A REVIEW OF THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY FISCAL YEAR 2020 BUDGET REQUEST

HEARING

BEFORE THE

SUBCOMMITTEE ON RESEARCH AND TECHNOLOGY

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

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C O N T E N T S

April 9, 2019

A REVIEW OF THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY FISCAL YEAR 2020 BUDGET REQUEST

TUESDAY, APRIL 9, 2019

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON RESEARCH AND TECHNOLOGY,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, D.C.

The Subcommittee met, pursuant to notice, at 10 a.m., in room 2318 of the Rayburn House Office Building, Hon. Haley Stevens [Chairwoman of the Subcommittee] presiding.

U.S. HOUSE OF REPRESENTATIVES
SUBCOMMITTEE ON RESEARCH & TECHNOLOGY
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
HEARING CHARTER

A Review of the National Institute of Standards and Technology FY 2020 Budget Request

Tuesday, April 9, 2019
10:00 a.m. – 12:00 p.m.
2318 Rayburn House Office Building

PURPOSE

On Tuesday, April 9, 2019, the Subcommittee on Research and Technology of the Committee on Science, Space, and Technology will hold a hearing to exam the President's Fiscal Year 2020 budget request for the National Institute of Standards and Technology (NIST) and related policy and management issues. We will discuss major areas of research under NIST's laboratory programs, the agency's role in working with industry to advance U.S. competitiveness, and key facilities construction and maintenance issues on both of NIST's campuses.

WITNESS

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

OVERARCHING QUESTIONS

- What would be the impact of the proposed 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 NIST campuses and what is the impact on NIST's ability to carry out its mission?
- What would be the impact of the proposed budget on U.S. leadership in international standards development, including for emerging technologies?

OVERVIEW OF FY 2020 BUDGET REQUEST FOR NIST

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. NIST has strong partnerships with the private sector, other government

agencies, and universities to develop and apply the technology, measurements, and standards needed for new and improved products and services.[1] The President's FY 2020 budget request would provide a total of $687 million[2] for NIST, representing a 30 percent ($299 million) decrease below FY 2019 funding. The request proposes funding under NIST's three accounts: Scientific and Technical Research and Services (STRS); Industrial Technology Services (ITS); and Construction of Research Facilities (CRF).

	FY 2018 Enacted ($M)	FY 2019 Enacted ($M)	FY 2020 Request ($M)	FY 2020 Request +/(-) over FY 2019 Enacted ($M)	FY 2020 Request % Over FY 2019 Enacted
STRS	**$724.5**	**$724.5**	**$611.7**	**($112.8)**	**-15.6%**
Laboratory Programs	628.0	628.1	553.7	(74.4)	-12%
Corporate Services	17.3	17.3	11.9	(5.4)	-31%
Standards Coordination & Special Programs[3]	79.2	79.1	46.1	(33.0)	-42%
ITS	**$155.0**	**$155.0**	**$15.2**	**($139.8)**	**-90.2%**
Hollings Manufacturing Extension Partnership	140.0	140.0[4]	0.0	(140.0)	-100.0%
Manufacturing USA	15.0	15.0	15.2	0.2	1.3%
CRF	**$319.0**	**$106.0**	**$59.9**	**($46.1)**	**-43.5%**
Construction & Major Renovations	255.0	31.0	19.2	(11.8)	-38%
Safety, Capacity, Maintenance & Major Repairs	64.0	75.0	40.7	(34.3)	-46%
Total, NIST Discretionary	**1,198.5**	**985.5**	**686.8**	**(298.7)**	**-30.3%**

[1] All facts, figures, and other information in this document are available through the President's FY 2020 Budget Request Congress for the National Institute of Standards and Technology or www.nist.gov.

[2] This figure includes $19 million in funding for construction of research facilities contingent upon the enactment of the *Federal Capital Revolving Fund Act of 2019*. Excluding this $19 million, the total request is $668 million, which represents a 32% cut from FY 2019 enacted.

[3] Includes $2.2M Baldrige Performance Excellence Program funding.

[4] Without a $2M rescission of prior year unobligated balance to reduce budget authority.

LAB PROGRAMS

The Scientific and Technical Research and Services (STRS) account funds NIST's laboratory research and includes collaborative research with industry. NIST operates five laboratories and two national user facilities in carrying out these activities. These include two metrology laboratories: the Material Measurement Laboratory and the Physical Measurement Laboratory; and three technology laboratories: the Engineering Laboratory, the Information Technology Laboratory, and the Communication Technology Laboratory. The two national user facilities are the Center for Nanoscale Science and Technology and the NIST Center for Neutron Research.

The FY 2020 budget request for the labs program is $611.7 million, 16% below FY 2019 funding. The request would reduce funding for most of the research carried out under the laboratory program and reduce personnel by 400 staff, an approximate 17% reduction of NIST scientists and engineers.

The proposed budget also includes elimination of all three centers of excellence funded by NIST, including the Forensic Science Center of Excellence led by Iowa State University, the Community (Disaster) Resilience Center of Excellence led by Colorado State University, and the Advanced Manufacturing Center of Excellence led by Northwestern University. The request would also eliminate funding for NIST's climate measurement research carried out under the Urban Dome program.

The request would make cuts to the following STRS focus areas:

- 41.2% decrease for Advanced Communications, Networks, and Scientific Data Systems
- 20.5% decrease for Advanced Manufacturing and Materials Management
- 1.5% decrease for Exploratory Measurement Science
- 12.3% decrease for Fundamental Measurement, Quantum Science, and Measurement Dissemination
- 14% decrease for Health and Bioscience
- 8.4% decrease for NIST User Facilities
- 30.5% decrease for Physical Infrastructure and Resilience

Advanced Communications, Networks, and Scientific Data Systems – The Advanced Communications program funds important research in areas such as AI, internet of things (IoT), 5G wireless communications, and wireless spectrum sharing technologies. The FY 2020 budget includes an additional $8 million for AI for a total of $24 million. This would fund AI user facilities for training and testing AI systems, modeling AI behavior, and comparing systems. NIST's work has included measuring AI trustworthiness issues including privacy, security, explainability, resilience, and reliability. In addition, NIST invests in AI technology evaluation for natural language processing, visual understanding, information retrieval, identity, and

usability. Research in 5G wireless would also be a priority. However, the increases for AI and 5G would come at an even greater cost for this program's other important work. The Administration proposes to eliminate funding for internet infrastructure protection, cloud computing, medical record interoperability, data visualization, cyber physical systems interoperability, and other ongoing information technology and data challenges.

Advanced Manufacturing and Material Measurements – NIST works closely with industry to assist U.S. manufacturers in competing in the global market. It facilitates the development of standards, test methods and reference for innovative technologies including robotics, additive manufacturing, and biopharmaceuticals. The Administration has prioritized microelectronics research across agencies, including in the Materials lab at NIST. However, the Administration is proposing to eliminate funding for bridge and pipeline reliability testing, body armor testing, trace materials detection, and all work on energy and environment applications including an extramural grant to Troy University in Alabama supporting the recycling and reuse of plastics. It would also end long-standing investments in and operations for materials characterization at Brookhaven National Laboratory and Northwestern University.

Cybersecurity and Privacy – The FY 2020 budget request would maintain basically flat funding ($1m increase) for NIST's cybersecurity and privacy efforts. The proposed budget supports development of the first post-quantum standards, maintaining the NIST National Vulnerability Database, the NIST Cybersecurity for the Internet of Things program, development of a Privacy Framework, and NIST's continued leadership of the National Initiative for Cybersecurity Education (NICE) program.

Exploratory Measurement Science – The budget includes basically flat funding ($1m decrease) for NIST's high risk and potentially transformative research. The proposal would include elimination of the agency's support of the Joint Institute of Metrology in Biology (JIMB), a partnership with SLAC, a Department of Energy National Lab, and Stanford University.

Biosciences - Overall, the Administration proposes a 14% cut to health and biological systems measurement activities, including the elimination of JIMB. NIST's work supports the underlying technologies and measurements for precision medicine, medical imaging, synthetic biology, genomics, and more. The *Engineering Biology Research and Development Act,* introduced in previous Congresses and to be reintroduced by Chairwoman Johnson soon, would authorize much of the biosciences work at NIST slated for reduction or elimination in the FY 2020 budget proposal.

Fundamental Measurement, Quantum Science, and Measurement Dissemination – Last Congress, the Science Committee helped usher into law the *National Quantum Initiative Act* [P.L. 115-368]. NIST is one of three agencies charged under that Act with supporting and

expanding basic and applied quantum information science and technology research and development of standards. The FY 2020 budget proposal includes an additional $10 million for quantum information sciences, including operation of the Quantum Economic Development Consortium. However, the proposed 12% cut to the overall fundamental measurement program would require eliminating or reducing NIST's activities in support of customers in the communications, defense, manufacturing, transportation, and other sectors.

NIST User Facilities – The Administration proposes an 8.4% decrease in funding for the NIST Center for Neutron Research (NCNR) and the Center for Nanoscale Science and Technology (CNST). The NCNR and the CNST provide the U.S. research community with access to state-of-the art facilities for neutron measurement and nanostructure characterization. The proposed budget would require a significant reduction of service at NCNR, an already oversubscribed user facility.

Physical Infrastructure and Resilience – The budget includes a 30.5% decrease in spending for disaster resilience activities that provide guidance to communities for infrastructure safety, interoperability, and resilience against hazards such as fire, windstorms, and earthquakes.

MANUFACTURING

Manufacturing Extension Partnership (MEP) – Once again, the Administration proposes to eliminate funding for NIST's primary program that provides services to support adoption of new technologies in the manufacturing industry, the Hollings Manufacturing Extension Partnership (MEP) Program. Congress funded MEP at $140 million in FY 2019. MEP Centers are funded by the Federal government, state governments, and client fees on a cost-share basis and are operated in all 50 States and Puerto Rico. MEP Centers employ 81 federal workers and 1,300 non-federal technical experts.

Manufacturing USA- The FY 2020 budget includes $15 million for carrying out activities under Manufacturing USA, including ongoing support for NIST's only institute, the National Institute for Innovation in Manufacturing Biopharmaceuticals (NIIMBL), and support for NIST's role as the lead agency for interagency coordination. There are currently a total of 14 institutes, the remaining 13 supported by the Departments of Energy and Defense.

CONSTRUCTION OF RESEARCH FACILITIES

The FY 2020 budget proposal includes $60 million for NIST's construction budget, a $46 million (44%) decrease below the FY 2019 enacted level. However, this figure includes $19 million in funding for construction of research facilities contingent upon the enactment of the *Federal Capital Revolving Fund Act of 2019,* which is unlikely to occur. Therefore, the request in reality includes only $41 million in discretionary funding.

The renovation project for Building 245, the radiation physics building on the Gaithersburg campus, is now fully funded thanks to an influx of funding from Congress in FY 2018. Building 1 on the Boulder, CO campus is currently undergoing significant renovation. The building is comprised of multiple wings. The estimated cost to complete renovation of Wing 5 (which is underway) is $43 million in FY 2020. In total, to complete the renovation of Building 1 is estimated to cost $337 million over several years. It is this $337 million that the Administration is proposing to fund through a revolving fund through GSA, with NIST paying back into the fund annually through appropriations ($19 million in FY 2020). It is unlikely the Appropriators would support such a proposal. The $41 million in the discretionary proposal would support staff salaries and recurring preventative maintenance contracts and materials. Under this budget, previously scheduled equipment replacements for FY 2020 will be delayed and none of the $300 million of deferred maintenance of NIST infrastructure and utilities would be addressed.

Many of NIST's facilities date back to the 1950's. Currently, 54% of the facilities area (by square footage) in Boulder is in poor to critical condition per Department of Commerce standards. Similarly, 58% of Gaithersburg's facilities are in poor to critical condition. The Gaithersburg campus is losing approximately 50,000-70,000 gallons of water per day because of leakage in their steam heat system, and in the winter of 2018, an entire building was closed for a week due to a failed steam valve. That's just the tip of the proverbial iceberg of deferred maintenance at both campuses.

Chairwoman STEVENS. The hearing will come to order. Without objection, the Chair is authorized to declare recess at any time.

Good morning, and welcome to this hearing to review the National Institute of Standards and Technology (NIST) Fiscal Year 2020 Budget Request. Dr. Copan, welcome to the Committee and to what I hope will be a meaningful dialog about the critical national asset that is NIST. It was great to recently have you in Michigan's 11th District in Plymouth at our Michigan Manufacturing Technology Center, and it is a delight to have you here today.

NIST works with industry, academia, and other government agencies to advance science, support technological innovation, and increase competitiveness of U.S. companies. NIST's recognized excellence in measurement science and standards has underpinned U.S. leadership in areas as diverse as additive manufacturing, spectrum sharing, smart grid, biotechnology, cybersecurity, forensic science, and infrastructure resiliency. And that list goes on for quite a while. The agency has also played and will continue to play a key role in U.S. advancements in artificial intelligence and quantum science. I am happy to see increases for these two important areas of research in the Fiscal Year 2020 budget proposal for NIST.

Most Americans—and possibly most Members of Congress—don't know about NIST or understand the nature or impact of their work, but we all benefit from it. NIST's reference materials, technical standards, measurement services, and technical guidance have been used to validate the performance of the smoke alarms in our homes, ensure our law enforcement officers have body armor that they can rely on, develop the first widely used measurement standard for breast cancer diagnosis, and protect us all from bad actors in cyber space. These are just a few tangible examples of NIST's work that benefit everyday Americans.

For U.S. manufacturers of all sizes and sectors, NIST's measurement services and standards are essential to their ability to compete, grow, and create jobs. To say this is a disappointing budget request is an understatement. The Administration is once again proposing to zero out the Manufacturing Extension Partnership program even though in 2018, MEP (Manufacturing Extension Partnership) resulted in $16 billion in sales, $1.7 billion in cost savings, $4 billion in new client investments, and more than 122,000 jobs created and retained at a total cost to the Federal Government of $140 million. I'll say, that's some ROI (return on investment).

The Michigan Manufacturing Technology Center, an MEP center that's located in Plymouth, has helped create small and medium-sized manufacturing jobs. They've serviced manufacturing clientele and retained nearly 11,000 jobs. MEP also leads the Nation in getting ready for cybersecurity services. This is something we have seen at the Michigan Manufacturing Technology Center. It has been critical to helping manufacturers protect their operations on the factory floor and the devices that they produce as the industrial Internet of Things (IOT) continues to grow exponentially.

This budget would also result in the layoff of 400 NIST staff, including 17 percent of its scientists and engineers, a loss that would be hard and likely impossible to recover from. NIST scientists have

won five Nobel Prizes. They are the best and brightest. They could work anywhere, for probably double that salary, but they have chosen NIST because of its excellence, because of its delivery and their commitment to the public good. This request may be one of the more callous examples of this Administration's slash-and-burn approach to the Federal budget, but it is also one of the most troubling. To save $300 million, the Administration is putting on the line billions of dollars of economic growth for U.S. companies, not to mention our national security, our health, and our environment. It is hard for me to overstate the return on investment for our Nation from the money that we put into NIST's work.

Finally, for those of us who have visited the NIST campus in Gaithersburg, we understand why NIST has more than $300 million in deferred maintenance and is undertaking major renovations of some of their laboratories. We cannot expect NIST's scientists, as bright as they are, to do cutting-edge research with outdated equipment, leaking pipes, and crumbling buildings. I encourage all of my colleagues—in fact, I implore my colleagues to visit either of the NIST campuses and see for yourself both the incredible work that they do and how desperate their facilities situation has become.

I have had the privilege of visiting NIST in Gaithersburg several times throughout my career, and I am encouraged and I am inspired, and I am ready to do more.

I understand hard decisions have to be made in every budget, but the proposed $300 million cut to NIST would cause irreversible damage to our Nation.

Dr. Copan, I look forward to your testimony, and I thank you for being here. It is my hope that in our conversation today we will bring attention to the important work at NIST and the likely impacts of the proposed budget cuts. Thank you.

[The prepared statement of Chairwoman Stevens follows:]

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

Opening Statement

Chairwoman Haley Stevens (D-MI)
of the Subcommittee on Research and Technology

Subcommittee on Research and Technology Hearing:
A Review of the National Institute of Standards and Technology Fiscal Year 2020 Budget Request
April 9, 2019

Good morning and welcome to this hearing to review the National Institute of Standards and Technology Fiscal Year 2020 Budget Request. Dr. Copan, welcome to the Committee and to what I hope will be meaningful dialogue about the critical national asset that is NIST.

NIST works with industry, academia, and other government agencies to advance science, support technological innovation, and increase competitiveness of U.S. companies. NIST's recognized excellence in measurement science and standards has underpinned U.S. leadership in areas as diverse as additive manufacturing, spectrum sharing, smart grid, biotechnology, cybersecurity, forensic science, and infrastructure resiliency. And that list goes on for quite a while. The agency has also played and will continue to play a key role in U.S. advancements in artificial intelligence and quantum science. I am happy to see increases for these two important areas of research in the FY 2020 budget proposal for NIST.

Most Americans – and possibly most Members of Congress - don't know about NIST or understand the nature or impact of their work, but we all benefit from it. NIST's reference materials, technical standards, measurement services, and technical guidance have been used to validate the performance of the smoke alarms in our homes, ensure our law enforcement officers have body armor they can rely on, develop the first widely useful measurement standard for breast cancer diagnosis, and protect us all from bad actors in cyber space. These are just a few tangible examples of NIST's work that benefit every day Americans. For U.S. manufacturers of all sizes and sectors, NIST's measurement services and standards are essential to their ability to compete, grow, and create jobs.

To say this is a disappointing budget request is an understatement. The Administration is once again proposing to zero out the Manufacturing Extension Partnership program even though in 2018, MEP resulted in $16 billion in sales, $1.7 billion in cost savings, $4 billion in new client investments, and more than 122,000 jobs created and retained -- at a total cost to the Federal government of $140 million. The Michigan Manufacturing Technology Center, a MEP center in my district, has helped its small and medium manufacturing clients create and retain nearly 11,000 jobs. It also leads the nation in getting MEP centers ready to provide cybersecurity services, which are critical to helping manufacturers protect their operations on the factory floor

and the devices they produce as the Industrial Internet of Things continues to grow exponentially.

This budget would also result in the lay-off of 400 of NIST's staff, including 17 percent of its scientists and engineers, a loss that would be hard and likely impossible to recover from. NIST scientists have won 5 Nobel prizes. They are the best and brightest. They could work anywhere, for probably double their salary, but they have chosen NIST because of its excellence and because of their commitment to the public good.

This request may not be one of the most callous examples of this Administration's slash and burn approach to the Federal budget, but it is one of the most troubling. To "save" $300 million, the Administration is putting on the line billions of dollars in economic growth for U.S. companies, not to mention our national security, our health, and our environment. It is hard for me to overstate the return on investment to our nation from the money we put in to NIST's work. Finally, those of us who have visited the NIST campus understand why NIST has more than $300 million in deferred maintenance and is undertaking major renovations of some of their laboratories. We cannot expect NIST's scientists, as bright as they are, to do cutting edge research with outdated equipment, leaking pipes, and crumbling buildings. I encourage all of my colleagues to visit either of the NIST campuses and see for yourself both the incredible work they do and how desperate their facilities situation has become.

I understand hard decisions have to be made in every budget, but the proposed $300 million cut to NIST would cause irreversible damage to our nation. Dr. Copan, I look forward to your testimony and thank you for being here. It is my hope that our conversation today will bring attention to the important work at NIST and the likely impacts of the proposed budget cuts. Thank you.

Chairwoman STEVENS. The Chair now recognizes Mr. Baird for an opening statement.

Mr. BAIRD. Well, good morning, Chairwoman Stevens. I really want to thank you for convening today's hearing on the Fiscal Year 2020 Budget Request for the National Institute of Standards and Technology. And, Dr. Copan, I appreciate the opportunity to visit with you again.

Article 1 of Section 8 of the U.S. Constitution grants the Congress the power to fix the standard of weight and measure. And Congress created NIST and its predecessor agencies to fulfill that important Federal responsibility. Since 1901, NIST has been at the forefront of setting those standards for the United States and the world. Almost every Federal agency and U.S. industry sector uses the standards and the measurements and the certification services that NIST labs provide. I think many of our constituents may not appreciate how fundamental this work is to our economy and to the national security. From genetic sequencing to cybersecurity, NIST is at the forefront of advancing innovation.

As new technologies develop and evolve, NIST's services are critical. The President's budget request prioritizes investments in three critical technology areas: Quantum information science, microelectronics, and artificial intelligence. These investments will launch discoveries and advances that will significantly affect America's economy in the coming decades. I look forward to hearing more about them today.

NIST also works with small and medium manufacturers to help them compete in the emerging global marketplace for advanced manufacturing. By working with industry and universities like my alma mater Purdue, NIST is helping U.S. manufacturers adopt new technologies and processes to overcome shared technical obstacles. The adoption of new technologies is speeding up and improving development, driving efficiencies in production, and enabling new business models. I look forward to discussing what the next steps should be for the public-private sector partnership in manufacturing.

Finally, NIST plays a critical role in our Nation's cybersecurity. NIST provides mandatory guidelines and standards to help reduce cyber risk to Federal agencies and critical infrastructure. NIST also provides voluntary standards for the private sector.

One of the great challenges of the 21st century is cybersecurity. It is imperative that we do everything we can to protect our citizens and their privacy. The President's budget request prioritizes NIST's cybersecurity work, and I hope to learn more about those efforts today.

We have a constitutional obligation and a responsibility to ensure every taxpayer dollar spent is used as effectively and efficiently as possible. I appreciate that today's hearing gives us the opportunity to fulfill that duty, and I thank Dr. Copan for being here today and yield back the balance of my time.

[The prepared statement of Mr. Baird follows:]

Opening Statement of R&T Subcommittee Ranking Member Jim Baird at Subcommittee Hearing on NIST FY20 Budget

Apr 9, 2019

Opening Statement

Good morning Chairwoman Stevens. Thank you for convening today's hearing on the Fiscal Year 2020 budget request for the National Institute of Standards and Technology (NIST).

Article 1, Section 8 of the U.S. Constitution grants the Congress the power to "fix the Standard of Weight and Measures." Congress created NIST and its predecessor agencies to fulfill that important federal responsibility.

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I appreciate that today's hearing gives us the opportunity to fulfill that duty. I thank Dr. Walter Copan for being here today and yield back the balance of my time.

Chairwoman STEVENS. Thank you. The Chair now recognizes the Chairwoman of the Full Committee, Ms. Johnson, for an opening statement.

Chairwoman JOHNSON. Thank you very much and good morning and welcome to Dr. Copan before this Committee, really for the first time, so—and in this hearing today, we will review the Administration's Fiscal Year 2020 budget request for the National Institute of Standards and Technology.

In short, it is a myopic and harmful request given NIST's critical role in our Nation's economic competitiveness and national security. Once again, the Administration is proposing deep cuts to NIST's important work across nearly the entire portfolio of the agency, from its basic measurement science to its industrial partnerships. The consequences of the 35-day partial government shutdown that closed NIST's doors this past winter may be instructive if this budget proposal is enacted.

The shutdown of NIST's neutron research facility, according to NIST's own briefing materials, had repercussions on important industrial research and delayed the Ph.D. work of many graduate students who represent our future capacity to lead and innovate. Yet this budget proposes to cut—to shut down two of the facility's instruments and reduce maintenance funding, ensuring that the entire facility will have more frequent shutdowns.

The shutdown resulted in lost opportunities and delays in research critical to U.S. competitiveness, including research in advanced computing and communications. Yet this budget proposes to eliminate programs addressing multiple information technologies and data challenges.

The shutdown resulted in NIST's inability to participate in and contribute to important international dialog addressing emerging technology issues that will shape the future economy such as cybersecurity, Internet of Things, and digital connectivity. Yet this budget proposes to lay off 17 percent of NIST's scientists and engineers, the very U.S. experts who are needed to participate in the international discussions. Those are just three examples out of many.

It should be puzzling to all of us that the Administration can be so devoted to "cut, cut, cut" that they don't stop to think about the consequences of the cuts, even when the evidence is laid bare before them. NIST gets much more—much less recognition and support than it deserves, among both the general public and the political leadership in Washington.

While this hearing is to examine the troubling consequences of the 2020 budget request, it is also an opportunity to bring positive attention to NIST's mission and the critical work of NIST's dedicated scientists and engineers. I thank you, Dr. Copan, for being here this morning, and I look forward to the discussion. Thank you, and I yield back.

[The prepared statement of Chairwoman Johnson follows:]

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

Opening Statement

Chairwoman Eddie Bernice Johnson (D-TX)

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The shutdown of NIST's neutron research facility, according to NIST's own briefing materials, had repercussions on important industrial research and delayed the PhD work of many graduate students who represent our future capacity to lead and innovate. Yet this budget proposes to shut down two of the facility's instruments and reduce maintenance funding, ensuring that the entire facility will have more frequent shutdowns.

The shutdown resulted in lost opportunities and delays in research critical to U.S. competitiveness, including research in advanced computing and communications. Yet this budget proposes to eliminate programs addressing multiple information technology and data challenges.

The shutdown resulted in NIST's inability to participate in and contribute to important international dialogues addressing emerging technology issues that will shape the future economy, such as cybersecurity, internet of things, and digital connectivity. Yet this budget proposes to lay off 17 percent of NIST's scientists and engineers, the very U.S. experts who are needed to participate in these international discussions.

Those are just three examples out of many. It should be puzzling to all of us that the Administration can be so devoted to "cut, cut, cut" that they don't stop to think about the consequences of the cuts, even when the evidence is laid bare before them.

NIST gets much less recognition and support than it deserves, among both the general public and the political leadership in Washington. While this hearing is to examine the troubling

consequences of the 2020 budget request, it is also an opportunity to bring positive attention to NIST's mission and the critical work of NIST's dedicated scientists and engineers.

I thank Dr. Copan for being here this morning and I look forward to the discussion.

Chairwoman STEVENS. The Chair now recognizes the Ranking Member of the Full Committee, Mr. Lucas, for an opening statement.

Mr. LUCAS. Thank you, Chairwoman Stevens and Ranking Member Baird, for holding this hearing today. And thank you, Dr. Copan, for being here to testify on the National Institute of Standards and Technology's priorities for Fiscal Year 2020.

Many Americans may not know just how important and far-reaching this work is and how much it impacts our lives and businesses. For example, NIST keeps the official time for the United States with cutting-edge atomic clocks. This may seem trivial, but this precise and accurate time keeps our GPS system working. NIST conducts research and develops standards for building codes and new materials. In my home State of Oklahoma, NIST has provided critical research and guidance for constructing tornado-resistant buildings and infrastructures.

NIST also plays an important role in cybersecurity. NIST sets mandatory guidelines and standards for Federal agencies and provides voluntary standards for private industry. The NIST Cybersecurity Framework is considered the gold standard for cyber protection. Private industry trusts NIST because it has a track record of providing high-quality, reliable measurement and standards service and information. The world-class scientists and facilities at NIST help give United States industry a competitive edge that we must maintain.

The President's budget request prioritizes funding at NIST in three new areas that are critical to national security and the economy, including the National Quantum Initiative, microelectronics, and artificial intelligence, and I look forward to hearing more about these new efforts.

This Committee has a long, bipartisan record of support for NIST and its contributions to research and development. Our challenge is to set funding priorities that ensure America remains a leader in science and technology, while being able to balance the government's budget.

I'll remind my colleagues on both sides of the aisle, the President's budget proposal is just the start of the budget process. Under the Constitution, the President proposes but Congress decides how much will be funded. It is our job to ensure taxpayer dollars are properly spent, and this hearing is the next step in that process.

Thank you, and I yield back, Madam Chair.

[The prepared statement of Mr. Lucas follows:]

Opening Statement of Ranking Member Lucas at R&T Subcommittee Hearing on NIST Budget

Apr 9, 2019

Opening Statement

Thank you, Chairwoman Stevens and Ranking Member Baird for holding today's hearing. And thank you to Dr. Walter Copan for being here to testify on the National Institute of Standards and Technology's priorities for Fiscal Year 2020.

Many Americans may not know just how important and far-reaching NIST's work is and how much it impacts our lives and businesses.

For example, NIST keeps the official time for the United States with cutting edge atomic clocks. This may seem trivial, but this precise and accurate time keeps our GPS working.

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Thank you, and I yield back.

Chairwoman STEVENS. If there are any Members who wish to submit additional opening statements, your statements will be added to the record at this point.

At this time, I would like to introduce our witness. Dr. Walter G. Copan was confirmed as Undersecretary of Commerce for Standards and Technology and NIST Director in October 2017. Prior to joining NIST, Dr. Copan founded and served in leadership positions for several innovation and technology transfer organizations and companies. Dr. Copan was formerly Managing Director of Technology Commercialization and Partnerships at the Department of Energy's Brookhaven National Laboratory and Principal Licensing Executive for Technology Transfer at Department of Energy—DOE's—National Renewable Energy Laboratory.

Dr. Copan received his Ph.D. in physical chemistry, bachelor-of-science degree in chemistry, and bachelor-of-arts degree in music from Case Western Reserve University.

Dr. Copan, as you should know, you will have 5 minutes for your spoken testimony. Your written testimony will be included in the record for the hearing. When you've completed your spoken testimony, we will begin the questions. Each Member will have 5 minutes to question the panel—or you. And with that, Dr. Copan, your 5 minutes begins.

TESTIMONY OF HON. DR. WALTER G. COPAN, UNDERSECRETARY OF COMMERCE FOR STANDARDS AND TECHNOLOGY, AND DIRECTOR OF NIST

Dr. COPAN. Thank you so much. Chairwoman Stevens, Ranking Member Baird, Chair Johnson, and Ranking Member Lucas, thank you so much for being here, together with the Committee Members. I'm Dr. Walter Copan, 16th Director of the National Institute of Standards and Technology, NIST, and I am deeply honored to serve our Nation at this world-leading science and technology institute and to advance its mission for our economy, for innovation, and for U.S. industrial competitiveness.

In this role I serve as the President's principal advisor on standards policy, and standards are more important than ever before, essential to commerce and to global trade. Thank you again for the opportunity to testify today before you on the proposed fiscal budget for 2020 for NIST. I'm deeply grateful to this Committee for your continued work on behalf of NIST, its people, programs, and facilities.

NIST, as has already been said, plays a unique role as the measurement science institute of the United States. Advances in precision measurement enable advancing the frontiers of science itself, as well as engineering and manufacturing. As one of America's great women of science, U.S. Navy Rear Admiral Grace Hopper said, "One accurate measurement is worth a thousand expert opinions." This is why NIST is such a vital partner to U.S. industry, to academia, and to all of government.

The Fiscal Year 2020 budget request continues this Administration's effort to manage fiscal spending and to put the Nation on a sustainable path. The budget request for NIST aligns with the Administration's key priorities. The Administration requests $686.8 million for NIST in Fiscal Year 2020. This will support the Admin-

istration's efforts to lead the industries of the future by prioritizing Federal investment in key technology areas: Artificial intelligence, quantum science and engineering, advanced manufacturing, microelectronics, and advanced communications, including 5G, while maintaining NIST's core measurement science standards, technology, and cybersecurity capabilities.

NIST is the best in the world in its metrology mission, as evidenced by the unanimous agreement of the nations of the world to redefine the International System of Units in Versailles, France last November. NIST's leadership in this monumental achievement for universally accurate measurements, now based on the unchanging constants of nature, is rooted in our core values of excellence and perseverance, integrity, and inclusivity.

The budget requests $611.7 million for the Scientific and Technical Research Services account. This funds the NIST research programs, the frontiers of measurement science, which enable technology development in our manufacturing progress. NIST research and services are central to U.S. innovation, economic, and national security. Studies show that for every single dollar invested in NIST creates over $50 of direct value for the American economy.

Let me highlight some of our proposed investment increases: $8 million increase for artificial intelligence to expand our ongoing research, measurements, and standards supporting the market adoption of AI technologies; increase of $10 million for microelectronics to advance measurement science standards and new materials; an increase of $10 million for quantum science and engineering and industry consortium collaborations to accelerate quantum R&D (research and development) and its applications. This aligns with the White House strategy for quantum information science and with the *National Quantum Initiative Act*, which was championed by this Committee and passed by Congress earlier this year. NIST has a critically important role in this initiative.

NIST is the Department of Commerce's lead agency for cybersecurity, and the FY 2020 request maintains strong support for cybersecurity and privacy, including the full funding for the NIST Cybersecurity Center of Excellence.

With this budget, NIST will focus on critical priority areas of science and technology such as the standards accelerating deployment of next-generation communications technologies, including 5G, and NIST's work is essential for interoperable secure systems, self-driving vehicles, the Internet of Things, drones, trusted AI applications.

The Fiscal Year 2020 budget request for the NIST Manufacturing USA program is $15.2 million. The request continues to fund the National Institute for Innovation and Manufacturing Biopharmaceuticals in Delaware, as well as program coordination for Manufacturing USA network.

In addition, the FY 2020 request includes $59.9 million for construction, including maintenance, improvements, and renovation of NIST facilities. It also requests $288 million for needed renovations to Building 1 in Boulder, Colorado, to be funded through a new General Services Administration (GSA) capital revolving fund.

In conclusion, NIST's broad technical portfolio, scientific and engineering depth positions the agency to contribute effectively to

emerging national needs. With NIST's brilliant dedicated staff, unique facilities, and trusted, objective, nonregulatory role, we are positioned to continue delivering high-leverage impact for our economy, quality-of-life, and national security. Thank you again for this opportunity.

[The prepared statement of Dr. Copan follows:]

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Testimony of

Dr. Walter G. Copan
Under Secretary of Commerce for Standards and Technology
Director
National Institute of Standards and Technology (NIST)
United States Department of Commerce

Before the
United States House of Representatives
Committee on Science, Space, and Technology
Subcommittee on Research and Technology

A Review of the National Institute of Standards and Technology Fiscal Year 2020 Budget Request

April 9, 2019

Introduction
Madam Chairwoman Stevens and Ranking Member Baird. Thank you for the opportunity to testify today before the Committee on Science, Space, and Technology's Subcommittee on Research and Technology on the programs and priorities of the National Institute of Standards and Technology—known as NIST. Today I will highlight the unique mission and role NIST plays in measurements science, standards, technology, and innovation. I will cover my priorities as we position NIST to meet our nation's needs of the future of our economic prosperity and industrial competitiveness. I am deeply grateful to this Committee for your work on behalf of NIST, its people, and programs.

The President's FY 2020 Budget request continues this Administration's efforts to manage federal investment levels in order to put the nation on a sustainable fiscal path. The budget request for NIST is aligned with the Administration's key priorities including promoting a healthy economy and maintaining a strong national defense. The FY 2020 request for NIST totals $686.8 million and will support the Administration's efforts to lead the industries of the future, prioritizing investment in support of artificial intelligence, quantum science, advanced manufacturing, microelectronics, and advanced fifth-generation (5G) communications technologies, while maintaining NIST's core measurements science, standards, and technology development capabilities that are essential to driving innovation and economic competitiveness.

NIST's Unique Mission
NIST's mission is crucial for U.S. commerce and global competitiveness. NIST is the best in the world at performing its metrology mission, as the world witnessed again in the Redefinition of the International System of Units, the SI, by the unanimous vote of the member nations in Versailles on November 16, 2018. NIST's leadership in this monumental achievement for universally accurate measurements based upon the unchanging constants of nature, is rooted in our core values of excellence and perseverance, integrity and inclusivity. The quality of our research and our people is borne out by numerous awards—including NIST's five Nobel prizes.

SCIENTIFIC AND TECHNICAL RESEARCH SERVICES (STRS) ($611.7 million)
The NIST research programs work at the frontiers of measurement science to ensure that the U.S. system of measurements is firmly grounded in sound scientific and technical principles. Today, the NIST laboratories address increasingly complex measurement challenges, ranging from the very small (nanoscale devices for advanced computing) to the very large (vehicles and buildings), and from the physical (resilient infrastructure) to the virtual (cybersecurity and data science). As new technologies develop and evolve, NIST's measurement research and services remain central to national defense, homeland security, trade, and innovation.

Advanced Communications, Networks and Scientific Data Systems ($40.2 million)
NIST's Advanced Communications, Networks, and Scientific Data Systems activities enable secure, reliable, high-speed wireless and wireline communications critical to U.S. economic competitiveness, safety, and security. NIST measurement science research and support for the development of standards accelerates the deployment of next-generation communication technologies, including 5G, a term used to describe future wireless networks that will be faster and more reliable. These technologies will be necessary for self-driving cars, internet of things (IoT) applications, drones, and future artificial intelligence (AI) systems. NIST is committed to

solving the measurement and deployment challenges of these fast-moving fields to help the U.S. achieve and maintain global leadership in these areas. This request funds measurement science research and standards development that will strengthen the growth of 5G communications, smart systems, and AI. NIST will consolidate efforts on its highest priority capabilities and research.

In the area of AI, NIST will focus an additional $8.0 million to develop resources needed by users of AI to train and test AI systems, model AI behavior and compare systems. NIST will also apply AI solutions to its research in advanced materials, robotics, and more. This requested increase also supports NIST's role in providing standard leadership and expertise that is essential for the U.S. to reap the economic benefits of emerging technologies such as AI.

Advanced Manufacturing and Material Measurements ($117.5 million)
NIST has partnered with the U.S. manufacturing sector for more than a century and has a proven track record of delivering the tools and technical expertise that existing manufacturers and aspiring start-ups need. NIST's Advanced Manufacturing and Material Measurements activities provide industry with precision measurement technologies, tests, protocols, trusted systems, and world-class scientific and engineering knowledge through targeted research across a broad portfolio—including advanced materials development, advanced sensing, biomanufacturing, and smart manufacturing systems.

The FY 2020 request would refocus an additional $10 million to support advances and breakthroughs in measurement science, standards, and material characterization by NIST that will accelerate the design, development, and manufacturability of next generation microelectronics. NIST will specifically focus on challenges around nanophotonic, which will also directly support the agencies efforts in quantum engineering.

Cybersecurity and Privacy ($84 million)
NIST is the Department of Commerce's lead agency on Cybersecurity issues.
NIST's Cybersecurity and Privacy activities strengthen the security of our digital world through a portfolio bridging foundational and applied cybersecurity research, and through the development of publicly available standards and technical guidance. NIST's sustained outreach supports the effective application of standards and best practices enabling the adoption of practical cybersecurity, advanced cryptography, and privacy approaches, including leadership in the development of a national Privacy Framework. Through internal research and collaboration with stakeholders, NIST addresses the nation's current and future measurement science needs. The President's FY 2020 request fully funds NIST current portfolio of cybersecurity activities including work on IoT cybersecurity, maintaining the National Cybersecurity Vulnerabilities Database, and the NIST Cybersecurity Center of Excellence.

Exploratory Measurement Science ($65.7 million)
NIST's mission requires deep expertise in a broad range of disciplines. To best position NIST to support U.S. technological interests well into the future, it is essential that NIST maintain a portfolio of exploratory measurement science research. This portfolio includes investing in higher-risk and potentially transformative projects selected in a competitive internal process, and

the NIST National Research Council Postdoctoral Research Associateship Program that brings researchers of exceptional promise to NIST.

Fundamental Measurement, Quantum Science, and Measurement Dissemination ($191.4 million)
The President's FY 2020 Budget continues to support NIST measurement science and standards efforts to address our nation's most pressing technological challenges and economic opportunities, among which is the U.S. priority to attain quantum supremacy. Continued U.S. leadership in quantum technology is critical for both national security and future economic competitiveness. The recent achievements by other nations, including China's significant advances in quantum communications, adds urgency to the issue.[1]

As part of the FY 2020 request NIST will prioritize an additional $10 million towards its efforts in Quantum Information Science. Continued U.S. leadership in quantum technology is critical for both national security and future U.S. economic competitiveness. The recent achievements by other nations, like China's significant advances in quantum communications, adds urgency to the issue. The requested funds will also enable NIST to expand its existing joint institutes with the University of Maryland-College Park and the University of Colorado-Boulder, and potentially additional academic research-focused partnerships that could materialize an entirely new mechanism for NIST to engineer quantum science breakthroughs into functional quantum devices.

Health and Bioscience ($16.8 million)
NIST is paving the way for a vibrant U.S. biotechnology market by developing measurements that enable the reproducibility of biomedical research results to ensure the efficacy and safety of treatments and ultimately increase confidence in clinical decisions. NIST's programs range from supporting underlying technologies and measurements for precision medicine and medical imaging to accelerating understanding in synthetic biology and genomics. New and improved measurement capabilities provide the basis for industries to harness this information for future medical technologies.

Breakthrough technologies such as gene sequencing, gene editing, and advanced imaging have laid the foundation for significant growth opportunities in fields beyond medicine and health, such as chemical manufacturing, energy, and agriculture. NIST is focusing its bioscience efforts to build the measurement science capabilities that will support progress in these emerging areas.

NIST User Facilities ($47.0 million)
NIST operates two unique and valuable user facilities that provide U.S. scientists with access to cutting-edge expertise and capabilities to perform innovative research beyond the reach of the user's own laboratory. The NIST Center for Neutron Research (NCNR) features world-class neutron instrumentation and expertise in the development and application of neutron measurement technologies. The Center for Nanoscale Science and Technology (CNST) provides users rapid access to state-of-the-art tools needed to fabricate and characterize nanoscale structures, devices, and materials. These facilities annually provide over 5,000 scientists from

[1] Emerging Technology from arXiv, "First Object Teleported from Earth to Orbit," 10 July, 2017, https://www.technologyreview.com/s/608252/first-object-teleported-from-earth-to-orbit/

academia, industry, and government unique world-class capabilities that help move the state-of-the-art forward in advanced materials, quantum science, energy, medicine, and other critical technology areas.

Physical Infrastructure and Resilience ($46.5 million)
NIST's Physical Infrastructure and Resilience activities support the safety, interoperability, and resilience of the nation's infrastructure at the component, structure, and system levels. NIST's research supports the development of building codes that make the built environment healthier for occupants, more resilient against hazards, and safer for both residents and first responders. In collaboration with policy makers, building officials, and planning groups, NIST produces guides to help communities integrate resilience into their economic development, zoning, mitigation, and other local planning activities that impact buildings, public utilities, and infrastructure systems.

Industrial Technology Services (ITS) Account ($15.2 million)
NIST's extramural programs, help U.S. industry develop and implement new technology, develop robust supply chains, implement cybersecurity capabilities, and refine manufacturing their systems for efficiency and effectiveness, making U.S. corporations more competitive in the global economy.

The FY 2020 budget request for Manufacturing USA is $15.2 million, $0.2 million above the FY 2019 Enacted level. Manufacturing USA, the National Network for Manufacturing Innovation serves to create effective robust manufacturing research infrastructure for U.S. industry and academia to solve industry-relevant problems. The Manufacturing USA consists of linked Institutes for Manufacturing Innovation with common goals, but unique concentrations. In an Institute, industry, academia, and government partners leverage existing resources, collaborate, and co-invest to nurture manufacturing innovation and accelerate commercialization. The request continues to fund the National Institute for Innovation in Manufacturing Biopharmaceuticals (NIIMBL) manufacturing institute as well as the coordination of the Manufacturing USA network.

The FY 2020 President's Budget request continues the discontinuation of federal funding for the Hollings Manufacturing Extension Partnership (MEP) program, a reduction of $140 million from the FY 2019 Enacted level. MEP is a federal-state-industry partnership that provides U.S. manufacturers with access to technologies, resources, and industry experts. The MEP program consists of Manufacturing Extension Partnership Centers located across the country that work directly with their local manufacturing communities to strengthen the competitiveness of our Nation's domestic manufacturing base. In FY 2020, no federal funding will be provided for MEP Centers and the Centers will be required to rely on non-Federal funding.

CONSTRUCTION AND MAINTENANCE OF RESEARCH FACILITIES AND INFRASTRUCTURE (CRF) ($59.9 million)
The NIST Construction of Research Facilities (CRF) appropriation funds NIST construction activities, including the maintenance, repair, improvements, and major renovation of facilities occupied and used by NIST in Gaithersburg, Maryland; Boulder and Fort Collins, Colorado; and Kauai, Hawaii, to meet the current and future measurements, standards, research and technology

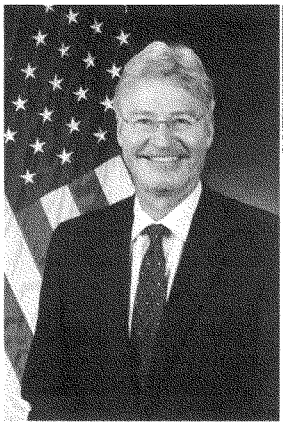
needs of the Nation. The funds requested in FY 2020 support Safety, Capacity, Maintenance, and Major Repairs (SCMMR) and Construction and Major Renovations. The request supports staff salaries and recurring preventive maintenance contracts and materials.

NIST's Building 1 project at the Boulder campus has been identified as a candidate project to be funded through the General Services Administration (GSA) Federal Capital Revolving Fund. The Fund would provide up-front funding, estimated to be $288.0 million, for renovations of critical laboratory space in Boulder. At the FY 2020 base funding level, NIST would repay this GSA revolving fund through annual discretionary appropriations in 15 annual payments of $19.2 million.

Summary

NIST maintains its longstanding commitment to advancing the frontiers of measurements science in order to accelerate innovation and to increase the competitiveness of U.S. industry. NIST's broad technical portfolio and scientific and engineering depth positions the agency to contribute effectively and rapidly to emerging national needs. The 2020 Budget focuses NIST's research and services on key national priorities, such as quantum science and artificial intelligence. With NIST's dedicated technical staff, one-of-a-kind facilities, and the Institute's trusted, objective, non-regulatory role, we are well positioned to continue delivering a positive impact on the U.S. economy, quality of life, and national security. With the continued support of this Committee, NIST will continue to thrive in its important mission to advance U.S. innovation and industrial competitiveness.

I am happy to answer any question you may have.



Walter G. Copan
Under Secretary of Commerce for Standards and Technology and NIST Director

Dr. Walter G. Copan was confirmed by Congress as Under Secretary of Commerce for Standards and Technology and NIST Director on October 5, 2017.

As NIST Director, Dr. Copan provides high-level oversight and direction for NIST. He has had a distinguished and diverse career as a science and technology executive in large and small corporations, U.S. government, nonprofit, and other public-sector settings.

Dr. Copan formerly served as president and CEO of the IP Engineering Group Corporation, providing services in intellectual property strategy, technology commercialization and innovation. Until June 2017, he was founding CEO and chairman of Impact Engineered Wood Corporation, an advanced materials technology company. He also is a founding board member of Rocky Mountain Innovation Partners, where he led technology transfer programs and innovation services on behalf of the U.S. Air Force Academy, U.S. federal labs and academic institutions and helped foster entrepreneurial businesses in the Rocky Mountain West. He also served with the National Advisory Council to the Federal Laboratory Consortium for more than five years, providing industry inputs to advance the U.S. economic impacts of the federal laboratory system.

From 2010 to 2013, Dr. Copan served as managing director of Technology Commercialization and Partnerships at the Department of Energy's Brookhaven National Laboratory (BNL). Among his accomplishments were leading the creation and implementation of the new DOE technology transfer mechanism, "Agreement for Commercializing Technology" (ACT), to facilitate collaborations between the federal labs and U.S. corporations. He led the "Startup America" initiative on behalf of DOE for entrepreneurial business creation, and he initiated the DOE's new Small Business Innovation Research—Technology Transfer (SBIR-TT) program, which built upon the experiences of NIST. He served as founding partner and board member of the "Accelerate Long Island" alliance for innovation, economic development and early stage investment.

From 2005 to 2010, Dr. Copan was executive vice president and chief technology officer at Clean Diesel Technologies, Inc., an international technology development and licensing firm. He spearheaded the company's transformation, growth and listing on NASDAQ (CDTI), as well as the company's subsequent merger. Prior to joining CDTI, Dr. Copan served at the DOE's National Renewable Energy Laboratory (NREL) as Principal Licensing Executive, Technology Transfer. There, he led organizational changes that strengthened relationships with industry and the investment community and led to the more productive commercialization of energy-related technologies.

After earning dual B.S./B.A. degrees in chemistry and music from Case Western Reserve University in 1975, Dr. Copan began his career in chemicals and materials research at the Lubrizol Corporation (now part of the Berkshire Hathaway Group). He earned a Ph.D. in physical chemistry from Case Western in 1982, and subsequently held leadership positions at Lubrizol in research and development, strategy, business unit management, venture capital, and mergers, acquisitions and strategic alliances in the U.S. and abroad. As managing director, Technology Transfer and Licensing, from 1999 to 2003, he was responsible for Lubrizol's corporate venturing and open innovation, technology strategy, business development, intellectual assets and the technology licensing business.

Dr. Copan is a patent holder, has authored numerous professional publications and presentations, and has served on the boards of many organizations, including the Licensing Executives Society (LES) USA and Canada, where he recently served as regional vice president for LES USA. He has contributed to the U.S. National Academy of Sciences, the Council on Competitiveness, the World Intellectual Property Organization and the United Nations on innovation, technology transfer, energy, and economic development matters.

Chairwoman STEVENS. Thank you, Dr. Copan.

At this point we will begin our first round of questions, and the Chair recognizes herself for 5 minutes.

Dr. Copan, our Committee recently held a hearing on the importance of the Manufacturing USA program started in the Obama Administration. In addition to housing one of the institutes, NIST has played a leading role among the Manufacturing USA institutes writ large. And based on the feedback that we received during the hearing and over time from various stakeholders, the Committee is looking at reauthorizing the program and updating it where necessary. What recommendations, if any, do you have for continuing to strengthening the Manufacturing USA program so that it can meet its statutory goals? And I'm also particularly interested in your views of the interagency work as it relates to R&D and technology transfer throughout the supply chain and workforce development. Thank you.

Dr. COPAN. Thank you so much, Chairwoman Stevens. Manufacturing USA has been an outstanding program for the country, and it represents really one of our leading public-private partnerships. It brings together industry, academia, and government to address the main challenges of the future. We have seen that the institutes have delivered great value. There is uncertainty currently in terms of future funding for the institutes and for maintaining their mission, but the program of engagement and also the open competition process that was utilized for funding and initiating the National Institute for Innovation and Manufacturing of Biopharmaceuticals, which is closely engaged with NIST and located in Delaware, has been an outstanding example of delivering value to the business community, as well as to ensure the retooling of the American workforce.

I encourage this Committee to continue its work in looking to the future of the reauthorization of the Manufacturing USA program, the *RAMI* (*Revitalize American Manufacturing and Innovation Act of 2013*) legislation as well, and we look forward to engaging with you to ensure that you have the information required so that the best decisions are made.

Chairwoman STEVENS. Dr. Copan, I'm also particularly interested in NIST's scientific and technical research services, in particular your lab programs, advanced communications networks and scientific data systems, which the current budget proposes a 41.2 percent decrease in funding, advanced manufacturing and material measurement, cybersecurity and privacy, exploratory measurement sciences, biosciences, fundamental measurement, quantum science and measurement and dissemination.

And in part with your labs I was recently at the Canadian Embassy, and they were reflecting on their partnership with several European countries in artificial intelligence. And I got a little elbow nudge saying, well, we're waiting for the United States to jump in and to show us the way.

And the current, you know, budget kind of doesn't do enough for what I'd like to see us doing in the advanced communications network, with AI and the IOT space, I think this is a real role for leadership. But I don't think our labs are getting enough attention in NIST. And what I'd love for you to reflect on here is how you're

working if at all throughout the Federal Government with other agencies informing interagency collaborations.

Dr. COPAN. Thank you so much for that question, Chairwoman Stevens. NIST indeed is a great collaborator across the entire Federal network. With artificial intelligence we're actually the co-leads of the National Science and Technology Council's expert committee on AI, and also have leading engagements around the industrial and other applications, such as the Internet of Things. The collaborations are very strong. We have an opportunity, I believe, for the Nation to step forward and to demonstrate leadership because the collaborations are there. I believe that NIST has generally taken a bit of a low-key approach, and some of the comments made by the Members this morning have reinforced that perception.

But I believe we do have the chance because we are rooted in the integrity of science and the ability of using measurements to assure the trustworthiness of artificial intelligence systems to advance U.S. leadership globally in artificial intelligence, AI, and advanced communications, and a series of other important fields that you've mentioned. Thank you.

Chairwoman STEVENS. And with my remaining time, I would just like to commend you for your recent report on the return on investment, which I think showcased some of this interagency work and the collaboration that we're seeing throughout our government as it pertains to scientific advancement and the work of NIST, and thank you for your leadership and your phenomenal team.

Now, I'd like to recognize Mr. Baird for 5 minutes.

Mr. BAIRD. Thank you, Madam Chair.

Dr. Copan, since 1901—and we made reference to this earlier in her questioning and comments—NIST has been at the forefront of setting standards for the United States and the world. I understand that over 400 NIST staff regularly participate in international standards activities, as technical experts and in leadership roles. So I guess my question has two parts. Would you mind elaborating on what the value is to have our own NIST experts participate in those kind of programs? And then how does this affect our broader U.S. effort to lead in emerging technologies like the quantum and the AI that you made reference to, please?

Dr. COPAN. Thank you so much, Ranking Member Baird. The role that NIST plays in setting standards is both a national and a global role. NIST coordinates with other agencies across the Federal Government to ensure that the Federal Government's standards needs are addressed with one voice in a coordinated way. NIST also works as a partner to U.S. industry to ensure that in national, as well as international negotiations, that the U.S. positions are well-coordinated and articulated to ensure that U.S. industries' needs are at the forefront of the standards-setting process.

Documentary standards are a negotiation process that affect both the key players across industry, as well as the key players across international boundaries. We are now seeing for the first time a highly organized international competition for standards setting. NIST's role in this process, is of course, to continue to provide the leadership that's established through our technical leadership within each of the science and technology committees where we have a role but also to provide the underpinning technical excellence

that's needed to guide the standards negotiators who may be leading committees on behalf of the United States' interest.

And so with this changing dynamic internationally, it's important for us to remember that of course this is a free-market society, and each company has freedom to negotiate for its own internal corporate strategic needs and goals. And so it winds up being a challenge for us sometimes to ensure that those industry players actually do speak together with one voice, that the outcomes that are most important for U.S. leadership in these emerging fields are ultimately achieved, and within the international standards process, we have seen other nations now taking a much more aggressive position for committee leadership to try to dominate committees that are in their nation's best interest. And so it's important for U.S. industry to remain highly engaged. And recommendations have come from the ROI Initiative that Chairman Stevens had referenced, talks about encouraging U.S. industry once again to fully engage in this process. Thank you.

Mr. BAIRD. One additional question, as we all know, the world is becoming more and more interconnected, as you made reference to, and the relative insecurity of many devices present enormous challenges. And that's why I've cosponsored H.R. 1668, the *Internet of Cybersecurity and Improvement Act of 2019*. So if you could, how does this budget proposal support NIST's examination of the IOT capabilities and the growing measurement and security challenges created by the convergence of digital technologies with the physical world?

Dr. COPAN. Thank you so much, Ranking Member Baird. Cybersecurity is obviously a top priority for NIST. It's a top priority for the Nation, and thank you so much for your leadership in that effort. The budget proposal for NIST for 2020 maintains our core capabilities for cybersecurity, as well as our commitments to advance the privacy framework and the privacy agenda for this Nation in an open, transparent, and collaborative process with stakeholders from the public and the private sectors.

The National Cybersecurity Center of Excellence is one of the leading centers globally for the Internet of Things and for its assessment for the evaluation of vulnerabilities and for the determination of interoperability and standards challenges and opportunities, together with the players across multiple U.S. industry sectors. Thank you.

Mr. BAIRD. Thank you very much, and I yield back my time.

Chairwoman STEVENS. Thank you. And before we move to our next round of questioning, I'd just like to welcome the students that I think made their way into the Committee hearing. Do you mind identifying yourself quickly and where you all are from?

VOICE. We're from Paul VI Catholic High School in Fairfax.

Chairwoman STEVENS. Wonderful. Well, welcome to the committee of the future. This is the Science, Space, and Technology Committee. It is the Subcommittee for Research and Technology. You are dipping into the future with us, and you are seizing hold of a vision of that future, so thank you, and welcome to the hearing.

I now recognize our Chairwoman, Ms. Johnson, for 5 minutes of questioning.

Chairwoman JOHNSON. Thank you very much. And I will add my welcome for the students as well.

Dr. Copan, what analyses did the Administration use in deciding what programs to prioritize or eliminate?

Dr. COPAN. Thank you very much for that question, Chairwoman Johnson. The analysis that was utilized to make these decisions I don't have the exact insight. I know that there have been very clear statements made by the Administration, and NIST certainly was at the table in defining the key industries of the future and the requirements to invest for ongoing U.S. competitiveness. And so it's been the NIST response to the budget proposal from the Administration to do the very best that we could in laying out our priorities to meet also our legislative mandates in stepping up to ensuring that the core initiatives for the Nation around artificial intelligence, around the future of the U.S. microelectronics industry, for the future of quantum science, which represents both a great opportunity as well as a threat to our secure communications and cryptography. And so the NIST response quite clearly had to reflect those national priorities in our budget response.

Chairwoman JOHNSON. What is the state of the facilities of NIST's campuses, and what is the impact of NIST's ability to carry out its mission with this proposed direction of the Administration?

Dr. COPAN. This Administration has very clearly made a strong point about the importance of U.S. infrastructure and investment in the infrastructure requirements of the future. And I believe that the U.S. science and technology infrastructure is an essential element of U.S. leadership. The ability to carry out state-of-the-art research in state-of-the-art facilities or at least facilities that are trustworthy in their performance is an essential element that we're looking forward to the future of NIST.

The budget request for NIST is a significant reduction from our previous levels, but we will certainly be as responsive as we can to make the most of the investments in the facilities, and I'm encouraged by the opportunity to finance the $288 million that's needed for our Building 1 reconstruction in Boulder, Colorado, with a creative financing approach through the GSA revolving fund that's been proposed.

Chairwoman JOHNSON. OK. What would be the impact of the proposed budget on U.S. leadership in international standards development, including for emerging technologies?

Dr. COPAN. Thank you very much for that question. NIST is committed to do the very best it can with the budget that we are ultimately allocated through this process, and we're so grateful for the work of this Committee to ask the questions about these issues. We have had certainly publicized challenges that have been created through failures of NIST's infrastructure, our water systems, our electrical systems, flooding in buildings, and so on. We have a very resilient team, and so they have worked in a very cost-effective way within the funding that's been made available.

The NIST maintenance budget itself, just according to government standards, would be on the order of $140–150 million per year just to maintain the systems, and that does not even refer to the rebuilding process that we've just described the needs for. And so I look forward to the work of this Committee.

As Chairwoman Stevens had encouraged the Committee Members, we invite you to come out to make a visit to Gaithersburg or to Boulder, see the leading-edge science that's done in our facilities and how we can make the most of the facilities in sometimes challenging conditions to still carry out leading-edge science for this Nation for our global leadership.

Chairwoman JOHNSON. Well, thank you. Now, has NIST done any recent workforce planning, and do you face some graying of your technical workforce? And how are you planning to deal with that?

Dr. COPAN. Thank you. And I'm glad that we have the next generation of NIST scientists in this room with us today. This is wonderful because we look to the next generation. NIST's workforce planning focuses around the industries, the trends of the future. Measurement science is at the core of our ability to lead. And, as I indicated in my opening remarks, to measure ultimately enables the United States to lead.

And so the workforce requirements that we've identified for both NIST and for the Nation focus on the requirements of our country for communications technologies, for cybersecurity, for advanced materials, and for the people involved in the field of artificial intelligence. NIST has issued a report on the future of cybersecurity education in this country, and that's tied with the curriculum and the expectations of the NIST cybersecurity education program.

And the other elements that we see that are so important are the future of our advanced telecommunications, as well as the chip designs of the future. We've issued a workforce on those electronic systems as well.

Chairwoman JOHNSON. Thank you. I yield back my time.

Chairwoman STEVENS. I now recognize Mr. Marshall for 5 minutes.

Mr. MARSHALL. Yes, thank you, Chairwoman. I think first I just want to compliment all my fellow minority Members for making it to these hearings, and it looks like that once again the dais kind of tilted over here toward our right, so I appreciate the participation.

My first question, Dr. Copan, would be to do with cybersecurity framework, which has been a success. In September 2018, NIST announced the launch of its privacy framework effort. It's intended to complement the cybersecurity framework to help organizations manage privacy risk. Maybe got two or three questions. You can bundle them together here. How is the development of the privacy framework progressing? What's NIST heard from government, industry, academia regarding the usefulness or necessity of guidance like the privacy framework? Is it something government and industry have asked for or suggestions that might be helpful in managing their privacy risk?

Dr. COPAN. Thank you so much, Congressman. This is a key area of NIST's focus currently. NIST launched its work in the development of the privacy framework actually at the encouragement of the private sector, who was being challenged with a patchwork of regulations that they were seeing to manage across the United States, as well as globally. And the success that we've had in the cybersecurity framework was seen as an excellent model. It's one

where the private sector, government, public-sector entities could collaborate and look to the aspirations of the future to have a framework that truly represents best practices and not a regulatory approach, a checkbox kind of mindset. Industry has appreciated so much the approach of having a framework that looks always to managing the risk environment, the threat environment.

And so after the launch of the privacy framework activities in which I've been personally involved and delighted to support, NIST has had several public engagement opportunities to bring feedback together. On February 27, we issued a framework outline and initial summary of feedback received from public—private sector stakeholders. We are planning our follow-up workshop in Atlanta, Georgia, May 13 and 14. We had originally planned that during February, but a certain thing called a government funding lapse kind of got in the way.

But we are pleased that we're back on track. We're looking to make a lot of progress this year, and we're anticipating a working draft of this framework for public feedback within the next several months.

Mr. MARSHALL. Great. Let's talk about microelectronics for a second. As a physician, I've always been curious about the microelectronics, and it's been actually like 20 years ago, that they introduced these little cameras that they could drop into someone's mouth and it would go through the stomach and the small intestines and of course through the colon as well. Anybody who's had the pleasure of an EGD (esophagogastroduodenoscopy) or a colonoscopy, this was great promise, but yet it's still not really taken hold. It's still not the gold standard. We're still doing of course colonoscopies and EGDs. So you've got $10 million for the microelectronics. Maybe just share a little bit more about it and its importance to United States' security and economic competitiveness and access to trusted and assured microelectronics.

Dr. COPAN. Thank you so much for that question in follow up, Congressman. Microelectronics have been a core of U.S. industrial leadership, and I'm pleased to indicate that NIST has been involved from the very beginning of the NIST electronic industry initiatives to enable industry to measure, to create the kind of standards that are necessary to have the advances in medicine, in communications, in computational technologies, and so on. Our budget proposal would really increase our ongoing efforts in the development of measurements.

New materials are absolutely critical to achieve the kind of device miniaturization and high degrees of performance and also to be able to have the kind of connectivity that's necessary and the ability to do remote medicine, for example, and to have patients in other parts of the Nation who can take advantage of 5G communications technologies that connect with microelectronics systems and enable intelligent personalized medical procedures to be carried out.

It's so important to have a rigorous standardization process as well, and NIST works closely with industry to ensure that in all aspects from the manufacturing process to the standards of commerce and how these systems will be used, and now we're working on standardization for all radiological devices and for magnetic res-

onance imaging because there's been so much repeated testing that's been done because of that lack of standardization. We look forward to that work continuing under this increased funding. Thank you.

Mr. MARSHALL. Thank you so much. I yield back.

Chairwoman STEVENS. Thank you. The Chair now recognizes Mr. Foster for 5 minutes.

Mr. FOSTER. Thank you, Madam Chair, and thank you for coming here to try to clear some things up for us. I'd like to talk briefly about the budget cuts to some centers. You're planning to end your $15 million Centers for Excellence program, which currently sponsors three centers dedicated to advanced materials, as you just mentioned the importance of, also community resilience and forensic science.

And so I'm very concerned about this, you know, particularly the Advanced Materials Center for Excellence, which is located near my district in Illinois. The center was awarded in December 2013 to the Center for Hierarchical Materials Design, which is a partnership, which I'm going to also return to, between the DOE national labs, Argonne and Northwestern University and the University of Chicago, and others. And not only does this center employ people living near my district, but the research has the potential to revolutionize materials science. The current research spans metals, polymers, biological materials with applications in areas such as electronics, energy, aerospace, health care, and so on. Do you view these as unimportant technologies? What is the motivation for shutting these down?

Dr. COPAN. Thank you so much, Congressman, for that question. Indeed, the centers that you're talking about, including CHiMaD (Center for Hierarchical Materials Design) in Illinois, has been an absolutely outstanding example of public-private partnerships. It's delivered tremendous value through what's called a Materials Genome Initiative that's enabled the effective creation of the application of artificial intelligence machine learning to the much more rapid design of materials. We are very pleased with the work of these programs. We do see that they will have ongoing benefit, including in the microelectronics area that I just described.

But under these budget proposals, difficult decisions need to be made. And in order to be able to carry out the priority needs of the industries of the future, these tough choices unfortunately have resulted in these proposed changes. And so we look forward to working with this Committee on the budget implications, anything that we can do to provide insights on the work that's planned and the ramifications, and we look forward to the ongoing efforts of the Committee on behalf of the budget process to be brought to completion.

Mr. FOSTER. Yes. Now, when you see the budget jerked around this way, a program ramped up and then abruptly cutoff, do you have a feeling from what sort of violence that does to the attitudes of the incoming workforce to know that they may be starting down a road that will be slammed shut without warning by a future Administration such as we're facing?

Dr. COPAN. Thank you so much for that question. It is indeed challenging. NIST has a wonderful global reputation, and we look

forward to continuing to be able to provide the kind of leadership opportunities for science and technology for the brightest and best of American talent in the future. It does create challenges certainly, and we work hard at NIST to keep people focused on their mission and regardless of budget ups and downs—and some of our people have been through these journeys during previous cycles, as you've intimated. And they look forward to the hard work of this Committee to make sure that the right choices are ultimately made and that the long-term strategic goals of this Nation are ultimately addressed regardless of Administration, regardless of political cycle, that we can ensure that American leadership is secured.

Mr. FOSTER. Yes, but sometimes obviously the wrong choices can be made at the top-line level in the budgets from which you cannot—no amount of brilliance, you know, down deeper in the budget can recover from.

Dr. COPAN. Thanks for that question. We count on the brilliance of Congress to work on budget issues. We recognize, as I believe our Ranking Member had indicated early on, that the budget proposal is the beginning of the journey, and we look forward to the fiscal accountability, as well as to the needs of the Nation ultimately to be exercised as a result of the process.

Mr. FOSTER. OK. I'm pretty sure I can read between the lines of what you're saying, and we're on your side in this. And I just wish you luck in all your negotiations upwards in the org chart. Thanks much, and I yield back.

Dr. COPAN. Thank you.

Chairwoman STEVENS. The Chair now recognizes Mr. Gonzalez for 5 minutes.

Mr. GONZALEZ. Thank you, Madam Chair. Thank you, Dr. Copan. Great to see a fellow Clevelander. Welcome. Great to see you, high school students. You're probably more brilliant than us, despite what Dr. Copan just said, so you'll see that as this unfolds.

So I think there's a lot to be excited about with the current state of the economy, right? GDP is around 3 percent, unemployment all-time low, wages finally starting to rise. We can go through a whole litany of data that would suggest that in the present moment the economy is doing better than it has in a very, very long time.

This Committee is largely about balancing present with future priorities, one of the reasons I love this Committee so much, and when I look at the state of the global economy and who our main competitors are and what we are going to be competing on, it's China and cutting-edge technologies. That is the race that we have to win. They know they have to win that. They're investing like crazy. They're focused. They're very diligent about it and cheating in a lot of ways, but, if nothing else, they're focused.

My concern when I look at the budget is I'm worried that maybe we're pulling back when I think we should be pressing forward on some of these cutting-edge technologies. So my first question would just be a basic one. With respect to the budget for NIST, were you consulted, was NIST consulted, and how much on this particular budget?

Dr. COPAN. Thank you very much, Congressman Gonzalez, and thank you for representing Ohio and northeastern Ohio in particular. The budget process is one that I don't have full trans-

parency to in terms of the way in which the initial work has been carried out. I know that as the proposal came to NIST, we have done our very best to be able to respond to work with the Department of Commerce. Secretary Ross certainly has been involved in those negotiations and been looking after the broader interests of the Department of Commerce. And of course we're in the midst of preparing for the decennial census, which is another challenge for budget realities.

Mr. GONZALEZ. Thank you. And then specifically on the manufacturing side, this proposal would eliminate the MEP program I believe. And, as you know, in northeast Ohio we take pride in our manufacturing base. We're excited about it, and we want to make sure that we're always at the cutting edge. So if this were to go through or if not, how would you make sure that we aren't losing our edge in the manufacturing sector?

Dr. COPAN. Thanks so much for that question. And indeed, as the United States is looking at this particular budget and fiscal responsibility and the U.S. deficit, we also are facing unprecedented global challenge. And you mentioned China in particular. I indicated earlier the highly organized way in which China is working to achieve strategic advantage for its companies and its national interests.

U.S. manufacturing is the heartbeat of this Nation, and as people make things, they learn things, and we've seen that in Manufacturing USA, we've seen that in our Manufacturing Extension Partnerships. The Manufacturing Extension Partnerships has been a long-term success for this Nation. Fritz Hollings just passed away, and it was a great gift that he gave to the U.S. in his legacy that he leaves with the MEP.

We would anticipate that under this budget scenario that the MEP centers, if they do indeed lose Federal funding, would have to work closely with NIST to try to transition to an entirely different funding model. They would need to find funding from the private sector to find new ways of increasing their funding base from their client companies. States, of course, and economic development organizations, the non-profit sector has an important role to play there, but we realize that if the budget would go through in this particular case, that there would be an important transition process to ensure that the long-term impacts of the MEP, such an important part of the U.S. manufacturing sector, could continue to deliver value for the Nation.

Mr. GONZALEZ. Great. And then with my final question, with respect to standards and codifying standards internationally, what is NIST doing to ensure that the 5G standards are developed in a collaborative manner? And how is it working with international, interagency partners to ensure that we don't get locked into a Chinese 5G standard?

Dr. COPAN. Yes, thanks so much for that question. 5G is absolutely essential. NIST is highly involved in that, and in the budget scenario, even though the overall budget bucket that includes advanced communications technologies has been reduced in the budget response, our work in continuing 5G to maintain U.S. leadership, to work with U.S. industry players, and to ensure that U.S. industry interests are represented in the global standards fora is

an absolute top priority for us, and we would look forward to continuing that close engagement for American leadership.

Mr. GONZALEZ. Great. Thank you, Dr. Copan, and I yield back.

Chairwoman STEVENS. Thank you so much. It's certainly a great day when we can dive a little bit deep. And for me it's fair to say I came here for the Manufacturing Extension Partnership centers. We're so admiring of what MEP has been able to do across the country, and we also recognize that words matter, that budgets matter. And while I don't expect MEP to be eradicated, I will repeat what I said in my opening remarks, which is $16 billion in sales, $1.7 billion in cost savings, $4 billion in new client investments, and more than 122,000 jobs created or retained at a total cost of $140 million. This is a best practice in our country. And so I will bellow here in this Committee and anywhere that folks will listen about how important the Manufacturing Extension Partnership centers are to regional economies like mine in southeastern Michigan and many of my colleagues.

I also appreciate the dialog that I have with my Ranking Member, Mr. Baird, who is what I consider a budget expert but also a believer and a fan and doer for the sciences and workforce development and advanced manufacturing growth. So rest assured we have a great partnership here and a commitment to progress.

And now I would like to recognize Ms. Herrera Beutler for 5 minutes.

Ms. HERRERA BEUTLER. Thank you. Just a couple quick clarifications. This is the first time on this Subcommittee. I'm new to the Committee, but I'm not new to Congress. I actually serve on the Appropriations Committee. And just for clarity's sake, there has been a recommendation from the Administration, and that recommendation from the Administration is bound under current law, meaning that the law that Congress passed is what they're writing their budget to.

The majority here in the House, which would be the Democratic party, has the authority to put forward a new budget with higher levels with which you can then draw your budget. Am I correct in that?

Dr. COPAN. I believe that how you've described it is accurate, yes.

Ms. HERRERA BEUTLER. Yes. So as someone who has yet—you know, I serve on Appropriations, and we are waiting for a budget direction from the majority party as to how to allocate our Subcommittee assignments, including the Department of Commerce and including NIST under that umbrella. We stand ready to make sure that we are appropriately allocating funding, manufacturing extended partnerships, and all the like. I mean, I think manufacturing is one of the things that's helping drive our economy. We want to see that continue.

And you know, I've heard a lot of comments about the budget, but I just wanted to remind folks that the majority here in the House has the authority to say thank you but no thank you to the recommendation from this Administration or any. You know, having served under the last Administration, they put forward recommendations based on current law that we took some of and we didn't take some of.

So before everybody gets all panicked about this, I would just remind the majority they have the authority to increase your budget, and I think many of this on this side of the aisle support making sure that you can continue to do this work because we're seeing the benefit of it in our districts, in our regions.

And what I really love is the commitment to the public-private partnership because I think that's one of the areas where we get the science out of the academia, we get it out of the theoretical and into practice. And there's so many in the private sector within the innovating sector I would say who are just raring to go. And you play such an important role, so thank you.

Dr. COPAN. Thank you.

Ms. HERRERA BEUTLER. I just wanted to get that clarification on record.

And in that vein, you know, my district in southwest Washington I often refer to as a silicone forest. We used to have a lot more development in our timber and timber manufacturing, which I'd like to see continue, but now we have a growing silicone forest essentially where we're manufacturing chips and wafers and technology. And I feel like, you know, you all responding and meeting some of those needs. I wanted to ask about the Return on Investment Initiative for Unleashing American Innovation. That's a long one—which is focused on coordinating and improving technology transfer programs across Federal agencies. So what role—this is—again, I'm learning here—does NIST play in promoting the transfer of technology from federally funded R&D to the private sector?

Dr. COPAN. Thank you so much for that question, for the comments that you've laid out in terms of clarifying the budget process and the expectations. And I'm delighted that the work that NIST has been doing across the country and also in Washington has delivered such benefit. It's also an important part of retooling industry with new technologies and keeping the United States' manufacturers at the leading edge.

NIST plays a very important role in the U.S. innovation system because we do have oversight for some of the important legislation and policy about Federal technology transfers. For example, the *Bayh-Dole Act of 1980* truly enabled our Nation's universities and many of our Federal labs to partner with industry to hold intellectual property and to ensure that it resulted in value for the economy through licensing, through new company startups. And so that legislation had an underpinning well before the digital economy.

There are many things that are changing about public-private partnerships. We need much faster, much more agile and flexible tools to enable industry, academia, and government entities to engage.

You are aware of my background in this field of innovation and tech transfer, and I'm highly passionate to see the value ROI created from our Nation's investment in basic science. And no matter how much we invest that we'll get more value from that by streamlining regulation, by removing known barriers or those uncertainties for the private-sector investment, and ultimately to enable so much more value to come for our economy and for our people from this investment.

We've seen China and other nations have dramatically higher trajectories later of their intellectual property filings, as well as their work in standardization. These are areas that we are very focused upon in the United States, and so we need the Federal labs actually to have more access to intellectual property protections not only in this country but around the world to enable U.S. industry to compete globally.

Chairwoman STEVENS. Thank you so much. How lucky we are to have an appropriator on our Committee who seems to intend to reject the cuts to MEP. The majority certainly is eager to make the intended investments to advance our scientific and research agenda.

And a district that, you know, is south of Olympia and Aberdeen and just north of Portland might not seem to have too much in common with metro Detroit, but they're both export destinations, and they're both regions that are contingent on a robust supply chain and technology sectors. And when I look to our audience, the reason why we have these debates and discussions and why sometimes things in the budget become upsetting like a cut to the Special Olympics or a cut to an educational research program is because this is why we're doing this is, we're doing this for the students. We're doing this for the next generation. We're doing this to leave this place better than we found it. So thank you.

I now yield to or recognize Mr. Balderson for 5 minutes.

Mr. BALDERSON. Thank you, Madam Chair. And Dr. Copan, thank you for being here this morning and welcome, students, also.

I had the chance to ask about the Manufacturing Extension Partnership, which has had some discussion here this morning. And we've also had discussions in previous Committee hearings. This program has helped businesses in my district, which is also located in central Ohio——

Dr. COPAN. Yes.

Mr. BALDERSON [continuing]. Innovate and adapt to changing marketplace, as well as improve their products overall. Can you speak to how NIST is leading the way in leveraging the public-private partnership as a way of sparking innovation and improving the American industrial competitiveness?

Dr. COPAN. Thank you so much, Congressman Balderson. Thank you for your service to the Nation and to Ohio. The public-private partnership model that we're talking about in this Committee, the Manufacturing Extension Partnerships is a great example of leveraging Federal investment with other funding sources to create much higher value for the economy to address issues of workforce. I described earlier some of the work that we do across NIST to look to the workforce needs and to help prepare the workforce requirements so that, as industries change and as manufacturing sectors evolve, that we have the right skills with the right people at the right time for this Nation.

We're looking forward to a very exciting time of artificial intelligence, and many of our MEP centers, as well as Manufacturing USA, are pioneers in the use of robotics technologies, additive manufacturing, digital manufacturing concepts that are so important to the supply chain of the Department of Defense.

It's interesting actually, as we look at Manufacturing USA, which is a sister public-private partnership that has an intertwined mission with Manufacturing Extension Partnerships, that was actually set up after—in a similar vein in Germany at the Fraunhofer Institutes under the Marshall Plan. And the United States has recreated its new version of the public-private partnership as Manufacturing USA in this Nation.

And to follow up on the point that was raised earlier about follow-on legislation and the importance of that program to U.S. manufacturers across the Nation and even the access to facilities such as America Makes in Youngstown and its partner facilities in other parts of the Nation, it's so important to revitalize our manufacturing communities across the Nation, provide them the opportunities to rebuild workforce, as well as to address new and entrepreneurial opportunities that are created by industry change.

Mr. BALDERSON. Well, thank you very much for that answer. And I look forward to working with you on another Committee that I serve on, Small Business. Representative Crow from Colorado is the Chairman, I'm the Ranking Member for the Innovation and Workforce Development. And this is something that's a passion of mine and making sure that those jobs are out there and we educate and train these young adults that are sitting behind you right now.

My last and final question, as we seek out a higher return on investment for basic research at the Federal level, can you share with us how you and your team ensure that NIST partnerships and research lead industry to develop market-ready products that will produce this return on taxpayers' investment?

Dr. COPAN. Thank you again, Congressman Balderson. The ROI initiative is in part looking at some of the structural and workforce—some of the strategic elements that are so important for the United States to continue to get value from its Federal investment in science and technology, at our national laboratories, at our universities, and in collaborations with industry. So we look forward to this process going forward.

The Green Paper on the Return on Investment Initiative is expected to be released within the next several weeks, and we look forward to continued robust engagement with the community of practice.

Many of the technologies that come out of the Federal labs and universities are relatively early-stage, and so as we look to translational research to get those ready for the commercial marketplace, that requires getting industry working side-by-side with our labs and with our universities. And so having the right kind of incentives, having the right kind of structures that make it feasible for entrepreneurs to spin out a company that's based on an emerging technology from our universities and our Federal labs is absolutely an essential part of this initiative.

There are many elements. I look forward to working with you. We work closely across the Federal sector and with the Small Business Administration as well. The SBIR (Small Business Innovation Research) program has been a proven strong value for the Nation's entrepreneurs and represents yet another example of public-private partnership where strong recommendations have come out of the ROI Initiative.

Mr. BALDERSON. Thank you.

Chairwoman STEVENS. Thank you. And now three Midwesterners remain: Ohio, Indiana, and Michigan. We got sworn in, the 116th Congress, in an interesting time in the middle of a government shutdown, a partial government shutdown, which we recognize affected and impacted NIST greatly, furloughed workforce, people working without pay, and I would like to take a minute in this hearing to recommit to your workforce, how much they mean to us, how much their talents mean to our economy, and our intentions to advance scientific research innovations and grow regional economies.

Sometimes being in Congress is like being on a boat. There are two sides of the aisle. It rocks back and forth through great debate and discourse, but yet we're still all on the same boat looking up, looking for that North Star, looking for progress, looking to create the most good.

And so before I bring this Committee hearing to a close, I would like to thank our sole witness, Dr. Copan, for testifying before us here today and shouldering all of the questions. You did a fabulous job.

The record will remain open for 2 weeks for additional statements from Members or for any other additional questions the Committee may ask of our witness. The witness is excused, and the hearing is now adjourned.

Dr. COPAN. Thank you so much. Thank you all.

[Whereupon, at 11:13 a.m., the Subcommittee was adjourned.]

Appendix I

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Hon. Dr. Walter G. Copan

HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY SUBCOMMITTEE ON RESEARCH AND TECHNOLOGY

"A Review of the National Institute of Standards and Technology FY 2020 Budget Request"

Questions for the Record to:

The Honorable Walter G. Copan
Undersecretary of Commerce for Standards and Technology
Director, National Institute of Standards and Technology
Submitted by Chairwoman Haley Stevens

1.) In the FY 2020 request, the Administration proposes to lay off 17 percent of NIST's scientists and engineers. NIST scientists have won five Nobel Prizes. They are truly the best and brightest. NIST competes for this top talent with private industry that offers a much bigger pay check or with academia for its education mission, but scientists are attracted to the agency because of their commitment to public service and NIST's efforts to build a positive work environment.

- Has NIST done any recent workforce planning? Do you face the same graying of the technical workforce that many other federal agencies do? What steps have you taken to ensure the agency can continue to attract the top talent it needs to be successful in its mission?

NIST Response:

NIST is committed to continue to attract and retain the top talent to advance our measurement and standards mission for the Nation. In alignment with the President's Management Agenda and to simplify and expedite the hiring process, NIST continues to leverage its post-doctoral programs, including its longstanding partnership with the National Research Council, to bring in research scientists and engineers of unusual promise and ability to perform advanced research in line with the Administration's priorities of quantum, artificial intelligence, and microelectronics. In addition, NIST leverages its recruitment and retention flexibilities to attract and retain top talent in the Administration's high priority areas. Over 39% of NIST's current workforce is in the 25-45 year age range, while almost 53% is in the 46-65 year age range. Recognizing this distribution, NIST has programs in place, such as the Building the Next Generation Program and the New Leaders Program, to attract, mentor, and grow the next generation of NIST leaders and managers. The NIST community of federal service has strong values of inclusivity, excellence, integrity and perseverance, which are reinforced from the first day of onboarding.

2.) Biotechnology already contributes roughly 2% to the total U.S. GDP, and the sector is projected to expand in the years to come. For the time being, we still have the edge

in biotechnology, but other countries have made it a national priority to lead in biotech, with China in particular putting the weight of their integrated government-supported system behind their bioeconomy.

- What is NIST's strategy to ensure that the U.S. leads in the standards setting and technology development to bolster our global leadership in the bioeconomy?

NIST Response:

NIST agrees that biotechnology plays a critical role in the economy. NIST has prioritized research and standards efforts in the areas underpinning the bioeconomy to address the measurement and standard needs of these rapidly evolving technology and market domains. In the areas of standards, NIST leads and administers the U.S. mirror committee to Technical Committee 276: Biotechnology, of the International Organization for Standardization (ISO/TC276) bringing together more than 100 organizations to best represent U.S. interests in international standards development for biotechnology. With the National Institute of Innovation in Manufacturing Biopharmaceuticals (NIIMBL), a NIST Manufacturing USA institute, as well as our joint institutes and cross-cutting research programs, NIST strengthens engagement with industry, academic, and federal partners to maintain U.S. leadership in measurements and standards. Additionally, NIST supports efforts to make biotechnology-related standardization more accessible to U.S. industry. As an example, NIST works closely with the Standards Coordinating Body for Gene, Cell, and Regenerative Medicines and Cell-Based Drug Discovery (SCB), which helps with regenerative medicine stakeholders and standards development efforts for advanced therapies, and serves as a vehicle for communication among all stakeholders, including government agencies.

3.) A 2018 GAO report found that NIST has not implemented its role under the Trade Agreements Act of 1979 to monitor the adequacy of U.S. representation in private international standards activities. In the U.S., we have a private-sector-led standards system unlike some other place in the world, such as Europe where government plays a much bigger role.

- Given the growing importance of international standards for U.S. produced goods and services, what are the risks of inadequate federal U.S. representation? What is the appropriate role for NIST in the international standards arena?

NIST Response:

Office of Management and Budget (OMB) Circular A-119 notes the importance of federal agencies' engagement in the development of standards. Federal agency participation in standards development, including international standards, ensures that federal agencies' and U.S. perspectives and interests are reflected in the resulting standards and such standards are also suitable for agencies addressing their mission objectives. NIST experts contribute significant technical expertise, informed by NIST measurement and research programs, to the

development of standards across a range of standards bodies and technologies globally. Examples include expert contributions in well-established fields such as chemical characterization, to advancing technologies such as 5G communications, and emerging technologies such as Artificial Intelligence. NIST experts also play valued leadership roles in many standards development activities, helping to ensure technical rigor, quality, and efficacy of these standards activities, and in close partnership between the U.S. private and public sectors. Consistent with responsibilities assigned in the National Technology Transfer and Advancement Act (Public Law 104-113) and Circular A-119, NIST facilitates information exchange among federal agencies about standards-related developments and trends and collaborates with federal agencies and private sector stakeholders to address standards aspects of national priorities, such as the standards-based Cybersecurity Framework.

4.) A 2018 GAO study recommended that NIST review the agency's measurement services to assess gaps and to ensure alignment with stakeholders' needs. What steps has the agency taken to ensure its services address the greatest needs?

NIST Response:

NIST is committed to ensure that our measurement services are aligned with our mission to promote U.S. innovation and industrial competitiveness. In its response to the GAO study, NIST noted that "NIST measurement services are comprehensively reviewed periodically via the NIST Measurement Services Council (NMSC), the documented NIST Quality Measurement System, regular scheduled National Research Council technical reviews, and external experts. Additionally, internal reviews at the Division level continuously evaluate the impact of NIST measurement service projects. NIST will continue to document these ongoing comprehensive assessment activities."

5.) NIST increased its investments in forensic science and standards after the seminal 2009 National Academies report brought attention to the woefully poor quality of science often relied on by juries to convict people in our nation's criminal courtrooms. There have been some very high-profile cases of defendants being exonerated, sometimes many years later when it was proven that the so-called forensic evidence used to convict them was highly flawed, and sometimes even knowingly misrepresented.

- Improving the reliability of forensic evidence used in our judicial system is a matter of both better science and more standards. NIST does both. Can you elaborate on NIST's role in forensic science and standards? What would be the impact of the significant cuts proposed in this Administration's budget, including the shuttering of the Forensics Center for Excellence at Iowa State University?

NIST Response:

The funding requested in FY2020 will require NIST to reduce its forensic science research. However, NIST will continue to conduct laboratory research on a number of areas relevant to forensic science research including DNA and biological evidence, fingerprint and pattern evidence, drugs and toxicology, digital evidence, and ballistics and trace evidence. The work that NIST conducts in these areas provides physical reference standards and data that help forensic laboratories validate their analytical methods and ensure accurate test results.

6.) NIST works closely with industry to assist U.S. manufacturers in competing in the global market to facilitate the development of standards, test methods, and reference for innovative technologies. The Administration is proposing to eliminate funding for all work on energy and environment applications including an extramural grant to Troy University in Alabama supporting the recycling and reuse of plastics. The OECD estimates that global production of plastics has increased from two million tons of plastic per year in 1950 to 400 million tons today. Since China's 2018 ban on many contaminated recyclable plastics from the U.S., it is more important than ever to ensure the development of standards for recycling technologies for a strong U.S. plastic recycling industry.

- The U.S. plastic recycling industry sees this as an opportunity to increase domestic recycling rates, of which estimates range from 10 to 30 percent. Can you elaborate on NIST's role in polymer recycling research? What will be the impact of NIST walking away from supporting research and science in this area?

NIST Response:

Through a grant to the Center for Recycled Plastics at Troy University (AL), NIST is supporting the development of standardized methods for chemical, thermal, and mechanical characterization of recycled plastics. These methods are being developed in partnership with chemical manufacturers and plastics recyclers to accelerate the recycling of a wider range of plastic materials and to promote the use of recycled content in higher-value applications, such as electronics and health care.

In collaboration with chemicals and materials manufacturers and academic researchers, NIST research activities help to develop, characterize, and validate technological innovations that support the circular economy, including next-generation easy-to-recycle plastics and advances in labeling and tagging for identifying materials during product life-cycle. NIST is developing critical laboratory-based measurements and associated standard reference materials that enable automated sorting and classification of plastic waste in waste streams and increase yield, efficiency, and value of post-consumer recycled feedstocks.

The funding requested in FY2020 will require NIST to reduce its research in this area, including the termination of grants supporting the recycling and reuse of plactics.