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The National Institute of Standards and Technology: An Appropriations Overview

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SUMMARY

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The National Institute of Standards and Technology: An Appropriations Overview

The National Institute of Standards and Technology (NIST), a laboratory of the Department of Commerce, is mandated to provide technical services to facilitate the competitiveness of U.S. industry. NIST is directed to offer support to the private sector for the development of precompetitive generic technologies and the diffusion of government-developed innovation to users in all sectors of the American economy. NIST research is intended to provide measurement, calibration, and quality assurance techniques to support U.S. commerce, technological progress, improved product reliability, manufacturing processes, and public safety.

Funding for NIST extramural programs directed toward increased private sector commercialization has been a topic of congressional debate. Some Members of Congress have expressed skepticism over a "technology policy" based on providing federal funds to industry for development of precompetitive generic technologies. This approach, coupled with pressures to balance the federal budget, led to significant reductions in funding for NIST. The Advanced Technology Program (ATP) and the Manufacturing Extension Partnership (MEP), which accounted for over 50% of the FY1995 NIST budget, were subsequently proposed for elimination. In 2007, ATP was terminated and replaced by the Technology Innovation Program (TIP). TIP was subsequently defunded in the FY2012 appropriations legislation. President Trump proposed the elimination of federal funding for the MEP program in fiscal years 2018 to 2021. The FY2023 request includes a 74.2% increase for MEP.

Concerns about the adequacy of federal funding for physical science and engineering research led to efforts by successive Presidents and Congresses to double funding for the NIST laboratory and construction accounts, together with the National Science Foundation and the Department of Energy Office of Science. President George W. Bush's proposal was to do so over 10 years; the America COMPETES Act (P.L. 110-69) set authorization levels consistent with a seven-year doubling and the America COMPETES Reauthorization Act of 2010 set authorization levels consistent with an 11-year doubling. However, appropriations did not keep pace with authorization levels or presidential requests. In addition, the authorization levels for the accounts targeted for doubling lapsed at the end of FY2013. Appropriations for the targeted NIST accounts increased by 42.3% (a 3.6% compound annual growth rate) from FY2006 to FY2016. The CHIPS and Science Act (P.L. 117-167) authorized NIST appropriations for FY2023-FY2027, authorizing an increase in overall agency funding to $2.283 billion from its $1.230 billion level in FY2022. The authorized growth is primarily a result of increases in NIST's Industrial Technology Services (ITS) account—including increases of $392 million (248.1%) for the Manufacturing Extension Program and $233.5 million (1415.2%) for the Manufacturing USA program—and its laboratories (up $433.4 million, 41.0%).

In December 2014, Congress enacted the Revitalize American Manufacturing and Innovation Act of 2014 (Title VII of Division B of P.L. 113-235), establishing a Network for Manufacturing Innovation (also referred to as Manufacturing USA). In total, 16 Manufacturing USA institutes have been sponsored by the Department of Defense (DOD, nine institutes), Department of Energy (six institutes), and Department of Commerce (one institute).

The CHIPS Act of 2022, Division A of P.L. 117-167, builds on the CHIPS for America provisions in the 2021 National Defense Authorization Act (P.L. 116-283), providing funding to the Commerce Department (being executed by NIST) for a variety of efforts to increase semiconductor fabrication capacity in the United States and to ensure future U.S. leadership in semiconductor technology. The funding includes cash and tax incentives for establishing and equipping semiconductor fabrication facilities in the United States; research and development funding for NIST; and funding for the establishment of a National Semiconductor Technology Center, a National Advanced Packaging Manufacturing Program, and up to three semiconductor-focused Manufacturing USA institutes.

For FY2022, Congress provided $1.230 billion for NIST, including $850.0 million for the Scientific and Technical Research and Services (STRS) account, $174.5 million for the ITS account, and $205.6 million for the Construction of Research Facilities (CRF) account. Within the ITS account, Congress provided $158.0 million (up $8 million, 5.3%) for the Manufacturing Extension Partnership (MEP) program and $16.5 million for Manufacturing USA (up $5 million, 43.5%).

The President is requesting $1.468 billion for NIST in FY2023, an increase of $237.5 million (19.3%) from the FY2022 enacted level, including $975 million for STRS (up $125 million, 14.7%), $372.3 million for ITS (up $197.8 million, 113.4%), and 120.3 million for CRF (down $40.3, 50.4%). Within the ITS account, the request seeks$275.3 million (up $117.3 million, 74.2%) for the MEP program and $97.0 million (up $80.5 million, 487.9%) for Manufacturing USA.

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Mission

The U.S. Department of Commerce (DOC) National Institute of Standards and Technology (NIST) is the "lead national laboratory for providing the measurements, calibrations, and quality assurance techniques which underpin United States commerce, technological progress, improved product reliability and manufacturing processes, and public safety."[1]

By statute, NIST is "to assist private sector initiatives to capitalize on advanced technology; to advance, through cooperative efforts among industries, universities, and government laboratories, promising research and development projects, which can be optimized by the private sector for commercial and industrial applications; and to promote shared risks, accelerated development, and pooling of skills which will be necessary to strengthen America's manufacturing industries."[2]

NIST conducts leading-edge research in its seven research laboratories located in facilities in Gaithersburg, MD, and Boulder, CO.[3] NIST employs approximately 3,000 scientists, engineers, technicians, and support personnel, and hosts about 3,500 guest researchers and associates from academia, industry, and other government agencies, who collaborate with NIST staff and access user facilities. Research is focused on measurement, standards, test methods, and basic "infrastructural technologies" that enable development of advanced technologies. Infrastructural technologies assist industry in characterizing new materials, monitoring production processes, and ensuring the quality of new product lines. Cooperative research with industry to overcome technical barriers to commercialization of emerging technologies is a major component of NIST's work.

In addition, NIST manages extramural programs such as the Hollings Manufacturing Extension Partnership (MEP) program and Manufacturing USA. Several other extramural programs previously conducted by NIST have been eliminated or integrated into other NIST activities. These programs are discussed in the next two sections.

History and Selected Statutory Authorities

Unlike most federal laboratories, NIST has a mission specified by statute (15 U.S.C. 271-282a), has a separate authorization and appropriation, and is headed by a Senate-confirmed presidential appointee (the Under Secretary of Commerce for Technology and Standards). NIST was originally created by the NBS Organic Act of 1901 (P.L. 56-177) as the National Bureau of Standards (NBS), at a time when the first centralized industrial labs were being established.[4]

Under the act, NBS was charged with working on "the solution of problems which arise in connection with standards" and to engage in the "determination of physical constants and the properties of materials, when such data are of great importance to scientific or manufacturing interests and are not to be obtained of sufficient accuracy elsewhere." These objectives remain central to NIST's laboratory work today.

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[1] §5111, Omnibus Trade and Competitiveness Act of 1988 (P.L. 100-418).

[2] Ibid.

[3] The seven laboratories are the Materials Measurement Laboratory, Physical Measurement Laboratory, Engineering Laboratory, Information Technology Laboratory, Communications Technology Laboratory, Center for Nanoscale Science and Technology, and Center for Neutron Research.

[4] General Electric Research Laboratory, widely recognized as the first industrial research facility, was established in 1900 in Schenectady, NY.

Malcolm Baldrige National Quality Improvement Act of 1987

In 1987, the Malcolm Baldrige National Quality Improvement Act of 1987 (P.L. 100-107) established the Baldrige Performance Excellence Program under the management of NBS.[5] The act directs the President or the Secretary of Commerce to "periodically make the award to companies and other organizations which in the judgment of the President or the Secretary have substantially benefited the economic or social well-being of the United States through improvements in the quality of their goods or services resulting from the effective practice of quality management, and which as a consequence are deserving of special recognition."[6]

Omnibus Trade and Competitiveness Act of 1988

The following year, amid widespread concerns about the state of U.S. industrial competitiveness, the Omnibus Trade and Competitiveness Act of 1988 (P.L. 100-418) significantly expanded the role of NIST as the "lead national laboratory for providing the measurements, calibrations, and quality assurance techniques which underpin United States commerce, technological progress, improved product reliability and manufacturing processes, and public safety" by "moderniz[ing] and restructur[ing] that agency to augment its unique ability to enhance the competitiveness of American industry."[7] The act also changed the name from NBS to the National Institute of Standards and Technology to reflect its expanded mission. In addition to its long-standing work in standards and metrology,[8] NIST was directed to offer support to the private sector for the development of precompetitive generic technologies and the diffusion of government-developed innovation to users in all segments of the U.S. economy. Among its provisions, the act established the Advanced Technology Program (ATP), and a program now known as the Hollings Manufacturing Extension Partnership program.

Hollings Manufacturing Extension Partnership Program

The MEP is a program of regional centers that assist smaller, U.S.-based manufacturing companies in identifying and adopting new technologies. Operating under the auspices of NIST, centers in all 50 states and Puerto Rico provide technical and managerial assistance to firms. Federal funding for the centers is matched by nonfederal sources.[9]

Advanced Technology Program

The Advanced Technology Program was designed "to serve as a focal point for cooperation between the public and private sectors in the development of industrial technology," according to the report accompanying the bill, and to help solve "problems of concern to large segments of an industry." Placed within the National Institute of Standards and Technology in recognition of the laboratory's ongoing relationship with industry, ATP provided seed funding to single companies or to industry-led consortia of universities, businesses, and/or government laboratories for development of generic (broad-based), precompetitive technologies that have many applications across industries. Awards, based on technical and business merit, were for high-risk work past the basic research stage but not yet ready for commercialization. Market potential was an important

[5] The program is currently managed under NIST's Baldrige Performance Excellence Program.

[6] Malcolm Baldrige National Quality Improvement Act of 1987 (P.L. 100-107).

[7] §5111, P.L. 100-107.

[8] Metrology is the science of measurement.

[9] For additional information on the Hollings Manufacturing Extension Partnership program, see CRS Report R44308, *The Hollings Manufacturing Extension Partnership Program*, by John F. Sargent Jr.

consideration in project selection. Scientific and technical review generally was performed by federal and academic experts. Business plan assessments were made by individuals from the private sector.

America COMPETES Act/America COMPETES Reauthorization Act of 2010

The America COMPETES Act (P.L. 110-69) and the America COMPETES Reauthorization Act of 2010 (P.L. 111-358) authorized NIST appropriations and several programs and activities.

Technology Innovation Program

In 2007, the America COMPETES Act replaced ATP with a new program, the Technology Innovation Program (TIP). While similar to ATP in the promotion of research and development (R&D) expected to be of broad-based economic benefit to the nation, TIP appeared to have been structured to avoid what was seen as government funding of large firms that opponents argued did not necessarily need federal support for research. The committee report to accompany H.R. 1868, part of which was incorporated into P.L. 110-69, stated that TIP replaced ATP in consideration of a changing global innovation environment focusing on small and medium-sized companies. The design of the program also "acknowledges the important role universities play in the innovation cycle by allowing universities to fully participate in the program."[10] Appropriations for TIP were provided from FY2008 to FY2011; no appropriations have been provided for TIP since FY2011.

NIST Doubling Effort

The America COMPETES Act authorized appropriations for NIST accounts for FY2008-FY2010, and the America COMPETES Reauthorization Act of 2010 authorized appropriations for NIST accounts for FY2011-FY2013. The authorization levels for NIST were part of a larger effort to double funding for selected accounts—all of the National Science Foundation, the Department of Energy Office of Science, and the NIST laboratory and construction accounts—that support physical sciences and engineering research.[11] Congress's appropriations fell short of the authorizations in these acts. No presidential budget request has referenced the America COMPETES Act doubling goal since FY2017.

Middle Class Tax Relief and Job Creation Act of 2012

As part of the Public Safety Trust Fund provided for in the Middle Class Tax Relief and Job Creation Act of 2012 (P.L. 112-96), a share of Federal Communications Commission (FCC) spectrum auction proceeds are to be made available to NIST as part of a Wireless Innovation (WIN) Fund to help develop cutting-edge wireless technologies for public safety users. WIN funds are to be used for developing leading-edge wireless technologies for public safety users, including helping industry and public safety organizations conduct research and develop new standards, technologies, and applications to advance public safety communications in support of the initiative's efforts to build an interoperable nationwide broadband network for first responders. According to NIST,

[10] For more information on the Technology Innovation Program, see CRS Report RS22815, *The Technology Innovation Program*, by Wendy H. Schacht (available to congressional clients upon request to CRS).

[11] For more information on the doubling effort, see CRS Report R41951, *An Analysis of Efforts to Double Federal Funding for Physical Sciences and Engineering Research*, by John F. Sargent Jr.

The fund's availability extends through 2022 and began to execute in FY 2015; $92.7 million was transferred to NIST in FY 2015, $7.3 million was released from sequester in FY 2016, an additional $186.4 million was transferred in FY 2016, and $13.6 million was released from sequester in FY 2017. Currently, WIN has $108.7 million in total resources with $71.9 million available for obligation in FY 2021 and $36.8 million to be available in FY 2022. Additional transfers to NIST from NTIA are possible as proceeds from the spectrum auctions become available.[12]

The Revitalize American Manufacturing and Innovation Act of 2014 and Subsequent Amendments: Manufacturing USA

In his FY2013 budget, President Obama proposed the creation of a National Network for Manufacturing Innovation (NNMI) to help accelerate innovation by investing in industrially relevant manufacturing technologies with broad applications, and to support manufacturing technology commercialization by bridging the gap between the laboratory and the market. Congress did not act on this request or a subsequent one made in President Obama's FY2014 request. President Obama renewed the request in his FY2015 budget.

In December 2014, Congress enacted the Revitalize American Manufacturing and Innovation Act of 2014 (RAMI Act) as Title VII of Division B of the Consolidated and Further Continuing Appropriations Act, 2015 (P.L. 113-235), establishing a Network for Manufacturing Innovation (NMI), largely similar to President Obama's concept for the NNMI. President Obama signed the bill into law on December 16, 2014. The RAMI Act directed the Secretary of Commerce to establish a Network for Manufacturing Innovation program within NIST. In September 2016, the Department of Commerce rebranded the NMI as "Manufacturing USA."

The purpose of Manufacturing USA is to improve the competitiveness of U.S. manufacturing and to increase the production of goods manufactured predominantly within the United States; to stimulate U.S. leadership in advanced manufacturing research, innovation, and technology; to facilitate the transition of innovative technologies into scalable, cost-effective, and high-performing manufacturing capabilities; to facilitate access by manufacturing enterprises to capital-intensive infrastructure, including high-performance electronics and computing, and the supply chains that enable these technologies; to accelerate the development of an advanced manufacturing workforce; to facilitate peer exchange and the documentation of best practices in addressing advanced manufacturing challenges; to leverage nonfederal sources of support to promote a stable and sustainable business model without the need for long-term federal funding; and to create and preserve jobs.[13]

The RAMI Act included provisions authorizing NIST, the Department of Energy, and other agencies to support the establishment of manufacturing institutes, and providing for the establishment and operation of a network of these institutes.

The Consolidated Appropriations Act, 2016 (P.L. 114-113) provided specific funding, for the first time, for the establishment and coordination of the institutes. The act provided NIST with $25.0

[12] Department of Commerce, NIST, *National Institute of Standards and Technology/National Technical Information Service, Fiscal Year 2022 Budget Submission to Congress*, p. NIST-175.

[13] For more information on the NMI, see CRS Report R43857, *The Network for Manufacturing Innovation*, by John F. Sargent Jr. For more information on the NNMI proposal, see CRS Report R42625, *The Obama Administration's Proposal to Establish a National Network for Manufacturing Innovation*, by John F. Sargent Jr.

million for FY2016 for the NNMI, to include funding for establishment of institutes and up to $5.0 million for coordination activities.[14]

On December 16, 2016, NIST awarded NIIMBL, led by the University of Delaware, "to advance U.S. leadership in biopharmaceutical manufacturing."[15] Congress has subsequently provided funding to support NIIMBL and to coordinate the Manufacturing USA network.

Section 1741 of the National Defense Authorization Act for Fiscal Year 2020 (P.L. 116-92) amended the RAMI Act. Among its provisions, the act codified the 2016 rebranding of the program by DOC as the Manufacturing USA program, expanded the scope of potential technology focus areas for institutes, established required and permissible activities for each institute, and authorized the designation of "substantially similar" institutes as Manufacturing USA institutes for purposes of participation in the network. P.L. 116-92 also authorized the Secretaries of Commerce and Energy and other agency heads (except DOD) to make financial awards of five to seven years in duration to establish Manufacturing USA institutes, and to renew the awards subject to merit review. Further, P.L. 116-92 eliminated a RAMI Act provision requiring consideration be given to whether a proposed institute could function without long-term federal funding, and authorized appropriations for Manufacturing USA institutes and network support for NIST through 2030 and for DOE Manufacturing USA institutes through FY2024.

Previous NIST Programs

In July 2013, NIST launched the Advanced Manufacturing Technology Consortia (AMTech) program and the Manufacturing Technology Acceleration Centers (M-TAC) program.

Advanced Manufacturing Technology Consortia Program

Originally included in President Obama's FY2013 budget request, AMTech makes planning awards to "establish industry-led consortia to identify and prioritize research projects supporting long-term industrial research needs." AMTech seeks to incentivize manufacturers to share financial and scientific resources with universities, state and local governments, and nonprofit organizations.[16] AMTech does not have a statutory authorization; the Consolidated and Further Continuing Appropriations Act, 2013 (P.L. 113-6) provided first-year funding of $14.5 million.

In December 2015, the Consolidated Appropriations Act, 2016 (P.L. 114-113) directed NIST to merge the Advanced Manufacturing Technology (AMTech) Consortia program with the NNMI.[17]

Manufacturing Technology Acceleration Centers Program

The M-TAC program was a pilot effort under MEP that sought to address "the technical and business challenges encountered by small and mid-sized U.S. manufacturers as they attempt to adopt, integrate, and execute advanced product and process technologies into their operations."[18]

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[14] The act also directs NIST to merge its Advanced Manufacturing Technology Consortia (AMTech) program into the NNMI.

[15] Advanced Manufacturing National Program Office, NIST, DOC, website, "NIST Manufacturing USA Institutes," https://www.nist.gov/amo/nist-manufacturing-usa-institutes.

[16] NIST, "President's FY 2013 Budget Request for NIST Targets Advanced Manufacturing, Critical Science and Technology Programs," press release, February 13, 2012, http://www.nist.gov/public_affairs/releases/budget_2013.cfm.

[17] Explanatory Statement, Consolidated Appropriations Act, 2016, P.L. 114-113, Division B, p. 7.

[18] Advanced Manufacturing National Program Office, NIST, DOC, website, "Explaining AMTech, M-TAC and

The funded project work on all the MTAC projects has been completed and a final presentation was made by each awardee to MEP Center directors and staff in May 2016.

NIST Authorizations and Appropriations in the CHIPS and Science Act

Over the past several years, some Members of Congress and other policymakers have expressed concerns:

- that only a small share of the world's most advanced semiconductor fabrication production capacity is located in the United States;
- about the concentration of production in East Asia and related vulnerability of semiconductor supply chains in the event of a trade dispute or military conflict and other risks such as product tampering and intellectual property theft;
- about the economic and military implications of a loss of U.S. leadership in semiconductors; and
- that China's state-led efforts to develop an indigenous, vertically-integrated semiconductor industry, unprecedented in scope and scale, could, if successful, significantly shift global semiconductor production and related design and research capabilities to China, undermining U.S. and firms' leading positions.

To address these concerns, in January 2021, Congress first enacted Title XCIX (Creating Helpful Incentives to Produce Semiconductors (CHIPS) for America) of the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021 (2021 NDAA, P.L. 116-283), which authorized new NIST programs intended to re-shore semiconductor manufacturing to the United States and to bolster future U.S. leadership in semiconductor through a range of public and public-private research and development activities.

Subsequently, in July 2022, Congress passed the Creating Helpful Incentives to Produce Semiconductors (CHIPS) and Science Act (P.L. 117-167) which, among other things, included the CHIPS Act of 2022 as Division A. The CHIPS Act of 2022 funded and amended NIST authorities established under P.L. 116-283. In addition, Division B of Title II of the act, National Institute of Standards and Technology for the Future, provides a broad range of authorizations NIST activities as well as NIST appropriations. The following section addresses provisions of the CHIPS Act of 2022 (Division A, P.L. 117-167) and is followed by the NIST related provisions in National Institute of Standards and Technology for the Future (Division B, P.L. 117-167).

Semiconductor-Related Authorizations and Appropriations

Selected NIST-Related Provisions of the 2021 NDAA and CHIPS Act of 2022

The CHIPS Act of 2022 provides authorizations and appropriations to the Secretary of Commerce for a **CHIPS for America Fund** for the purpose of carrying out the provisions specified in Sections 9902 and 9906 of P.L. 116-283. These provisions seek to expand U.S. domestic semiconductor manufacturing fabrication capacity by offering financial incentives—direct financial assistance (i.e., grants, loans, loan guarantees) and tax deductions—and to help ensure

NNMI: New NIST Programs in Support of Advanced Manufacturing," http://www.manufacturing.gov/docs/Explaining_AMTech_M-TAC_NNMI.pdf.

U.S. technological and industrial leadership in semiconductor technology through R&D and the formation of public-private joint research activities. Of the $39 billion appropriated for execution of this section, $2.0 billion is provided "to incentivize investment in facilities and equipment in the United States for the fabrication, assembly, testing, or packaging of semiconductors at mature technology."[19]

Section 9902: Incentives for Establishing and Equipping U.S. Semiconductor Fabrication Facilities

Section 9902 of P.L. 116-283 authorizes the Secretary of Commerce to provide financial assistance to "covered entities" to incentivize investment in facilities and equipment in the United States for semiconductor fabrication, assembly, testing, advanced packaging, or research and development of semiconductors. By statute, covered entities include "a nonprofit entity, a private entity, a consortium of private entities, or a consortium of public and private entities with a demonstrated ability to substantially finance, construct, expand, or modernize a facility relating to fabrication, assembly, testing, advanced packaging, or research and development [R&D] of semiconductors."[20]

Under the act, a covered entity may submit an application for financial assistance to the Secretary of Commerce. Subject to availability of funds and considerations specified in the act, the Secretary may determine the appropriate amount and funding type for each award made to a covered entity, up to $3.0 billion. Awards in excess of $3.0 billion may be made if the Secretary, in consultation with the Secretary of Defense and the Director of National Intelligence, recommends such an award to the President, and the President certifies and reports to the appropriate committees of Congress, that a larger investment is necessary to significantly increase the proportion of reliable domestic supply of semiconductors relevant for national security and economic competitiveness.[21]

Section 9906(c): National Semiconductor Technology Center

Section 9906(c) directs the Secretary of Commerce, in collaboration with the Secretary of Defense, to establish a National Semiconductor Technology Center to conduct research and prototyping of advanced semiconductor technology to strengthen the economic competitiveness and security of the domestic supply chain. The center is to be operated as consortium, with participation from the private sector, the Department of Energy, and the National Science Foundation. The center's work is to emphasize advanced test, assembly, and packaging capability in the domestic semiconductor ecosystem; materials characterization, instrumentation and testing for next-generation microelectronics; virtualization and automation of maintenance of semiconductor machinery; and metrology for security and supply chain verification.[22]

Section 9906(d): National Advanced Packaging Manufacturing Program

Section 9906(d) directs the Secretary of Commerce to establish a National Advanced Packaging Manufacturing Program, led by the Director of the National Institute of Standards and Technology (NIST), to strengthen semiconductor advanced test, assembly, and packaging

[19] 15 U.S.C. 4652(e).

[20] 15 U.S.C. 4651(2).

[21] 15 U.S.C. 4652.

[22] 15 U.S.C. 4656(c).

capability in the United States, and to coordinate its efforts with the National Semiconductor Technology Center, authorized by Section 9006(c), and the Manufacturing USA institute, authorized by Section 9006(f) (discussed below).[23]

Section 9906(e): NIST Semiconductor R&D Program

Section 9906(e) authorizes the Director of NIST to conduct an R&D program to enable advances and breakthroughs in measurement science, standards, material characterization, instrumentation, testing, and manufacturing capabilities for next-generation microelectronics metrology, and to ensure U.S. competitiveness and leadership in microelectronics.[24]

Section 9906(e): Manufacturing USA Institutes

Section 9906(f) authorizes the establishment of up to three Manufacturing USA institutes to pursue research in support of the virtualization and automation of maintenance of semiconductor machinery; the development of new advanced test, assembly and packaging capabilities; and the development and deployment of educational and skills training curricula needed to support the industry sector and to ensure the United States can build and maintain a trusted and predictable talent pipeline.[25]

CHIPS Act of 2022 Appropriations

The CHIPS Act of 2022 provides the following appropriations to support the activities authorized in P.L. 116-283:

- $39.0 billion for the semiconductor incentives authorized by Section 9902, including $19.0 billion for FY2022 and $5.0 billion for fiscal years 2023 through 2026;
- $2.0 billion in FY2022 for the establishment of the National Semiconductor Technology Center authorized by Section 9906(c);
- $2.5 billion in FY2022 for the National Advanced Packaging Manufacturing Program authorized by Section 9906(d); and
- $500.0 million in FY2022 for NIST microelectronics research authorized by Section 9906(e) and the semiconductor research-focused Manufacturing USA institute authorized by Section 9906(f).
- The act also provides additional funding for activities authorized by Section 9906(c), (d), (e), and (f), in aggregate, for FY2023 ($2.0 billion), FY2024 ($1.3 billion), FY2025 ($1.1 billion), and FY2026 ($1.8 billion).

These appropriations, totaling $50.2 billion over the FY2022-FY2026 period, are summarized in **Table 1**.

[23] 15 U.S.C. 4656(d).

[24] 15 U.S.C. 4656(e).

[25] 15 U.S.C. 4656(f)

Table 1. Appropriations for CHIPS for America Provisions

(in billions of dollars)

P.L. 116-283 Section	FY2022	FY2023	FY2024	FY2025	FY2026	Total
9902	19.0	5.0	5.0	5.0	5.0	39.0
9906(c)	2.0					2.0
9906(d)	2.5					2.5
9906(e) and (f)	0.5					0.5
9906(c), (d), (e), and (f)		2.0	1.3	1.1	1.6	6.0
Total	24.0	7.0	6.3	6.1	6.6	50.0

Source: CRS analysis of P.L. 117-167.

Notes: Table does not include appropriations for three related funds established by P.L. 117-163, discussed below.

The CHIPS Act of 2022 also establishes and provides appropriations for three related funds in other federal agencies.

- The **CHIPS for America Defense Fund** to carry out section 9903(b) of P.L. 116-283, the development of a National Network for Microelectronics Research and Development, which is intended to (1) enable laboratory-to-fabrication transition of microelectronics innovations in the United States and (2) expand U.S. global leadership in microelectronics. Activities of the network are intended to enable cost effective exploration of new materials, devices, and architectures, and prototyping in domestic facilities to safeguard domestic intellectual property; to accelerate the transition of new technologies to domestic microelectronics manufacturers; and to support other relevant activities ($400 million per year for fiscal years 2022-2026, a total of $2 billion, appropriated to the U.S. Treasury to be transferred and merged with Department of Defense accounts used for such purposes).[26]
- The **CHIPS for America International Technology Security and Innovation Fund** to provide for international information and communications technology security and semiconductor supply chain activities, among other things ($100 million per year for fiscal years 2022-2026, a total of $500 million, appropriated to the U.S. Treasury for transfer to accounts within the Department of State, the U.S. Agency for International Development, the Export-Import Bank, and the U.S. International Development Finance Corporation).[27]
- The **CHIPS for America Workforce and Education Fund** to support microelectronics workforce development activities to meet the requirements of section 9906 ($25 million for FY2023, $25 million for FY2024, $50 million for FY2025, $50 million for FY2026, and $50 million for FY2027, a total of $200 million, appropriated to the National Science Foundation).[28]

[26] P.L. 117-163, Section 102(b).

[27] P.L. 117-163, Section 102(c).

[28] P.L. 117-163, Section 102(d).

National Institute of Standards and Technology for the Future

Title II of Division B of the CHIPS and Science Act, titled "National Institute of Standards and Technology for the Future," provides authorization of appropriations for fiscal years 2023 through 2027, as well as authorities for new activities.

Authorization of Appropriations for FY2023-FY2027

The act provides authorizations for three NIST accounts: the Scientific and Technical Research and Services (STRS) account that supports NIST's laboratory activities; the Industrial Technology Services (ITS) account; and the Construction of Research Facilities (CRF) account. These accounts and the programs and activities funded by them are described later in this report (see "NIST Appropriations" below). Authorizations of appropriations for these accounts is shown in **Table 1**.

Table 2. FY2022 Appropriation and FY2023-2027 Authorization of Appropriations

(in millions of current dollars)

	Appropriations	Authorization of Appropriations				
	FY2022	FY2023	FY2024	FY2025	FY2026	FY2027
Scientific and Technical Research and Services	850.0	979.1	1,047.6	1,120.9	1,199.4	1,283.4
Industrial Technology Services	174.5	372.4	404.0	719.0	759.0	800.0
Manufacturing Extension Program	*158.0*	*275.3*	*300.0*	*550.0*	*550.0*	*550.0*
National Supply Chain Database		*31.0*	*26.0*	*26.0*	*26.0*	*26.0*
Manufacturing USA	*16.5*	*97.1*	*104.0*	*169.0*	*209.0*	*250.0*
Construction of Research Facilities	205.6	200.0	200.0	200.0	200.0	200.0
Safety, Capacity, Maintenance, and Major Repairs	*80.0*	*80.0*	*80.0*	*80.0*	*80.0*	*80.0*
IT Infrastructure			*20.0*	*20.0*	*20.0*	*20.0*
Total	**1,230.1**	**1,551.5**	**1,651.6**	2,039.9	**2,158.4**	**2,283.4**

Source: P.L. 117-167.

Notes: Programs in italics nested under the accounts are included in the account's funding but are non-adds in this table.

a. 42 USC 18961, as established by Section 10253 of P.L. 117-167.

For several accounts and programs, the authorizations for FY2023-FY2027 represent a substantial increase over current funding levels. The authorization would increase FY2023 funding over FY2022 levels by:

- $321.4 million (26.1%) in total NIST appropriations;
- $129.1 million (15.2%) for the STRS account;
- $197.9 million (11.4%) for the ITS account;
- $117.3 million (74,2%) for the MEP program; and

- $80.6 million (488.5%) for Manufacturing USA.

The CRF account would decrease by $5.6 million (2.7%).

Comparing the FY2027 authorization levels to FY2022 appropriations:

- total NIST appropriations would increase by $1.053 billion (85.6%);
- the STRS account would increase by $433.4 million (51.0%);
- the ITS account would increase by $625.5 million (358.5%);
- the MEP program would increase by $392.0 million (248.1%); and
- Manufacturing USA would increase by $233.5 million (1,415.2%).

The CRF account would decrease by $5.6 million (2.7%).

Other NIST Authorizations

The act provides addition NIST authorizations for its work in measurement science (metrology), general activities, the MEP program, and Manufacturing USA.

Measurement Science

The act directs NIST to:

- directs NIST to conduct a wide range of activities in engineering biology and biometrology:
- directs NIST to carry out a measurement research program to inform the development or improvement of best practices, benchmarks, methodologies, procedures, and technical standards for the measurement of greenhouse gas emissions and to assess and improve the performance of greenhouse gas emissions measurement systems placed in situ and on space-based platforms;
- amends NIST responsibilities for cybersecurity and privacy activities;
- directs NIST to conduct a variety of activities related to software security and authentication;
- amends the Cybersecurity Enhancement Act of 2014, directing NIST to carry out research to support the development of voluntary, consensus-based technical standards, best practices, benchmarks, methodologies, metrology, testbeds, and conformance criteria for identity management; to work with public and private stakeholders to develop and maintain a technical roadmap for digital identity management R&D focused on enabling the voluntary use and adoption of modern digital identity solutions; and to provide definitions and voluntary guidance to stakeholders for digital identity management systems;
- direct NIST to establish a program to support measurement research to inform the development of best practices, benchmarks, methodologies, procedures, and voluntary, consensus-based technical standards for biometric identification systems, including facial recognition systems, to assess and improve the performance of such systems;

- amends the National Institute of Standards and Technology Act (NIST Act)[29] to require as part of its standards and guidelines for information security, performance standards and guidelines for high risk biometric identification systems, including facial recognition systems;
- amends the NIST Act to require NIST in its activities to protect research from cyber security theft to consider institutes of higher education;
- amends the NIST Act to require NIST to disseminate and make publicly available resources to help qualifying institutions identify, assess, manage, and reduce their cybersecurity risk related to conducting research;
- amends the NIST Act to require the establishment of program of measurement research for advanced communications technologies;
- directs NIST to develop a strategic plan for the future of its Center for Neutron Research after the current neutron reactor is decommissioned;
- directs NIST to continue to support the development of artificial intelligence and data science, and carry out the activities of the National Artificial Intelligence Initiative Act of 2020 authorized under the 2021 NDAA;
- directs NIST to carry out activities in support of sustainable chemistry, including coordinating and partnering with stakeholders to support clean, safe, and economic alternatives, technologies, and methodologies to traditional chemical products and processes;
- directs NIST to create a program for premise plumbing research, including conducting metrology research in relation to water safety, security, efficiency, sustainability, and resilience; and coordinating research activities with academia, the private sector, nonprofit organizations, and other federal agencies; and
- directs NIST to carry out the Dr. David Satcher Cybersecurity Education Grant Program.

General Activities

The act includes a number of provisions related to NIST's general activities. Among the provisions, the act:

- provides NIST with "other transaction" authority (often referred to as OTA) as necessary in the conduct of its work and on such terms as it may determine appropriate;
- provides NIST with special hiring and pay authorities for up to 15 scientific, engineering, and professional personnel at rates set by the Secretary of Commerce, but not to exceed the pay authorized for the Vice President of the United States;
- directs NIST to lead information exchange and coordination among federal agencies and communication from federal agencies to the U.S. private sector to ensure effective federal engagement in the development and use of international technical standards;

[29] 15 U.S.C. 272.

- directs the Government Accountability Office (GAO) to conduct a study of NIST's policies and protocols to protect its research and to combat undue foreign influence; and
- requires NIST to establish a competitive program of grants to nongovernmental standards development organizations for developing, approving, disseminating, maintaining, and reviewing forensic science voluntary consensus standards and best practices that shall be available to the public free of charge.

Hollings Manufacturing Extension Partnership

The act includes a number of provisions related to NIST's Manufacturing Extension Partnership program. Among the provisions, the act establishes an Expansion Awards Pilot Program to make awards to MEP centers or consortiums of centers for:

- providing worker education, training, development, and entrepreneurship training and for connecting individuals or business with such services offered in their community;
- providing services to improve the resiliency of domestic supply chains;
- mitigating vulnerabilities to cyberattacks, including helping to offset the cost of cybersecurity projects for small manufacturers;
- expanding advanced technology services to U.S.-based small- and medium-sized manufacturers; and
- building capabilities across the MEP network for domestic supply chain resiliency and optimization.

The grants are to be made on a competitive, merit-based system, and to have broad geographic diversity among selected proposals. Recipients are not required to provide matching funds.

National Supply Chain Database

The act requires NIST to establish a voluntary National Supply Chain Database to assist the federal government and industry sectors in minimizing disruptions to U.S. supply chains by having an assessment of U.S. manufacturers' capabilities.

The act directs the database be established through the MEP program and that it provides a national overview of the networks of U.S. supply chains of the United States and provide support for understanding of whether there is a need for some manufacturers to retool in some critical areas to meet the urgent need for key products. The database may include basic private sector entity information; an overview of capabilities, accreditations, and products; and proprietary information.

The act requires the database be multi-leveled with information provided and available according to mutually agreed to disclosure:

- Level 1 is to have the capability of providing basic private sector entity information and is to be made available to the public;
- Level 2 is to have the capability of providing a deeper, nonproprietary overview into capabilities, products, and accreditations and shall be available to all companies that contribute to the database; and
- Level 3 is to have the capability to hold proprietary information.

Manufacturing USA

The act amends the NIST Act related to the Manufacturing USA program in a number of ways. Among these provisions, the act:

- directs that a number of preferences be given special consideration in the selection of Manufacturing USA institutes, including geographic diversity, location in an area with a low per capita income, location in an area with a high proportion of socially disadvantaged residents, and location in small and rural communities;
- directs that efforts be made to integrate specified "covered entities" in new and existing Manufacturing USA institutes, including historically Black colleges and universities, tribal colleges and universities, minority-serving institutions, minority business enterprises, and rural-serving institution of higher education;
- directs NIST and the Department of Defense to establish policies to promote the domestic production of technologies developed by the Manufacturing USA network; and
- directs NIST to develop a strategy for retaining domestic public benefits from Manufacturing USA institutes once federal funding has been discontinued.

NIST Appropriations

Overview of NIST Appropriations Accounts

Discretionary funding for NIST is generally provided through three appropriations accounts:

- The Scientific and Technical Research and Services (STRS) account supports NIST in-house laboratory research. The account also provided funding for the Baldrige Performance Excellence Program through FY2011 and in some subsequent years.
- The Industrial Technology Services (ITS) account supports NIST's extramural programs. In FY2018, the ITS account provides funding for the MEP and Manufacturing USA programs, as well as the National Supply Chain Database. In earlier years, ITS provided funding for the Advanced Technology Program, the Technology Innovation Program, and the AMTech program.
- The Construction of Research Facilities (CRF, also referred to in this report as construction) account supports construction, maintenance, and repair of NIST facilities at its facilities in Gaithersburg, MD, and Boulder, CO. From FY2008 to FY2010, CRF provided funding for a competitive grant program that funded the construction of research facilities at U.S. universities and research institutions.

NIST Request for FY2023 Appropriations

The following sections provide information on NIST's FY2023 request, in aggregate and for each of its three accounts, as well as the FY2022 enacted appropriations for each. (See **Table 3**; the FY2023 NIST authorization levels are included in the table for reference.) On March 15, 2022, President Biden signed into law the Consolidated Appropriations Act, 2022 (P.L. 117-103), providing, among other things, NIST appropriations for FY2022. As of the date of this report,

neither the House nor Senate has acted on the Commerce, Justice, and Science Appropriations Act that appropriates funding for NIST.

Total NIST Funding Requested for FY2023

The President is requesting $1,467.6 million for NIST in FY2023, an increase of $237.5 million (19.3%) above the FY2022 enacted appropriation of $1,230.1 million.

Scientific and Technical Research and Services

The President's FY2023 request for NIST includes $975.0 million for R&D, standards coordination, and related services in the STRS account, an increase of $125.0 million (14.7%) above the FY2022 enacted level of $850.0 million.[30] Of these funds, $855.4 million is requested for Laboratory Programs, $101.1 million for Standards Coordination and Special Programs, and $18.5 million is for Corporate Services.

Industrial Technology Services

The President's FY2023 request for NIST would provide $372.3 million for the ITS account, up $174.5 million (113.4%). Within the ITS account, the request would provide $275.3 million for the Manufacturing Extension Partnership program, an increase $117.3 million (74.2%) from the FY2022 enacted level of $158.0 million. The FY2023 ITS request also includes $97.0 million for Manufacturing USA, an increase of $80.5 million (487.9%) from the FY2022 enacted level of $16.5 million. The increase in requested Manufacturing USA funds would provide first-year funding for four new institutes.[31]

Construction of Research Facilities

The President is requesting $120.3 million for the NIST CRF account for FY2023, down $85.3 million (41.5%) from the FY2022 enacted level of $205.6 million.[32] The entirety of these funds is requested for Safety, Capacity, Maintenance and Major Repairs; no funding is requested for Construction and Major Renovations.

[30] CRS analysis of data from Department of Commerce, National Institute of Standards and Technology, National Institute of Standards and Technology/National Technical Information Service, Fiscal Year 2022 Budget Submission to Congress, p. NIST-3, https://www.commerce.gov/sites/default/files/2021-06/fy2022_nist_congressional_budget_justification.pdf.

[31] Ibid., pp. NIST-112-NIST-120.

[32] Ibid., p. NIST-3.

Table 3. NIST Authorizations and Appropriations

(budget authority, in millions of dollars)

Budget Account	FY2022 Enacted	FY2023 Authorized (P.L. 117-163)	FY2023 Request	FY2022 House	FY2022 Senate	FY2022 Enacted
Scientific and Technical Research and Services	850.0	979.1	975.0			
Industrial Technology Services	174.5	372.4	372.3			
Manufacturing Extension Partnership	*158.0*	*275.3*	*275.3*			
National Supply Chain Database		*31.0*				
Manufacturing USA	*16.5*	*97.1*	*97.0*			
Construction of Research Facilities	205.6	200.0	120.3			
Safety, Capacity, Maintenance, and Major Repairs	80.0	80.0	120.3			
Congressionally-directed Extramural Projects	125.6					
NIST, Total	**1,034.5**	**1,551.5**	**1,467.6**			

Source: Department of Commerce, NIST, National Institute of Standards and Technology/National Technical Information Service, Fiscal Year 2023 Budget Submission to Congress (FY2023 request); P.L. 117-103 (FY2022 enacted); P.L. 117-167 (FY2023 authorizations).

Note: Columns may not add to totals due to rounding.

Funding Trends for NIST Accounts and Selected Programs

This section provides an overview of appropriations data for NIST in total and for each of its appropriations accounts, as well as for the MEP and the Advanced Technology Program (eliminated in 2007) and the Technology Innovation Program (last funded in 2011). **Appendix A** provides requested and enacted funding levels for NIST and its accounts for FY2003-FY2022. **Appendix B** provides requested and enacted funding levels for selected NIST programs.

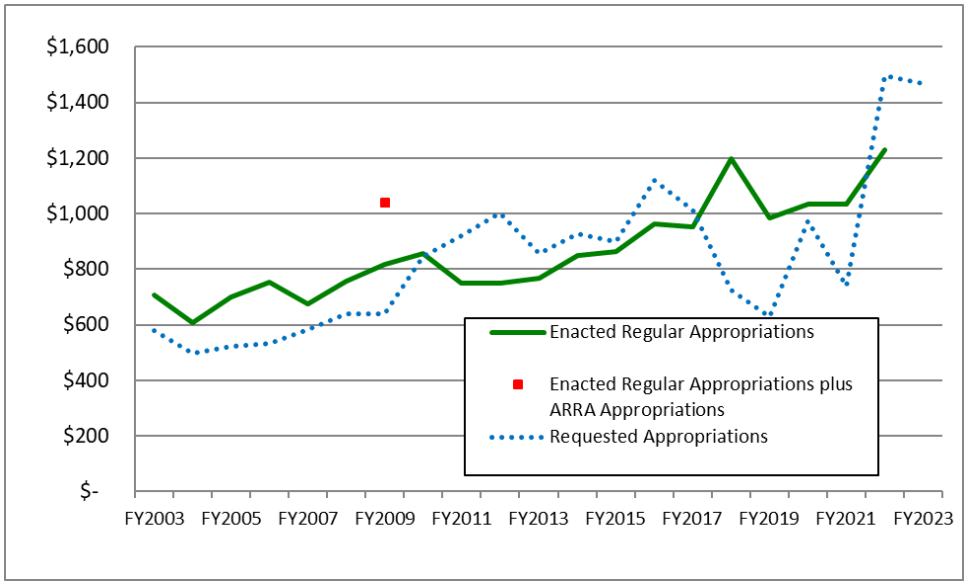
Total NIST Funding

Figure 1 illustrates total requested and enacted NIST funding levels. Total appropriations for NIST grew from $707.5 million in FY2003 to $1,230.1 million in FY2022, a compound annual growth rate (CAGR) of 3.0%. In FY2022, appropriations increased by $195.6 million (18.9%) over the FY2021 enacted level. President Biden is requesting $1,467.6 million for FY2023, an increase of $237.5 million (19.3%) above the FY202s enacted level.

Figure 1. Total NIST Appropriations

Enacted Appropriations, FY2003-FY2022; Requested Appropriations, FY2003-FY2023

(in millions of current dollars)



Sources: Department of Commerce, NIST budget documents, appropriations acts, and explanatory statements for FY2003-FY2023.

Note: ARRA = American Recovery and Reinvestment Act.

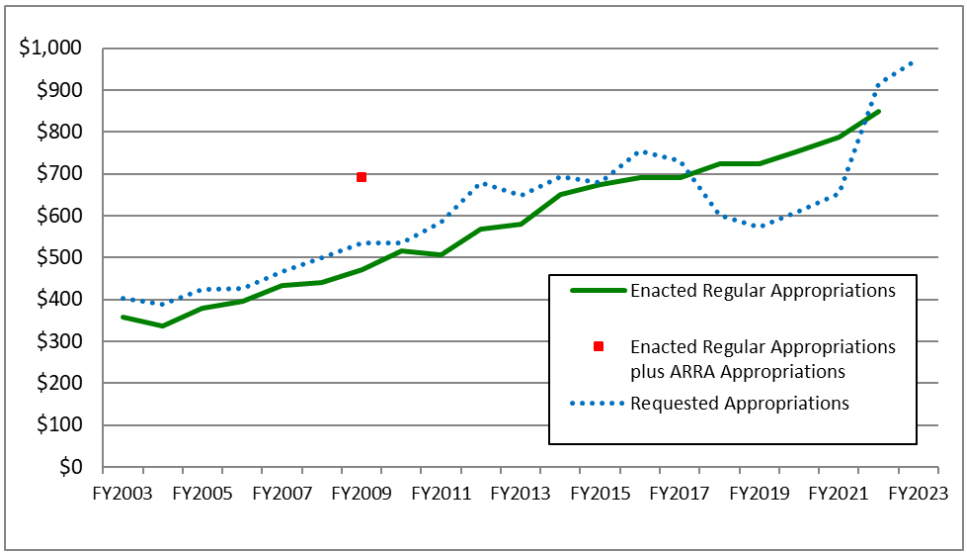
Scientific and Technical Research and Services Account

Figure 2 illustrates requested and enacted funding levels for the NIST STRS account. This account saw a steady rise in both request and appropriations levels through FY2016. STRS funding requests declined from FY2016 to FY2019 when it began to rise again. For FY2022, President Biden requested $915.6 million for STRS; Congress appropriated $850.0 million. President Biden's FY2023 request for STRS is $975.0 million, $125.0 million (14.7%) above the FY2022 enacted level.

Figure 2. Scientific and Technical Research and Services Account

Enacted Appropriations, FY2003-FY2022; Requested Appropriations, FY2003-FY2023

(in millions of current dollars)



Sources: Department of Commerce, NIST budget documents, appropriations acts, and explanatory statements for FY2003-FY2023.

Note: ARRA = American Recovery and Reinvestment Act.

Construction of Research Facilities Account

Figure 3 illustrates requested and enacted funding levels for the NIST CRF account. Construction account funding has fluctuated. CRF funding jumped from $72.5 million in FY2005 to $173.7 million in FY2006, fell to $58.7 million in FY2007, rose to $160.5 million in FY2008, and then rose to $532.0 million in FY2009 (of which $172.0 million was provided for in regular appropriations and $360 million provided under ARRA).[33] Funding fell from FY2010 to FY2012, dropping to $55.4 million, then it remained relatively flat through FY2015 (ranging from $50 million to $56 million per year). In FY2016, CRF appropriations jumped to $119.0 million; $60.0 million of the increase was designated for beginning "the design and renovation of [NIST's] outdated and unsafe radiation physics infrastructure." In FY2017, CRF appropriations were $109.0 million, of which $60.0 million was designated for design and renovation of NIST's radiation physics infrastructure.[34] In FY2018, CRF appropriations jumped to $319.0 million, $210.0 million (192.7%) above the FY2017 level. In FY2019, CRS appropriations fell to $106.0 million, rose to $118 million in FY2020, then fell to $80 million in FY2021. In FY2022, CRF appropriations rose to $205.6 million, of which $125.6 million was designated for congressionally-directed projects. President Biden is requesting $120.3 million for the NIST CRF account for FY2023.

In FY2008, FY2009, and FY2010, the CRF account provided funding for a competitive construction grant program that funded the construction of research facilities at U.S. universities and research institutions. Appropriations for CRF have also included funding for congressionally designated projects in some years. In FY2022, Congress provided $125.6 million for seven

[33] Of the $360 million that ARRA provided this account in FY2009, $180 million was designated for the competitive construction grant program.

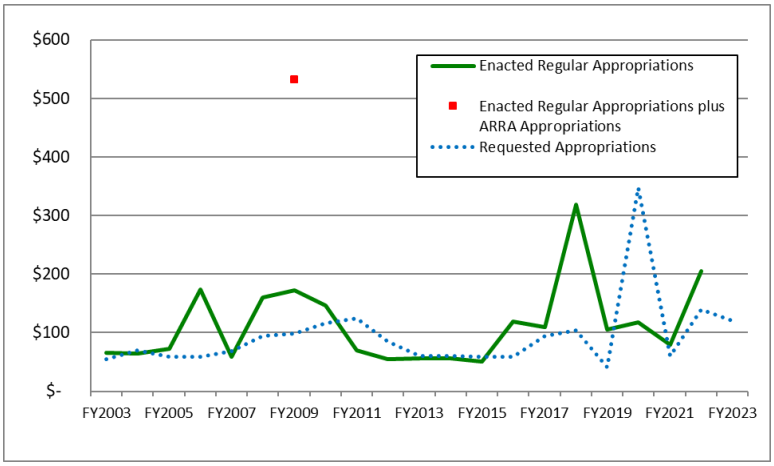
[34] P.L. 115-31.

projects. **Figure 4** illustrates the funding levels for the NIST CRF account **excluding** congressionally directed projects and the competitive grant program.

Figure 3. Construction of Research Facilities Account

Enacted Appropriations, FY2003-FY2022; Requested Appropriations, FY2003-FY2023

(in millions of current dollars)

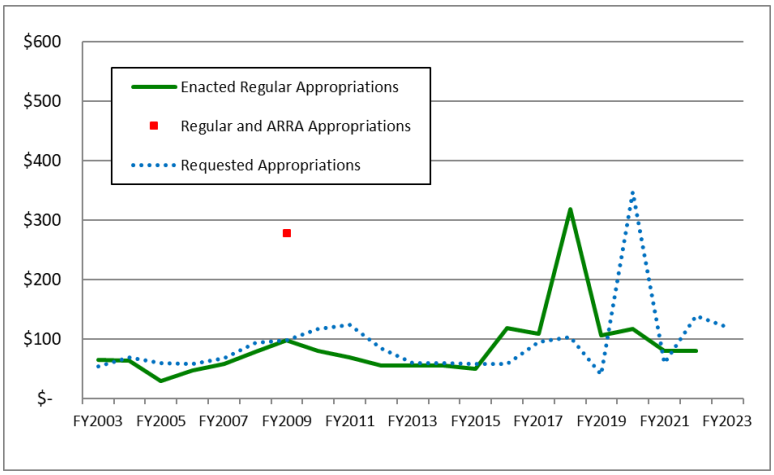


Sources: Department of Commerce, NIST budget documents, appropriations acts, and explanatory statements for FY2003-FY2023.

Note: ARRA = American Recovery and Reinvestment Act. The level shown for the FY2020 request includes those amounts ($288.0 million) requested by the President as part of a proposed GSA Federal Capital Revolving Fund to be used for NIST renovation. While the Administration requested the revolving funds be established via mandatory funding and repaid through NIST annual discretionary appropriations, the Congressional Budget Office (CBO) estimated this proposal in a manner consistent with current practice that capital expenditures are recorded on a cash basis in the federal budget.

Figure 4. Construction of Research Facilities Account, Excluding Funding for Congressionally Directed Projects and the Competitive Construction Grant Program

Enacted Appropriations, FY2003-FY2022 Requested Appropriations, FY2003-FY2023



Sources: Department of Commerce, NIST budget documents, appropriations acts, and explanatory statements for FY2003-FY2023.

Note: ARRA = American Recovery and Reinvestment Act. The level shown for the FY2020 request includes those amounts ($288.0 million) requested by the President as part of a proposed GSA Federal Capital Revolving Fund to be used for NIST renovation. While the Administration requested the revolving funds be established via mandatory funding and repaid through NIST annual discretionary appropriations, the Congressional Budget Office (CBO) estimated this proposal in a manner consistent with current practice that capital expenditures are recorded on a cash basis in the federal budget.

Industrial Technology Services Account

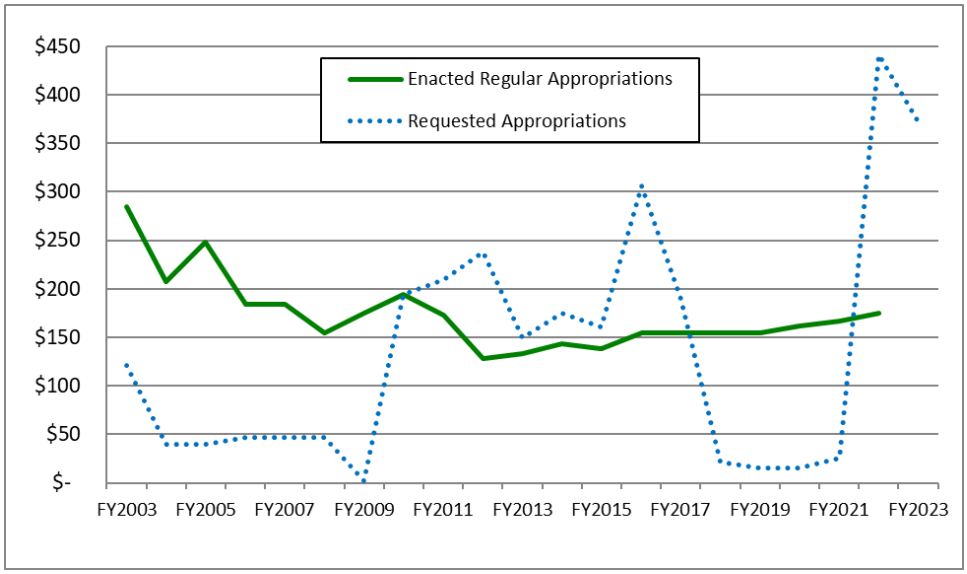
Figure 5 illustrates requested and enacted funding levels for the NIST ITS account. ITS requests and appropriations during this period have included the MEP, Manufacturing USA (formerly the NNMI), AMTech, ATP, TIP, and Baldrige programs in some or all years. Total appropriations for the ITS account fell from $284.8 million in FY2003 to $128.4 million in FY2012, grew to $155.0 million in FY2016 and remained flat before rising from $155 million in 2019 to $175 million in FY2022. The FY2023 request seeks $97.0 million for Manufacturing USA, $80.5 million (487.9%) higher than the FY2022 enacted level of $16.5 million. The additional funds would pay for the first-year of four additional institutes. The FY2023 request seeks $275.3 million for the MEP program.

Substantial fluctuations in the levels of funding requested and provided for the MEP, ATP, and TIP programs are reflected in aggregate in **Figure 5**, and illustrated and discussed in more detail on the following pages.

Figure 5. Industrial Technology Services Account

Enacted Appropriations, FY2003-FY2022; Requested Appropriations, FY2003-FY2023

(in millions of current dollars)



Sources: Department of Commerce, NIST budget documents, appropriations acts, and explanatory statements for FY2003-FY2023.

Manufacturing Extension Partnership Program

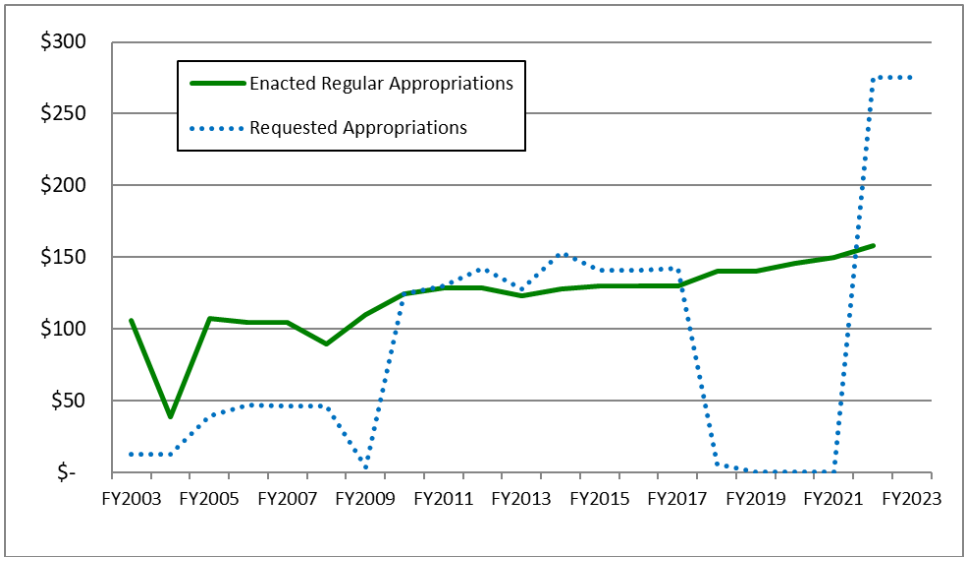
Figure 6 illustrates requested and enacted funding levels for the NIST MEP program. FY2003 enacted appropriations of $105.9 million were cut to $38.6 million in FY2004, but returned to near the FY2003 level in FY2005 ($107.5 million) and stayed near that level through FY2007. The MEP funding dipped again in FY2008, to $89.6 million, then rose over the next several years

to $140.0 million in FY2018. Requests from FY2003 to FY2009 were substantially lower than appropriations, falling to $2.0 million in FY2009. In FY2010, the Obama Administration requested $124.7 million for MEP. From FY2012 to FY2017, requests were somewhat higher than enacted appropriations. For FY2018, President Trump requested $6.0 million for the MEP program to provide "for the orderly wind down of federal funding for the program"; however, Congress appropriated $140.0 million.[35] For FY2019, FY2020, and FY2021, President Trump requested no funding for MEP; Congress appropriated $140.0 million, $146.0 million, and $150.0 million, respectively. For FY2022, President Biden requested $275.0 million; Congress appropriated $158 million. In FY2023 President Biden is requesting $275.3 million for MEP, $117.3 million (74.2%) above the FY2022 enacted level.

Figure 6. Manufacturing Extension Partnership Program

Enacted Appropriations, FY2003-FY20212 Requested Appropriations, FY2003-FY2023

(in millions of current dollars)



Sources: Department of Commerce, NIST budget documents, appropriations acts, and explanatory statements for FY2003-FY2023.

Advanced Technology Program/Technology Innovation Program

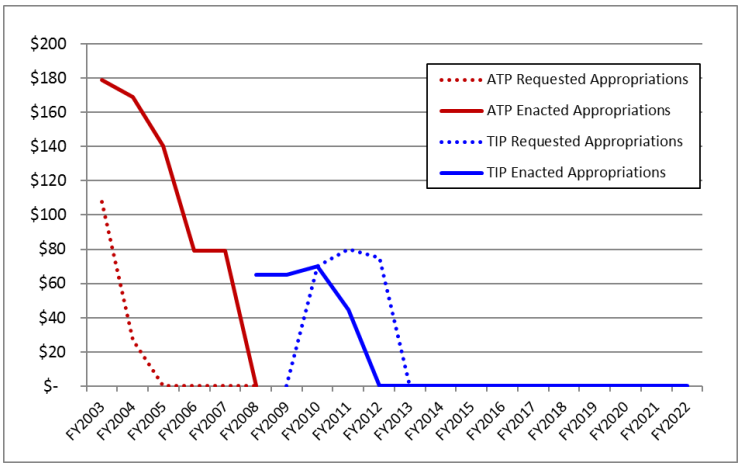
The Advanced Technology Program saw its requests fall from $107.9 million in FY2003 to zero in FY2005, and its appropriations fall from $178.9 million in FY2003 to zero in FY2008; no funding was requested in FY2005 and subsequent years. The Technology Innovation Program, which succeeded ATP, was first funded at $65.2 million in FY2008 and rose to $69.9 million in FY2010 before falling to $45.0 million in FY2011. The TIP program received no funding in FY2012 or in subsequent years. The $69.9 million requested for TIP in FY2010 was fully funded; in FY2011 the TIP request was $79.9 million, and in FY2012 it was $75.0 million. No funding has been requested for TIP since FY2012.

[35] NIST, *National Institute of Standards and Technology/National Technical Information Service Fiscal Year 2018 Budget Submission to Congress*, May 2017, p. NIST-4.

Figure 7. Advanced Technology Program and Technology Innovation Program

Enacted Appropriations, FY2003-FY2021; Requested Appropriations, FY2003-FY2022

(in millions of current dollars)



Sources: Department of Commerce, NIST budget documents, appropriations acts, and explanatory statements for FY2003-FY2022.

Concluding Observations

When NBS was renamed NIST under the provisions of the Omnibus Trade and Competitiveness Act of 1988, the laboratory was given additional missions and supporting programs. Two of the new programs—the Advanced Technology Program and the Manufacturing Extension Partnership program—were intended to improve U.S. innovation and industrial competitiveness. These programs generated criticism from some policymakers and analysts who objected to them on a variety of grounds, including whether such activities are appropriate for the federal government to undertake; whether they might result in suboptimal choices of technologies, choices better left to market forces; whether certain technologies, companies, or industries might be chosen for support based on criteria other than technical or business merit; and whether tax dollars should be awarded to already-profitable firms.

In contrast, NIST's historical mission of conducting laboratory research in support of standards and metrics continued to enjoy broad support and faced little controversy. Evidence of this support can be seen in the selection of the STRS account—through which NIST laboratory work is funded—as one of the targeted accounts in the doubling efforts of former Presidents George W. Bush and Barack Obama and successive Congresses. However, even with broad support and the absence of controversy, funding for the NIST STRS account did not grow at the pace its advocates supported in presidential budget requests and successive authorizations of appropriations due to tight overall fiscal constraints on the federal budget.

Most recently, Congress enacted the CHIPS and Science Act giving NIST new funding and authorities related to U.S. technological and industrial competitiveness, much of which is focused on the semiconductor industry.

These issues are discussed in more detail below.

CHIPS and Related Semiconductor Programs

The CHIPS and Science Act provides the Commerce Department $50 billion for a multifaceted program to incentivize the establishment and equipping of semiconductor manufacturing fabrication facilities in the United States, as well as to support R&D to bolster future U.S. semiconductor technology leadership.

During the legislative process, a number of concerns were raised about the effects of these authorities and appropriations. Among these concerns were:

- if and how the incentive programs might adversely distort market decisions;
- how the funds should be allocated for different types of semiconductor fabrication (e.g., logic, memory) and different generations of semiconductor fabrication (i.e., leading-edge, legacy); Congress specifically allocated $2.0 billion of the $39.0 billion in incentive funding for mature technology nodes for legacy chip production in the United States but left allocation of the balance of funding to NIST's discretion;[36]

[36] The CHIPS and Science Act defines legacy chips as those that include "(aa) a semiconductor technology that is of the 28 nanometer generation or older for logic; (bb) with respect to memory technology, analog technology, packaging technology, and any other relevant technology, any legacy generation of semiconductor technology relative to the generation described in item (aa), as determined by the Secretary, in consultation with the Secretary of Defense and the Director of National Intelligence; and(cc) any additional semiconductor technology identified by the Secretary in a public notice issued under clause (ii); and (II) does not include a semiconductor that is critical to national security, as determined by the Secretary, in consultation with the Secretary of Defense and the Director of National Intelligence."

- ensuring that incentive funds are not used for stock buy-backs or the payment of dividends to stockholders; Congress included a provision in the act to prevent such use; and
- ensuring that incentive funds are not used to offset planned expenditures that might then be used to support the company's semiconductor manufacturing, R&D, or related activities in China; Congress included a provision in the act requiring incentive recipients to agree to a 10-year moratorium on any significant transaction involving the material expansion of semiconductor manufacturing capacity in foreign countries of concern (e.g., China), but includes an exception for existing legacy chip fabrication facilities and equipment, and new legacy fabrication facilities that serve the market of the foreign country of concern.

Congress may opt to conduct oversight on NIST's administration of the funds appropriated under the CHIPS and Science Act, the effect the incentive funding may have on semiconductor fabrication domestically and globally, whether the economic and national security needs of the United States are adequately being addressed by these programs, whether funding recipients' are complying with the requirements of the act, and the effectiveness of the semiconductor R&D appropriations with respect to ensuring U.S. technological leadership and industrial competiveness.

NIST Doubling Effort

In the early 2000s, many industry, academia, and policy leaders expressed growing concern that federal investments in physical sciences and engineering research were not growing fast enough to keep the United States on the leading edge of technological innovation and commercial competitiveness. In his 2006 State of the Union remarks, President Bush announced the American Competitiveness Initiative (ACI), which, among other things, sought to double funding for targeted appropriations accounts that fund physical sciences and engineering research over a 10-year period. Among the targeted accounts were the NIST STRS and construction accounts. Subsequently, Congress passed the America COMPETES Act (P.L. 110-69), which set appropriations authorizations for the targeted accounts for FY2008-FY2010 that represented a compound annual growth rate (CAGR) of 10.1% that would have, if continued, resulted in a doubling over approximately seven years.

In his FY2010 *Plan for Science and Innovation*, President Obama stated that he (like President Bush) would seek to double funding for basic research over 10 years (FY2006 to FY2016) at the ACI agencies. Actual appropriations, however, did not keep pace with the America COMPETES Act authorization levels. In his FY2011 budget request, President Obama extended the period over which he intended to double these agencies' budgets to 11 years. In 2010, Congress enacted the America COMPETES Reauthorization Act of 2010 (P.L. 111-358), setting appropriations authorizations for the targeted accounts for FY2011-FY2013 at a level that effectively set an 11-year doubling pace (a 6.3% CAGR). However, as with the original act, appropriations did not keep pace with the authorization act levels. While reiterating President Obama's intention to double funding for the targeted accounts from their FY2006 levels, President Obama's FY2013 budget request did not specify the length of time over which the doubling was to take place. President Obama's FY2014 budget expressed a commitment to increasing funding for the targeted accounts, but did not commit to doubling. President Obama's FY2017 budget did not address the doubling effort. From FY2006, the base year for the doubling effort, through FY2016, funding for the NIST STRS and construction accounts grew by 42.3% in nominal terms, a compound annual growth rate of 3.6%, a rate that would result in doubling in about 20 years.

President Obama's FY2017 request sought an increase in aggregate funding for these accounts of 2.0%. Presidential budget requests since FY2018 have not mentioned the doubling goal.

The CHIPS and Science Act authorization of total appropriations for NIST would seek to increase funding from $1,230.1 million in FY2022 to $2.283 million in FY2027, an 85.6% increase over five years (a doubling pace of six years). It remains to be seen how appropriations match the aspirations of these authorization levels.

NIST Technology Policy

Some of NIST's external programs have faced substantial opposition over time. Beginning with the 104th Congress, many Members expressed skepticism over a "technology policy" based on providing federal funds to industry for development of precompetitive generic technologies. This philosophical shift from previous Congresses, coupled with pressures to balance the federal budget, led to significant reductions in funding for NIST's external programs. The Advanced Technology Program and the Manufacturing Extension Partnership, which accounted for over 50% of the FY1995 NIST budget, were proposed for elimination. Although in the past strong support by the Senate led to their continued financing, funding for ATP remained controversial. Beginning in FY2000, the House-passed appropriations bills did not contain funding for ATP, and many of the budget proposals submitted by former President George W. Bush called for abolishing the program. In the 110th Congress, the America COMPETES Act eliminated ATP and replaced it with the TIP initiative. While TIP received appropriations from FY2008 to FY2011, it has received no appropriations since.

In his FY2003 budget proposal, President Bush also recommended suspension of federal support for those MEP centers in operation for more than six years; the following year, funding for the MEP program was significantly reduced. However, the FY2005 Omnibus Appropriations Act brought support for MEP back up to the level necessary to fully fund the existing centers. Since then, funding has grown from $107.5 million in FY2005 to $130.0 million in FY2016. President Obama requested $142.0 million for MEP for FY2017, an increase of $12.0 million (9.2%); Congress provided $130 million, an amount equal to its FY2016 level. For FY2017, Congress provided $140.0 million for MEP. President Trump's FY2018 budget request sought to end the MEP program, providing $6.0 million in FY2018 to provide "for the orderly wind down of federal funding for the program."[37] President Trump's FY2019, FY2020, and FY2021 requests sought no funding for MEP; nevertheless, Congress provided consistent funding during this period. For FY2022, President Biden is seeking $275 million for MEP, an increase of $125.0 million above the FY2021 level. For more information on MEP, see CRS Report R44308, *The Hollings Manufacturing Extension Partnership Program*, by John F. Sargent Jr.

Manufacturing USA

Manufacturing USA, as originally envisioned by President Obama in his FY2013 budget as the National Network for Manufacturing Innovation (later Manufacturing USA), proposed $1 billion in mandatory funding to support the establishment of up to 15 institutes. In the absence of a statutory foundation and mandatory appropriation, the Obama Administration began—and the

[37] NIST, *National Institute of Standards and Technology/National Technical Information Service Fiscal Year 2018 Budget Submission to Congress*, May 2017, p. NIST-4.

Trump Administration continued—the establishment of institutes using existing Department of Defense and Department of Energy authorities and discretionary appropriations.[38]

In 2012, the Advanced Manufacturing National Program Office (AMNPO) sought nationwide input from companies, academia, state and regional governments, economic development authorities, industry associations and consortia, private citizens, and other interested parties to help guide the design of the NNMI. The input gathered from workshops and a request for information was used by the AMNPO in the preparation of a National Science and Technology Committee report, *National Network for Manufacturing Innovation: A Preliminary Design* (hereinafter the *Preliminary Design* report), published in January 2013. This document articulated the Obama Administration's perspective of the principles and characteristics that should guide development of the NNMI program.[22]

The *Preliminary Design* report proposed that the institutes be long-term partnerships between industry and academia (including universities and community colleges) enabled by federal, state, and local governments. The network and individual institutes were to have a strong focus on building clusters of advanced manufacturing capabilities that join expertise from industry, academia, and government. The NNMI's emphasis was to be on linking and integrating existing public and private resources into a robust national innovation ecosystem. The institutes were to serve as regional nodes of advanced manufacturing capabilities, where the processes to build next-generation products are being developed, demonstrated, and refined to the point where there is a clearer, lower-risk path to commercial-scale manufacturing. Institutes were to leverage existing regional or national innovation systems or catalyze the formation and sustainability of new innovation clusters. Institutes were to offer an "industrial commons" (the R&D, engineering, and manufacturing capabilities needed to turn inventions into competitive, manufacturable commercial products) to accelerate the formation and growth of small- and medium-sized enterprises, and were to integrate education and workforce training functions.

In large measure, these principles have guided the development of the NNMI/Manufacturing USA program. The *Preliminary Design* report, however, stated "the focus of each institute was to be proposed by the applicants and selected through a competitive application process."[39] Since the Department of Defense and Department of Energy relied on their own authorities and general appropriations to compete and award the institutes, the foci of the institutes were determined by the departments' missions and existing authorities, rather than being responsive to foci chosen by the applicants. Placing agency missions and authorities first in the selection process may de-emphasize the commercial focus and market needs that the institutes were intended to serve.

There are currently 16 Manufacturing USA institutes awarded by NIST, the Department of Defense, and Department of Commerce. In addition, Section 9906(f) of the 2021 NDAA, as amended, authorizes the establishment of up to three Manufacturing USA institutes to pursue research in support of the virtualization and automation of maintenance of semiconductor machinery; the development of new advanced test, assembly and packaging capabilities; and the development and deployment of educational and skills training curricula needed to support the industry sector and to ensure the United States can build and maintain a trusted and predictable talent pipeline. The CHIPS and Science Act authorizes funding of $500 million in FY2022 to support the establishment of these institutes, as well as NIST's conduct of semiconductor

[38] Only a single institute, NIST's National Institute for Innovation in Manufacturing Biopharmaceuticals, was established under the authorities provided by the RAMI Act.

[39] AMNPO, NSTC, Executive Office of the *President, National Network for Manufacturing Innovation: A Preliminary Design*, January 2013, p. 3.

research. The act also appropriates additional funding for FY2023-FY2026 for these purposes as part of a broader appropriation.

As Congress considers whether to increase the number of Manufacturing USA institutes sponsored by NIST and other federal agencies, it may choose to consider whether to provide direction to the agencies regarding the process to be used to select the focus of future institutes.

For more information on Manufacturing USA, see CRS Report R46703, *Manufacturing USA: Advanced Manufacturing Institutes and Network*, by John F. Sargent Jr.

Appendix A. Requested and Enacted Discretionary Appropriations for NIST Accounts

Table A-1. Requested and Enacted Appropriations for NIST Accounts

Enacted Appropriations, FY2003-FY2022; Requested Appropriations, FY2003-FY2023

(in millions of current dollars)

Fiscal Year	NIST, Total		Scientific and Technical Research and Services (STRS)[a]		Industrial Technology Services (ITS)[a]		Construction of Research Facilities (CRF)	
	Request	Enacted	Request	Enacted	Request	Enacted	Request	Enacted
2023	1,467.6		975.0		372.3		120.3	
2022	1,497.2	1,230.1	915.6	850.0	441.6	174.5	140.0	205.6
2021	737.5	1,034.5	652.0	788.0	25.3	166.5	60.2	80.0
2020	974.8	1,034.0	611.7	754.0	15.2	162.0	347.9	118.0
2019	629.1	985.5	573.4	724.5	15.1	155.0	40.5	106.0
2018	725.0	1,198.5	600.0	724.5	21.0	155.0	104.0	319.0
2017	1,014.5	954.0	730.5	690.0	189.0	155.0	95.0	109.0
2016	1,119.7	964.0	754.7	690.0	306.0	155.0	59.0	119.0
2015	900.0	863.9	680.0	675.5	161.0	138.1	59.0	50.3
2014	928.3	850.0	693.7	651.0	174.5	143.0	60.0	56.0
2013[b]	857.0	769.4	648.0	579.8	149.0	133.6	60.0	56.0
2012	1,001.1	750.8	678.9	567.0	237.6	128.4	84.6	55.4
2011[c]	918.9	750.1	584.5	507.0	209.6	173.2	124.8	69.9
2010	846.1	856.6	534.6	515.0	194.6	194.6	116.9	147.0
2009[d]	636.0	819.0	535.0	472.0	4.0	175.0	99.0	172.0
2009 ARRA[e]	—	580.0	—	220.0	—	—	—	360.0
2008[f]	640.7	755.8	500.5	440.5	46.3	154.8	93.9	160.5
2007	581.3	676.9	467.0	434.4	46.3	183.8	68.0	58.7
2006[g]	532.0	752.0	426.3	394.8	46.8	183.6	58.9	173.7
2005[h]	521.5	699.2	422.9	378.8	39.2	247.9	59.4	72.5
2004[i]	496.8	608.5	387.6	336.5	39.6	207.8	69.6	64.3
2003[j]	577.5	707.5	402.2	357.1	120.8	284.8	54.5	65.7

Sources: CRS analysis of Department of Commerce and NIST budget documents, FY2003-FY2023.

Notes: Dashes in cells in this table indicate no request or appropriation was made for that year. Accounts may not add to totals due to rounding.

a. Funding for the Baldrige Performance Excellence Program was provided in the STRS account appropriation through FY2011; in FY2012, funding was requested in the ITS account appropriation.

b. Enacted levels reflect the 1.877% rescission, 0.2% rescission, and the 5% sequester applied to 2013 annualized CR level.

c. Enacted levels include 0.2% across-the-board rescission.

d. Enacted levels for STRS appropriation include $3.475 million in congressionally directed projects. The FY2009 amount for CRF appropriation includes $44 million in congressionally directed projects and $30 million for a competitive construction grant program.

e. The American Recovery and Reinvestment Act of 2009 (ARRA) amount for CRF includes $180 million for a competitive construction grant program for research science buildings. Not reflected above, ARRA also included a $20 million transfer from the Department of Health and Human Services for standards-related research on electronic medical records and an expected $10 million from a Department of Energy interagency agreement to help develop a comprehensive framework for a nationwide smart electrical grid.

f. The enacted FY2008 level for STRS appropriations includes $893,000 in congressionally directed projects. The enacted FY2008 level for CRF appropriations includes $51.3 million in congressionally directed projects and $30 million for a new competitive construction grant program that was not requested by President Bush.

g. Enacted levels reflect across-the-board rescissions enacted in P.L. 109-108, FY2006 Science, State, Justice, and Commerce Appropriations Act and in P.L. 109-148, FY2006 Defense Appropriations Act ($9.7 million). Does not reflect MEP unobligated balances rescission of $7 million. The amounts for STRS and for the Construction of Research Facilities appropriation include $11.9 million and $125.4 million for congressionally directed projects, respectively.

h. Enacted levels reflect across-the-board rescissions enacted in P.L. 108-447, FY2005 Consolidated Appropriations Act ($9.5 million). Does not reflect ATP unobligated balances rescission of $3.9 million. The amounts for STRS and for the Construction of Research Facilities appropriation include $8.8 million and $42.9 million for congressionally directed projects, respectively.

i. Enacted levels reflect across-the-board rescissions enacted in the FY2004 Consolidated Appropriations Act, P.L. 108-199 ($6.6 million) and NIST's share of the Department of Commerce's unobligated balances rescission ($13.0 million).

j. Enacted levels reflect an across-the-board rescission enacted in P.L. 108-7 ($4.6 million).

Appendix B. Requested and Enacted Appropriations for Selected NIST Programs

Table B-1. Requested and Enacted Appropriations for Selected NIST Programs

Enacted Appropriations, FY2003-FY2022; Requested Appropriations, FY2003-FY2023

(in millions of current dollars)

Fiscal Year	Hollings Manufacturing Extension Partnership		Advanced Manufacturing Technology Consortia		Manufacturing Innovation Institutes Coordination		Manufacturing USA (formerly the NNMI)		Advanced Technology Program		Technology Innovation Program	
	Request	Enacted	Request	Enacted	Request	Enacted	Request	Enacted	Request	Enacted	Request	Enacted
2022	275.3		—		—		97.0		—		—	
2022	275.0	158.0	—	—	5.0	—	161.6[a]	16.5	—	—	—	—
2021	0.0	150.0	—	—	5.3	5.0[b]	20.0	11.5	—	—	—	—
2020	0.0	146.0	—	—	5.2	—[c]	10.2	16.0[c]	—	—	—	—
2019	0.0	140.0	—	—	5.1	5.0[d]	10.0	10.0[d]	—	—	—	—
2018	6.0	140.0	—	—	5.0	5.0[a]	10.0	10.0[a]	—	—	—	—
2017	142.0	130.0	—	—	—	5.0[f]	47.0	20.0[f]	—	—	—	—
2016	141.0	130.0	15.0	—	—		150.0	25.0	—	—	—	—
2015	141.0	130.0	15.0	8.1	5.0	[g]	[h]	—	—	—	—	—
2014	153.1	128.0	21.4	15.0	—	—	[h]	—	—	—	—	—
2013[i]	128.0	123.0	21.0	10.6	—	—	[h]	—	—	—	—	—
2012	142.6	128.4	12.3	—	—	—	—	—	—	—	75.0	—
2011[j]	129.7	128.4	—	—	—	—	—	—	—	—	79.9	44.8
2010	124.7	124.7	—	—	—	—	—	—	—	—	69.9	69.9
2009	2.0	110.0	—	—	—	—	—	—	—	—	—	65.0
2008	46.3	89.6	—	—	—	—	—	—	—	—	—	65.2
2007	46.3	104.7	—	—	—	—	—	—	—	79.1	—	—
2006[k]	46.8	104.6	—	—	—	—	—	—	—	79.0	—	—
2005[l]	39.2	107.5	—	—	—	—	—	—	—	140.4	—	—
2004[m]	12.6	38.6	—	—	—	—	—	—	27.0	169.1	—	—
2003[n]	12.9	105.9	—	—	—	—	—	—	107.9	178.8	—	—

Sources: CRS analysis of Department of Commerce and NIST budget documents, FY2003-FY2023.

Notes: Empty cells in this table indicate no request or appropriation was made for that year.

a. Includes $1.7 million for grants to develop industrial technology roadmaps.

b. Includes $1.5 million for a competitive grant program to develop technology roadmaps for advanced manufacturing clusters.

c. P.L. 116-93 and the accompanying Explanatory Statement state that $16.0 million is provided for the NNMI, but neither explicitly references funding for coordination activities of the network.

d. H.Rept. 116-9 states that $15.0 million is appropriated for the NNMI, of which $5.0 million may be used for coordination activities of the network.

e. House Print 29-456 states that $15.0 million is appropriated for the NNMI, of which $5.0 million may be used for coordination activities of the network.
f. House Print 25-289 states that $25.0 million is appropriated for the NNMI, of which $5.0 million may be used for coordination activities of the network.
g. P.L. 113-235 states, "To the extent provided for in advance by appropriations Acts, the Secretary may use not to exceed $5,000,000 for each of the fiscal years 2015 through 2024 to carry out this section from amounts appropriated to the Institute for Industrial Technical Services."
h. President Obama requested $1 billion in mandatory funding for the NNMI for FY2013; $1 billion in mandatory funding for FY2014; and $2.4 billion in mandatory funding for FY2015.
i. Enacted levels reflect the 1.877% rescission, 0.2% rescission, and the 5% sequester applied to 2013 annualized CR level.
j. Enacted levels include 0.2% across-the-board rescission.
k. Enacted levels reflect across-the-board rescissions enacted in P.L. 109-108, FY2006 Science, State, Justice, and Commerce Appropriations Act and in P.L. 109-148, FY2006 Defense Appropriations Act.
l. Enacted levels reflect across-the-board rescissions enacted in P.L. 108-447, FY2005 Consolidated Appropriations Act ($9.5 million). Does not reflect ATP unobligated balances rescission of $3.9 million.
m. Enacted levels reflect across-the-board rescissions enacted in the FY2004 Consolidated Appropriations Act, P.L. 108-199, and NIST's share of the Department of Commerce's unobligated balances rescission.
n. Enacted levels reflect an across-the-board rescission enacted in P.L. 108-7.

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