COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

HEARING CHARTER

Reauthorization of the National Institute of Standards and Technology

March 11, 2020
10:00 a.m.
2318 Rayburn House Office Building

PURPOSE

On Wednesday, March 11, 2020 at 10:00 am, the Subcommittee on Research and Technology of the Committee on Science, Space, and Technology will hold a hearing to explore the major areas of research under the National Institute of Standards and Technology (NIST) laboratory programs, the agency's role in working with industry to advance U.S. competitiveness, and key facilities construction and maintenance issues on the NIST campuses in Maryland and Colorado. The Subcommittee will also review the President's Fiscal Year 2021 budget proposal for NIST.

WITNESS

- **The Honorable Walter G. Copan**, Undersecretary of Commerce for Standards and Technology and Director, National Institute of Standards and Technology

KEY QUESTIONS

- What is the role of NIST in advancing U.S. economic competitiveness and national security?
- What would be the impact of the proposed FY 2021 budget on NIST's ability to carry out its mission? What analysis did the Administration use in deciding what programs to prioritize and what to eliminate?
- What is the state of facilities on the two NIST campuses and how does it relate to NIST's ability to carry out its mission?
- What additional resources and policy changes are needed to improve NIST's capacity to achieve its mission across its laboratories and other programs?

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY PROGRAMS

NIST is a non-regulatory agency within the Department of Commerce with a mission to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards,

and technology. The President's FY 2021 budget proposal provides a total of $718 million to NIST, a roughly 31 percent decrease from the FY 2020 enacted level.[1]

Figure 1: Budget comparison across FY 2019, FY 2020, and FY 2021 request.

	FY 2019 Enacted ($M)	FY 2020 Enacted ($M)	FY 2021 Request ($M)	FY 2021 Request +/(-) over FY 2020 Enacted ($M)	FY 2021 Request % Over FY 2020 Enacted
STRS	**$724.5**	**$754.0**	**$652.0**	**($102.0)**	**-13.5%**
ITS	**$155.0**	**$162.0**	**$25.3**	**($136.7)**	**-84.4%**
Hollings Manufacturing Extension Partnership	140.0	$146.0	$0.0	($136.7)	-100.0%
Manufacturing USA	15.0	$16.0	$25.3	9.3	58.1%
Construction	**$106.0**	**$118.0**	**$40.6**	**($77.4)**	**-65.6%**
Total, NIST Discretionary	**$985.5**	**$1,034.0**	**$717.9**	**(316.1)**	**-30.6%**

LAB PROGRAMS

The Scientific and Technical Research and Services (STRS) account funds NIST's laboratory research, including collaborative research with industry. The Administration proposes a budget for STRS of $652 million for FY 2021, a decrease of $102 million, or 14 percent from FY 2020.

NIST operates five laboratories and two national user facilities in carrying out these activities. These include two metrology laboratories, the Material Measurement Laboratory (MML) and the Physical Measurement Laboratory (PML), which focus on driving innovation through measurement science. There are also three technology laboratories that focus on the adoption and development of advanced technology solutions, including the Engineering Laboratory (EL), the Information Technology Laboratory (ITL), and the Communication Technology Laboratory (CTL). Finally, NIST has two national user facilities: The Center for Nanoscale Science and Technology and the NIST Center for Neutron Research. Across each of these laboratories and user facilities, NIST addresses national R&D efforts for a variety of emerging technologies.

METROLOGY LABORATORIES

Material Measurement Laboratory—MML is the United States' reference laboratory for measurements in the chemical, biological, and materials sciences. Its research focuses on the composition, structure, and properties of industrial, biological, and environmental materials and processes, as well as the development and dissemination of tools to help to ensure measurement quality. The Administration proposes a $43.5 million, or 30 percent, cut for advanced manufacturing and material measurement in its FY 2021 budget. These cuts would eliminate NIST's efforts related to structural materials challenges, including reliability testing for bridges

[1] All facts, figures, and other information in this document are available through the President's FY 2021 Budget Request Congress for the National Institute of Standards and Technology, at www.nist.gov.

and pipelines, as well as energy and environmental challenges, such as efforts related to recycling and reuse of plastics.

NIST's work at the MML also supports the underlying technologies and measurements for precision medicine, medical imaging, synthetic biology, genomics, and more. For example, the NIST Genome Editing Consortium addresses measurements and standards for genomic editing technologies and the NIST-Stanford Joint Initiative for Metrology in Biology develops measurement capabilities for produces and services in the bioeconomy.[2] The bipartisan *Engineering Biology Research and Development Act,* which passed the House in December 2019, would authorize much of the biosciences work at NIST.[3] The President's budget request would cut these programs by $2.1 million, or nearly 6 percent.[4]

Physical Measurement Laboratory—PML is focused on increasing the accuracy of physical parameters that underpin our society by disseminating technologies to standardize these parameters and conducting research to advance measurement approaches and standards. The NIST Boulder campus has four PML divisions devoted to Applied Physics, Quantum Electromagnetics, Sensor Sciences, and Time and Frequency, as well as a fifth division, Quantum Physics, located at the University of Colorado, Boulder. In Maryland, PML houses the four divisions devoted to Engineering Physics, Quantum Measurement, Radiation Physics, and Weights and Measures. One program, called "NIST-on-a-Chip," seeks to create prototypes for a new generation of ultra-compact, inexpensive measurement tools for various quantities—such as time and force—that will allow users to make precise measurements anywhere.[5]

PML plays a key role in advancing the fundamental science that underpins several industries of the future. Under the *National Quantum Initiative Act* [P.L. 115-368], NIST is one of three agencies charged with supporting and expanding quantum information science and technology research and development of standards. The President's budget request for FY 2021 proposes a $40.3 million budget to invest in a portfolio of quantum related research.

TECHNOLOGY LABORATORIES

Information Technology Laboratory— ITL develops and deploys standards, testing, and metrics to make the Nation's information systems more secure, usable, interoperable, and reliable. ITL supports a range of areas vital to our nation, including applied and computational mathematics, internet of things (IoT), quantum information science, and cybersecurity and privacy.

In the area of cybersecurity, ITL catalogues and publishes known vulnerabilities, produces standards and guidelines for cybersecurity risk management, and addresses major cybersecurity challenges, such as cryptographic systems that can resist quantum computers. ITL published the "Framework for Improving Critical Infrastructure Cybersecurity" in 2014, a document that

[2] NIST Genome Editing Consortium. NIST. accessed February 18, 2019.
[3] The Engineering Biology Research and Development Act. H.R.4373. 116th Cong. (2019).
[4] "President's FY 2021 Budget Request to Congress for the National Institute of Standards and Technology." NIST. February 2020.
[5] "NIST-on-a-Chip Portal." NIST. Accessed February 18, 2020.

provides flexible ways to manage cybersecurity risk.[6] ITL updated the framework in 2018, and is creating additional tailored guidance on application of the framework to several different sectors and circumstances. ITL also manages the National Cybersecurity Center of Excellence (NNCoE), where researchers define cybersecurity issues, develop technical descriptions of security problems, and engage with vendors to improve the security of their products.[7] Recently, ITL has expanded this work to include data privacy, publishing a framework for improving privacy through enterprise risk management in January 2020.[8] The President's budget request for FY 2021 includes a $1.9 million, or 2.5 percent increase, for cybersecurity and privacy.

Another major area of research for ITL is artificial intelligence (AI). In response to Executive Order 13859 released in February 2019, ITL created a plan to support innovation, public trust, and public confidence in AI systems and develop international standards to promote and protect these priorities.[9] The report promotes research on the trustworthiness of AI systems, offers Federal guidance for AI standards development, calls for AI-related public-private partnerships, and highlights tools that could support AI. The budget proposal would increase NISTs work on AI technologies by $25 million, but these increases come at the expense of other important information technology challenges, such as voting technologies and smart grid interoperability.

Communications Technology Laboratory – CTL supports standards and metrology in the area of advanced communications technologies, funding important research related to IoT devices, 5G wireless communications, and wireless spectrum sharing technologies. CTL also supports public safety communications, serving as future technology lead for the First Responder Network Authority (FirstNet), the U.S. public safety broadband network. The President's FY 2021 budget request would reduce funding to CTL by $36 million (or 52 percent).[10]

In 2015, the CTL jointly created the National Advanced Spectrum and Communications Test Network (NASCTN), with both the National Telecommunications and Information Administration and Department of Defense, to organize a network of test facilities to support spectrum-related testing, modeling, and analysis. NASCTN primarily works on pressing spectrum challenges as they are identified by industry or other federal agencies. The small staff is not equipped to independently select and pursue "hot button" spectrum issues, such as debates around future spectrum allocation decision.[11]

Engineering Laboratory – EL supports smart manufacturing, construction, and cyberphysical systems, such as by developing sustainable and energy-efficient manufacturing materials and supporting disaster-resilient infrastructure. EL facilitates the development of standards, test methods and reference for innovative technologies including robotics, additive manufacturing,

[6] "Cybersecurity Framework." NIST. April 16, 2018.
[7] "National Cybersecurity Center of Excellence." NIST. Accessed February 18, 2020.
[8] "Privacy Framework." NIST. January 2020.
[9] "NIST Releases Draft Plan for Federal Engagement in AI Standards Development." NIST. July 2, 2019.
[10] "National Institute of Standards and Technology - Fiscal Year 2021 Budget Submission to Congress." Department of Commerce. February 2020.
[11] "An Assessment of the Communications Technology Laboratory at the National Institute of Standards and Technology." The National Academies of Sciences, Engineering, and Medicine. 2019.

smart manufacturing, and biopharmaceuticals. The President's budget request would cut efforts related to physical infrastructure and resiliency by $16.4 million, a 28 percent decrease.[12]

NIST USER FACILITIES

NIST has two user facilities, the NIST Center for Neutron Research (NCNR) and the Center for Nanoscale Science and Technology (CNST). These facilities provide more than 5,700 researchers each year with access to advanced scientific tools.

The NCNR is a neutron scattering facility, where users can use neutrons to probe all kinds of different materials. NCNR contributes to several domains, including engineering, materials development, polymer dynamics, chemical technology, medicine, and physics. However, the NCNR reactor is 50 years old and a 2018 report by the National Academies of Sciences, Engineering and Medicine called on NIST to develop a plan to ensure continued access to a neutron scattering facility by its wide community of users. The budget in FY 2021 is approximately $54 million. The Administration has proposed reducing the budget for NCNR by 9 percent, halting modernization plans for the aging reactor, ceasing operation of two neutron scattering instruments, and reducing reactor maintenance.[13]

The CNST provides users with tools needed to create and characterize nanoscale structures, devices, and materials. The CNST is part of PML and promotes collaboration in nanotechnology both across NIST's laboratories and among researchers nationwide.

INDUSTRIES TECHNOLOGY SERVICES

The Industrial Technology Services Account includes NIST's extramural programs: Manufacturing USA and the Hollings Manufacturing Extension Partnership (MEP).

Manufacturing USA is a network of manufacturing innovation institutes coordinated through NIST that serve as partnerships between companies, academia, and entrepreneurs to develop and deploy manufacturing technologies. NIST currently operates a Manufacturing USA institute in Delaware called the National Institute for Innovation in Manufacturing Biopharmaceuticals (NIIMBL). The FY 2021 budget request proposes to cease funding for NIIMBL, providing $25 million, a 60 percent funding increase, to competitively award a second institute and continue support of the program's coordinating office.

The MEP program is a federal-state-industry partnership that consists of centers located across the country that work with local manufacturing communities to strengthen the U.S. domestic manufacturing base. The Centers also provide small and medium sized businesses with technical assistance and guidance on cybersecurity. MEP has proven to be a successful model for federal-state partnerships with significant payoff in economic growth and job creation across our Nation.

[12] "National Institute of Standards and Technology - Fiscal Year 2021 Budget Submission to Congress." Department of Commerce. February 2020.
[13] "President's FY 2021 Budget Request to Congress for the National Institute of Standards and Technology." NIST. February 2020.

According to NIST, for every dollar of Federal investment, the MEP National Network generates roughly $29 in new sales growth for manufacturers and $31 in new client investment.[14] The Administration is proposing, for the third year in a row, a complete elimination of MEP.

CONSTRUCTION OF RESEARCH FACILITIES

Many of NIST's facilities are aging or outdated. Based on Department of Commerce standards, roughly 60 percent of NIST's facilities are in poor to critical condition.[15] This decaying infrastructure has taken a toll on NIST's overall mission, limiting staffs' ability to pursue their research, reducing the accuracy and effectiveness of standards, and harming staff morale. Some facilities have leaking roofs and poor ventilation systems, which makes them inoperable for certain experiments. Routine requests for maintenance are often deferred for extended periods of time. There are over $700 million in deferred maintenance projects. In one startling example, one of NIST's campuses had a leaky pipe system that lost 50,000 to 70,000 gallons of water per day in steam that blocked a road for almost a year.

It is projected that NIST needs $200 million in sustained annual funding to both modernize its older buildings and address its maintenance backlog and capital projects. Unfortunately, the President's recent budget proposal would cut NIST's construction budget by $77 million, or 66 percent. The request covers some basic maintenance of NIST facilities. In lieu of direct funding, the budget proposes legislation, *the Federal Capital Revolving Fund Act of 2021,* which would fund large-dollar, federally owned, civilian real property capital projects using special rules.[16]

TECHNOLOGY TRANSFER

NIST has a unique role in the promotion, tracking, and coordination of Federal efforts in technology transfer. These efforts include convening the Interagency Working Group for Technology Transfer to coordinate Federal efforts, and the Lab-to-Market initiative to increase the economic impact of federally funded R&D by accelerating the transfer of new technologies from the laboratory to the commercial marketplace.[17]

In April 2019, NIST released *Return on Investment Initiative for Unleashing American Innovation*, a green paper that outlined a number of steps the Federal government could take to enhance technology transfer.[18] While NIST has worked to develop a legislative proposal that would implement the recommendations outlined in the green paper, the Administration has not yet released any such proposal. In addition, the FY 2021 budget request proposes to cut NIST's Lab 2 Market Initiative, which facilitates technology transfer across the Federal government, by $3.5 million.

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[14] "New MEP Center Will Serve the Needs of Alaska's Small and Medium-sized Manufacturers." NIST. March 2019.
[15] "National Institute of Standards and Technology - Fiscal Year 2021 Budget Submission to Congress." Department of Commerce. February 2020.
[16] The Federal Capitol Revolving Fund Act of 2021. 116th Cong. (2020).
[17] "Lab to Market "L2M." NIST. Accessed February 18, 2020.
[18] "Unleashing American Innovation: NIST Special Publication 1234." NIST. April 2019.