D printing) or right-sizing equipment and parts across multiple production operations to increase accessibility and affordability for all growers. USDA is advancing ways to create advanced microbial, thermochemical, and mechanical processing systems for efficient conversion of inedible biomass and waste into new materials, food, and fuels.

USDA supports research, development, and deployment of forest and agricultural feedstocks to produce biobased products such as biofuels, industrial chemical intermediates, performance polymers, and finished higher-value products, as well as biotechnologies to support new markets, such as cellular agriculture, alternative proteins, and precision nutrition.

⁶⁰ U.S. Department of Agriculture Strategic Plan Fiscal Years 2022–2026, Department of Agriculture.
<https://www.usda.gov/sites/default/files/documents/usda-fy-2022-2026-strategic-plan.pdf>

Appendix B. Abbreviations

AFFOA	Advanced Functional Fabrics of America Institute
AI	Artificial Intelligence
AIM Photonics	American Institute for Manufacturing Integrated Photonics
America Makes	The National Additive Manufacturing Innovation Institute
AMNPO	Advanced Manufacturing National Program Office
ARM	Advanced Robotics for Manufacturing Institute
ARMI BioFabUSA	Advanced Regenerative Manufacturing Institute
ARP Act	American Rescue Plan Act of 2021
ATE	Advanced Technological Education (NSF)
BAA	Broad Agency Announcement
BARDA	Biomedical Advanced Research and Development Authority
BioMADE	Bioindustrial Manufacturing and Design Ecosystem
CARES Act	The Coronavirus Aid, Relief, and Economic Security Act
CBER	Center for Biologics Evaluation and Research (HHS)
CDER	Center for Drug Evaluation and Research (HHS)
CDRH	Center for Devices and Radiological Health (HHS)
CESMII	Clean Energy Smart Manufacturing Innovation Institute
Co-op	Cooperative Education
COVID-19	Coronavirus disease 2019
CyManII	Cybersecurity Manufacturing Innovation Institute
DOC	Department of Commerce
DoD	Department of Defense
DOE	Department of Energy
DOL	Department of Labor
DPA	Defense Production Act (DoD)
ED	Education Department
EDA	Economic Development Administration (DOC)
EERE	Office of Energy Efficiency & Renewable Energy
EPSCoR	Established Program to Stimulate Competitive Research (NASA)
ERC	Engineering Research Center (NSF)
ETA	Employment and Training Administration (DOL)
EWD	Education and Workforce Development
FDA	Food and Drug Administration
FY	Fiscal Year

GAO	Government Accountability Office
GOALI	Grant Opportunities for Academic Liaison with Industry
HHS	Department of Health and Human Services
IUCRC	Industry-University Cooperative Research Centers (NSF)
IACMI	Institute for Advanced Composites Manufacturing Innovation
IBAS	Industrial Base Analysis and Sustainment (DoD)
IP	Intellectual Property
IT	Information Technology
LIFT	Lightweight Innovations For Tomorrow
Mfg Tech	Manufacturing Technology Roadmaps (NIST)
MEP	Manufacturing Extension Partnership
MIC	China's Manufacturing Innovation Centers (Made in China 2025)
MII	Manufacturing Innovation Institutes (DoD)
MxD	Manufacturing Times Digital
MRL	Manufacturing Readiness Level
OCET	Office of Counterterrorism and Emerging Threats (HHS)
PowerAmerica	Next Generation Power Electronics Manufacturing Innovation Institute
NASA	National Aeronautics and Space Administration
NextFlex	America's Flexible Hybrid Electronics Manufacturing Institute
NIIMBL	National Institute for Innovation in Manufacturing Biopharmaceuticals
NIST	National Institute of Standards and Technology (DOC)
NSF	National Science Foundation
OAM	Office of Advanced Manufacturing
PoR	Programs of Record (DoD)
RACER	Rapid Assistance (for) Coronavirus Economic Response Grant Program
RAMI Act	Revitalize American Manufacturing and Innovation Act of 2014
RAPID	Rapid Advancement in Process Intensification Deployment Institute
REMADE	Reducing Embodied Energy and Decreasing Emissions
R&D	Research and Development
SBIR	Small Business Innovation Research
SMM	Small and Medium-Sized Manufacturer
STEM	Science, Technology, Engineering, and Mathematics
STMD	Space Technology Mission Directorate (NASA)
STTR	Small Business Technology Transfer Research Program
TRL	Technology Readiness Level
USDA	Department of Agriculture

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