

Statement of Dr. John P. Holdren
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Executive Office of the President of the United States
to the
Committee on Science, Space, and Technology
United States House of Representatives
on
A Review of the President's FY 2015 Budget Request for Science Agencies
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Chairman Smith, Ranking Member Johnson, and Members of the Committee, it is my distinct privilege to be here with you today to discuss the civilian science and technology (S&T) components of the President's fiscal year (FY) 2015 Budget.

Science, Technology, and STEM Education for Opportunity and Growth

President Obama continues to place a high priority on research and on education, recognizing that these are foundational for the future of the Nation's economy; the health of the American people; the quality of our environment and the sustainability of the services it provides; and our national and homeland security.

Rooted in that recognition, the President's 2015 Budget will: sustain the Federal component of the world-leading U.S. research, development, and innovation enterprise; incentivize the private sector to lift its game in research, development, and innovation; advance public-private partnerships that are restoring U.S. leadership in manufacturing; boost research on growing public-health challenges including neurodegenerative diseases and antibiotic resistance; support further advances in cleaner, American energy; enhance the Nation's capacity to address global climate-change through a combination of emissions reductions, preparedness and resilience, and global leadership; continue to provide for the technological advances that have always given our armed forces the edge over every potential adversary; and strengthen science, technology, engineering, and math (STEM) education in ways that both inspire and prepare the workers and citizens of tomorrow for this century's challenges.

As past budgets from this Administration did, the President's 2015 Budget proposes to invest intelligently in research, innovation, education, and infrastructure to lay the foundations for the industries, jobs, workforce, and environmental and national-security benefits of tomorrow. But, of course, we need the continued support of the Congress to get it done. I say "continued support" because much of the President's Federal research and education investment portfolio enjoyed bipartisan support during the first term of the Administration. Congress has recognized that retaining America's global leadership position in science, technology, and innovation is not a partisan issue—and not an issue to gamble with. We hope to extend and to build on this mutual understanding and appreciation, in our interactions with both the Senate and the House, so we can continue to strengthen the Nation's science and technology portfolio and all the economic and other societal benefits it underpins.

In the remainder of this testimony, I will elaborate on how the science and technology components of the President's 2015 Budget support this agenda.

The Federal R&D Budget

The President's 2015 Budget provides \$135.4 billion for the Federal investment in research and development (R&D), an increase of \$1.7 billion or 1.2 percent over 2014 levels, sustaining the Administration's longstanding commitment to science, technology, and innovation. The 2015 Budget proposes an increase in defense R&D (Department of Defense (DOD) and Department of Energy (DOE) defense programs) to \$69.5 billion, \$1.2 billion or 1.7 percent more than the 2014 enacted level, and \$65.9 billion for non-defense R&D, an increase of 0.7 percent or \$477 million over the 2014 enacted level.

The 2015 Budget recognizes the essential role of the Federal Government in fostering groundbreaking scientific and technological breakthroughs through its support of basic and applied research, which is essential to improving our fundamental understanding of nature, revolutionizing key fields of science, and boosting long-term economic growth and quality of life through new technologies. The Federal investment in basic and applied research (the "R" in "R&D") totals \$64.7 billion in the 2015 Budget, up \$251 million or 0.4 percent compared to the 2014 enacted level. The Federal investment in development (the "D" in "R&D") totals \$68.0 billion in the 2015 Budget, an increase of 2.3 percent compared to the 2014 enacted level. Funding for R&D infrastructure, including facilities and capital equipment, totals \$2.6 billion, down \$121 million from the 2014 enacted funding level.¹

I would like to add that the Budget's science, technology, and innovation investments fit within an overall budget that continues to reduce projected deficits. The Budget adheres to the 2015 spending levels agreed to in the Bipartisan Budget Act of 2013, but also demonstrates the President's vision for an even stronger future for the country by including a fully-paid-for \$56 billion Opportunity, Growth, and Security Initiative showing where additional investments should be made in critical areas to create more jobs and opportunity and help the country reach its full potential. The Initiative is split evenly between defense and non-defense priorities and includes investments in the critical areas of education; research and innovation; infrastructure and jobs; opportunity and mobility; public health, safety, and security; and more efficient and effective government; and national defense. \$5.3 billion of the Initiative will support research and development (R&D) investments to help ensure our global edge in science and technology.

Budgets of Science Agencies

Three agencies have been identified as especially important to this Nation's continued scientific and economic leadership by the President's Plan for Science and Innovation, the America COMPETES Act of 2007, the Administration's Innovation Strategy, and the America COMPETES Reauthorization Act of 2010: the National Science Foundation (NSF), a primary source of funding for basic, curiosity-driven, academic research that leads to discoveries, inventions, and job creation; the Department of Energy's Office of Science, which leads fundamental research relevant to energy and also builds and operates much of the Nation's major research infrastructure—advanced light sources, accelerators, supercomputers, and facilities for

¹ All comparisons in the testimony are between the 2015 Budget and enacted 2014 appropriations. The testimony discusses changes in current dollars, not adjusted for inflation. The latest economic projections show inflation of 1.7 percent between FY 2014 and FY 2015 for the economy as a whole, using the GDP deflator. Unless noted otherwise, budget figures exclude the additional investment proposals in the Opportunity, Growth, and Security Initiative.

making nanomaterials—on which our scientists depend for research breakthroughs; and the National Institute of Standards and Technology (NIST) laboratories, which support a wide range of technically and economically essential pursuits, from accelerating standards development for health information technology to conducting measurement-science research to enable net-zero-energy buildings and advanced manufacturing processes. These three agencies were authorized through FY 2013 in the America COMPETES Reauthorization Act of 2010. I look forward to working with this Committee in coming months on reauthorizing the COMPETES legislation.

In recognition of the leverage these three agencies offer and their key role in maintaining America's preeminence in the global marketplace, Congress and this Administration have worked together to increase funding for these agencies significantly over the past 5 years. The Budget proposes \$13.0 billion in 2015 for these three agencies, an increase of \$0.2 billion over 2014 funding. These investments will expand the frontiers of human knowledge and establish the foundation for industries and jobs of the future, including in clean energy, advanced manufacturing, biotechnology, Big Data, and new materials.

I now turn to the budgets of individual agencies in a bit more detail. I will focus on the agencies under the jurisdiction of the Committee. Therefore, I will not provide details of the defense R&D portfolio (DOD and DOE's defense programs), U.S. Department of Agriculture (USDA) research programs, or the budget of the National Institutes of Health (NIH).

National Science Foundation (NSF)

The National Science Foundation (NSF) is the primary source of support for academic research for most non-biomedical disciplines, and it is the only Federal agency dedicated to the support of basic research and education across all fields of science and engineering. NSF has always operated under the belief that optimal use of Federal funds relies on two conditions: that its research is aimed – and continuously re-aimed – at the frontiers of understanding; and that funds are best awarded through competitive, merit-review processes leading to time-limited awards. When these two conditions are met, the Nation gets the most intellectual and economic leverage from its research investments. The 2015 Budget request for NSF is \$7.3 billion, a 1 percent increase above the 2014 funding level.

NSF puts the greatest share of its resources into the Nation's colleges and universities. Universities perform over half of all basic research in the United States. Basic research funding such as that provided by NSF is important not only because it leads to new knowledge and applications but also because it trains the researchers and the technical workforce of the future, ensuring the Nation will benefit from a new generation of makers and doers. In order to maximize this dual benefit to society and NSF's special contribution, the 2015 Budget provides \$333 million to NSF for its Graduate Research Fellowship program.

NSF will support job creation in advanced manufacturing and emerging technologies with \$213 million for multidisciplinary research targeted at new materials, smart systems, advanced manufacturing technologies, and robotics technologies. To encourage interdisciplinary research for America's emerging bio-economy, the Budget proposes \$29 million for innovative proposals at the interface of biology, mathematics, the physical sciences, and engineering (BioMaPS). NSF intends to invest approximately \$20 million for its contribution to The Brain Research Advancing Innovative Neurotechnologies (BRAIN) Initiative. NSF collaborates on this initiative with NIH, the Department of Defense's Defense Advanced Research Projects Agency (DARPA), and

private-sector partners. NSF also proposes \$125 million for a cyber-infrastructure initiative that will accelerate the pace of discovery in virtually every research discipline by advancing high-performance computing, creating new research networks and data repositories, and developing new systems to better visualize data (CIF21). The Budget proposes \$25 million for the public-private “Innovation Corps” program aimed at bringing together the technological, entrepreneurial, and business know-how necessary to bring discoveries ripe for application out of the university lab and into the commercial sphere. The Budget proposes an additional \$552 million for NSF in the Opportunity, Growth, and Security Initiative.

National Aeronautics and Space Administration (NASA)

The 2015 NASA Budget reaffirms the Administration’s commitment to that agency’s wide-ranging and important agenda, consistent with the bipartisan agreement reached between Congress and the Administration in the NASA Authorization Act of 2010 (the Act). NASA’s programs not only advance U.S. leadership in human and robotic space exploration, planetary science, astronomy, and cosmology, but through their contributions to commercial launch development, aeronautical research and Earth observation they directly support U.S. economic competitiveness and the Nation’s capacity to deal with the challenges of a changing environment. Consistent with the provisions of the Act, the 2015 Budget funds continued development of the Space Launch System (SLS) and Orion Multi-Purpose Crew Vehicle (MPCV) to enable human-exploration missions to new destinations; the operation and enhanced use of the International Space Station (ISS), which the Administration announced its commitment to extend through at least 2024; the development of private-sector systems to carry cargo and crew into low Earth orbit, thus re-establishing a cost-effective U.S. human spaceflight capability and shortening the duration of our sole reliance on Russian launch vehicles for access to the ISS; a balanced portfolio of space and Earth science, including a continued commitment to new satellites and programs for Earth observation; a dynamic space-technology development program; and a strong aeronautics research effort. I look forward to working with the Committee this year on reauthorizing NASA for the next several years.

Within the context of the Budget Control Act’s spending caps, NASA’s 2015 budget is \$17.5 billion, a slight decrease from the 2014 enacted level. The Budget provides \$848 million in NASA funding to be coupled with private-sector investments to develop new U.S. capabilities for transporting human crews to the International Space Station. It also provides \$2.8 billion for the next-generation, deep-space crew capsule and heavy-lift rocket that will send human-exploration missions to new destinations, and it invests \$706 million for the development of innovative new technologies that can expand the potential and lower the cost of our space science and exploration efforts as well as benefit other U.S. government and commercial space activities. The Budget provides \$5.0 billion for NASA Science to expand the frontiers of knowledge about the solar system, the universe, the Sun, and our planet. Within that total, the Budget provides \$1.8 billion for Earth Science to support climate research and sustain vital space-based Earth observations. The Budget also provides \$645 million for continued development of the James Webb Space Telescope, a much-more-capable successor to the Hubble Telescope. The Opportunity, Growth, and Security Initiative proposes \$886 million in additional NASA funding to invest in the development of game-changing technologies, enhance the ability of American companies to carry people to space, and bolster support for science missions and research that will enhance our understanding of the Earth and our solar system.

To enhance U.S. capabilities to defend our planet against near-earth objects (NEOs) such as asteroids, the subject of my testimony before the Committee last year, the Budget provides \$40 million to accelerate efforts to identify potentially hazardous objects and further investigate their attributes. This work supports an additional \$7 million to enable an exciting Grand Challenge bringing together Federal and private problem solvers. Earlier this month, NASA announced the first Asteroid Grand Challenge-related contest “Asteroid DATA Hunter.” The Challenge asks individuals to develop a significantly improved algorithm to identify asteroids in images from ground-based telescopes. This work will also support NASA’s first-ever mission to identify, capture, and redirect an asteroid. This Asteroid Redirect Mission, for which the Budget provides \$133 million represents an unprecedented technological feat -- raising the bar for human exploration and discovery, helping protect our planet, bringing us closer to a human mission to one of these mysterious objects, and building deep-space capabilities needed for future missions to Mars.

Department of Commerce National Institute of Standards and Technology (NIST)

The complex web of technology that keeps this Nation’s equipment and economy running smoothly depends on largely invisible but critical support in the fields of measurement science and standards. The National Institute of Standards and Technology (NIST) laboratories stand at the core of this Nation’s unparalleled capacity in these areas, promoting U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology. Reflecting NIST’s vital role in supporting the economy and infrastructure, the 2015 Budget of \$680 million for NIST’s intramural laboratories amounts to a 4 percent increase over the 2014 enacted level. That increase will support high-performance laboratory research and facilities for a diverse portfolio of investigations in areas germane to advanced manufacturing, cybersecurity, forensic science, advanced communications, and disaster resilience. For NIST’s extramural programs the Budget includes \$141 million, a \$13 million increase over the 2014 enacted level, for the Hollings Manufacturing Extension Partnership (MEP), which incorporates \$15 million to establish Manufacturing Technology Acceleration Centers (M-TACs) that will help smaller manufacturers adopt new technologies to improve their competitiveness. The Budget also supports \$15 million for the Advanced Manufacturing Technology Consortia (AMTech) program, a public-private partnership that supports innovative approaches to addressing common manufacturing challenges faced by American businesses, and \$5 million for Manufacturing Innovation Institutes Coordination. The Opportunity, Growth, and Security Initiative would provide NIST with \$115 million in additional resources.

Department of Commerce National Oceanic and Atmospheric Administration (NOAA)

NOAA plays a vital role supporting the monitoring, study, and stewardship of the Earth’s oceans, atmosphere, marine habitats, and living marine resources (including commercial/recreational species as well as protected species), which directly and indirectly are enormous sources of economic activity. The NOAA budget of \$5.5 billion in 2015, which includes \$688 million for R&D, strengthens support for critical weather satellite programs, Earth observations, living marine resource management, and NOAA’s other core science and stewardship responsibilities.

The Budget provides \$2.0 billion to continue the development of NOAA’s polar-orbiting and geostationary weather satellite systems, as well as satellite-borne measurements of sea level and potentially devastating solar storms. These satellites are critical to NOAA’s ability to provide

accurate forecasts and warnings that help protect lives and property. The Budget includes significant investments in NOAA's ocean and coastal research and observing programs, while increasing support for habitat and species science, conservation, and management activities that are essential to restoring and maintaining healthy, sustainable oceans. The Opportunity, Growth, and Security Initiative would provide NOAA with \$180 million in additional resources.

Department of Energy (DOE)

The Department of Energy (DOE) 2015 Budget positions the United States to be a world leader in clean energy and advanced manufacturing, enhances our energy security, cuts carbon pollution and responds to the threat of climate change, and modernizes our nuclear weapons stockpile and infrastructure with an R&D portfolio that totals \$12.3 billion, an increase of \$950 million or 8.4 percent over the 2014 enacted level. This excludes DOE's non-R&D cleanup, weapons, and energy demonstration and deployment programs. The 2015 Budget's priorities build on progress made over the last five years in putting the United States on the path to a cleaner and more secure energy future. Since the beginning of the Administration, responsible domestic oil and gas production has increased each year, while net oil imports have fallen to a 20-year low; renewable electricity generation from wind and solar sources has doubled; and by 2012, U.S. greenhouse gas emissions have fallen to their lowest level in nearly two decades. The Budget continues this approach, which has been working for the economy, our energy security, and the environment.

To support U.S. leadership in homegrown clean energy and to help cut carbon pollution, the 2015 Budget provides approximately \$5.2 billion for clean energy technology R&D and associated innovation activities at DOE. These activities range from basic clean energy research in the Office of Science to programs and infrastructure that support technology advancement for nuclear energy, for advanced sustainable vehicles and domestic renewable fuels, and for clean renewable power from solar, wind, water, and geothermal energy. They also support cleaner energy from fossil fuels, including \$25 million to support the demonstration of carbon capture and storage integrated with a natural gas power system and \$15 million for DOE to continue a research initiative to understand and minimize the potential environmental, health, and safety impacts of natural gas development from hydraulic fracturing, in collaboration with the Environmental Protection Agency (EPA) and the U.S. Geological Survey (USGS).

The Budget also establishes an Energy Security Trust that would invest \$2 billion over ten years on cost-effective transportation alternatives that use cleaner fuels to reduce our dependence on oil. The proposal, \$200 million in 2015 and \$2 billion over ten years, would be funded from existing Federal oil and gas development royalty revenues. This proposal is designed to invest in breakthrough R&D that will make future technologies cheaper and better through a reliable stream of funding for R&D focused on developing cost-effective transportation alternatives to current vehicle technologies. Funding would support research into technologies such as advanced vehicles that run on electricity, homegrown biofuels, renewable hydrogen, and domestically produced natural gas.

The 2015 Budget provides \$325 million for the Advanced Research Projects Agency – Energy (ARPA-E) within DOE to support transformational discoveries and accelerate solutions in the development of clean energy technology. ARPA-E performs short-term, high-risk, high-reward energy research focused on creating real-world solutions in areas ranging from grid technology and power electronics to batteries and energy storage. First funded in 2009, ARPA-E

was first authorized in the America COMPETES Act and was reauthorized in the America COMPETES Reauthorization Act of 2010.

The Department of Energy's Office of Science pursues fundamental discoveries and supports major scientific user facilities—including large-scale x-ray and neutron sources, particle colliders, supercomputers, fusion devices, and sophisticated facilities for nanoscience and genomic sequencing— that are key to maintaining U.S. leadership in many areas of research, especially those related to energy, the environment, and climate change. DOE's Office of Science (DOE SC), with a budget of \$5.1 billion in FY 2015, invests in basic research and research infrastructure to keep America competitive. The Office of Science supports researchers at all of the DOE laboratories and approximately 300 academic institutions. Approximately 28,000 researchers from universities, national laboratories, industry, and international partners are expected to use SC facilities in FY 2015.

Environmental Protection Agency (EPA)

EPA's R&D helps provide EPA with the best scientific information to underpin its regulatory actions and helps the agency find the most sustainable solutions for the wide range of environmental challenges facing the Nation today. The 2015 Budget supports high-priority research of national importance in such areas as potential endocrine-disrupting chemicals, human health risk assessment, air quality, sustainable approaches to environmental protection, and safe drinking water. The 2015 Budget proposes \$764 million for EPA's Science and Technology (S&T) appropriation, which supports most of EPA's R&D, an increase of \$5 million over the 2014 enacted level. EPA's budget includes \$14 million for EPA's research collaboration with USGS and DOE to reduce the potential health and environmental impacts of natural-gas development using hydraulic fracturing.

Department of the Interior and United States Geological Survey (USGS)

The 2015 Budget for the Department of the Interior provides \$925 million for R&D, an increase of 10 percent or \$85 million over the 2014 enacted level, to invest in science to support decision-making in the Department's resource-management and trust responsibilities and to support other Federal, state, local, and tribal entities in making sound, science-based decisions that affect environmental and human health and safety. This funding supports scientific monitoring, research, and analysis to assist decision-making in resource management and the special trust responsibilities of Interior and other federally mandated and nationally significant programs. Specific science activities highlighted in this budget will support sustainable energy development; ecosystem restoration and management with a focus on invasive species, contaminants, and priority ecosystems; Earth observations including water monitoring, Lidar elevation data, and Landsat satellites; information and tools to enhance climate preparedness and resilience; and tribal natural resource management. The total budget of Interior's United States Geological Survey (USGS) is \$1.1 billion, including \$686 million for USGS R&D (an increase of 5.5 percent). The 2015 Budget proposes \$19 million for USGS to continue its collaboration with EPA and DOE to conduct a research initiative to understand and minimize the potential environmental, health, and safety impacts of natural-gas development from hydraulic fracturing.

Department of Homeland Security (DHS)

The Department of Homeland Security (DHS) Directorate (S&T) is the primary core for DHS R&D. S&T's research programs target opportunities in cybersecurity, explosives detection, and chemical/biological detection and support ongoing enhancements of homeland security technology and development of state-of-the-art solutions for first responders. DHS R&D totals \$876 million in the 2015 Budget, down 15.1 percent from the 2014 enacted level because of reduced construction funding and a slight decrease in conduct of R&D. The Budget proposes \$300 million to leverage previously appropriated resources to construct the National Bio- and Agro-Defense Facility (NBAF), a state-of-the-art laboratory to study and develop countermeasures for animal, emerging, and zoonotic diseases that threaten human health and the Nation's agricultural industry.

Department of Transportation (DOT)

The 2015 Budget provides \$865 million for Department of Transportation (DOT) R&D, an increase of 1.4 percent compared to the 2014 funding level. The Budget includes funding for several R&D activities in support of the Federal Aviation Administration's Next Generation Air Transportation System, known as NextGen. The Budget continues R&D into vehicle-to-vehicle (V2V) crash avoidance technology, which has game-changing potential to significantly reduce the number of crashes, injuries and deaths on our nation's roadways. The Budget also supports the comprehensive, nationally coordinated highway research and technology program managed by DOT's Federal Highway Administration (FHWA), which performs a range of research activities associated with safety, infrastructure preservation and improvements, operations, and environmental mitigation and streamlining. Other DOT agencies conduct critical targeted research in support of transportation safety goals.

White House Office of Science and Technology Policy (OSTP)

The 2015 Budget requests \$5.55 million for operation of the White House Office of Science and Technology Policy (OSTP). This request is the same as the FY 2014 enacted level. OSTP's budget supports the Office's mission of coordinating science and technology efforts across the Executive Branch. OSTP works with the Office of Management and Budget (OMB) to set S&T priorities for all those executive branch departments and agencies with S&T and STEM-education missions and provides science and technology advice and analysis in support of the activities of the other offices in the Executive Office of the President. OSTP staff also supports me in my role as the Assistant to the President for Science and Technology in providing the President with such information about science and technology issues as he may request in connection with the policy matters before him. Through the National Science and Technology Council (NSTC), OSTP works closely with departments and agencies to coordinate a wide array of interagency science and technology initiatives to ensure that efforts are complementary, that data and facilities are appropriately shared, and that the maximum utility is gained from every research dollar. In addition, OSTP serves as the lead White House office in a range of international S&T activities. This work is accomplished with approximately 31 full-time equivalent staff supported by the OSTP appropriation, which includes the OSTP Director, up to four Associate Directors (for Science, Technology, Environment and Energy, and National Security and International Affairs), and a small administrative staff; approximately 55 scientific and technical experts detailed to OSTP from all across the executive branch; approximately a dozen other experts brought in under the Intergovernmental Personnel Act or various fellowship arrangements; and a handful of interns.

This mix of personnel provides OSTP with a wide range of expertise and leverages a multitude of resources to ensure that the science and technology work of the Federal government is appropriately supported, coordinated, and amplified.

Interagency Initiatives

A number of high-priority interagency S&T initiatives are highlighted in the President's 2015 Budget. The first three initiatives below are coordinated through the NSTC, which as noted above is administered by OSTP.

Networking and Information Technology R&D

The multi-agency Networking and Information Technology Research and Development (NITRD) provides strategic planning for and coordination of agency research efforts in cybersecurity, high-end computing systems, advanced networking, software development, high-confidence systems, health IT, wireless spectrum sharing, cloud computing, and other information technologies. The 2015 Budget proposal of \$3.8 billion for NITRD programs includes a focus on research to improve our ability to accelerate scientific discoveries and derive value from the fast-growing quantities and varieties of digital data ("Big Data") while appropriately protecting the privacy of personal data. The Budget continues to prioritize cybersecurity research framed by the *Trustworthy Cyberspace: Strategic Plan for the Federal Cybersecurity R&D Program* to develop novel approaches and technologies that can protect U.S. systems from cyber-attacks, promote R&D in high-end computing to address advanced applications, and emphasize research that advances the efficient use of wireless spectrum and spectrum sharing technologies. Further details of NITRD in the 2015 Budget are available in the NITRD budget supplement I am delivering to the Committee shortly.

National Nanotechnology Initiative

The 2015 Budget proposes \$1.5 billion for the multi-agency National Nanotechnology Initiative (NNI). The NNI member agencies support R&D focused on materials, devices, and systems that exploit the unique physical, chemical, and biological properties that emerge in materials at the nanoscale (approximately 1 to 100 nanometers). Participating agencies continue to support fundamental research for nanotechnology-based innovation, technology transfer, and nanomanufacturing through individual investigator awards; multidisciplinary centers of excellence; education and training; and infrastructure and standards development, including openly-accessible user facilities and networks. Furthermore, agencies have identified and are pursuing Nanotechnology Signature Initiatives in the national priority areas of sustainable nanomanufacturing, solar energy, sustainable design of nanoengineered materials, nanoinformatics and modeling, nanoscale technology for sensors, and nanoelectronics through close alignment of existing and planned research programs, public-private partnerships, and research roadmaps. Further details of NNI in the 2015 Budget are available in the NNI budget supplement I am delivering to the Committee shortly.

U.S. Global Change Research Program

The Budget continues the commitment to global-change research, with the understanding that insights derived today will pay off with interest in the years and decades ahead as the Nation works to limit and adapt to shifting environmental conditions. Investments in climate science over

the past several decades have contributed enormously to understanding of global climate. The trends in global climate are clear, as are their primary causes, and the investments in this research arena in the 2015 Budget are a critical part of the President's overall strategy to mitigate U.S. greenhouse-gas emissions and move toward a clean-energy economy even as the Nation adapts to those changes in climate that are inevitable. The 2015 Budget provides \$2.5 billion for the multi-agency U.S. Global Change Research Program (USGCRP).

The USGCRP was mandated by Congress in the Global Change Research Act of 1990 (P.L. 101-606) to improve understanding of uncertainties in climate science, expand global observing systems, develop science-based resources to support policymaking and resource management, and communicate findings broadly among scientific and stakeholder communities. Thirteen departments and agencies participate in the USGCRP. OSTP and the Office of Management and Budget (OMB) work closely with the USGCRP to establish research priorities and plans to maximize research-dollar efficiencies and ensure that the program is aligned with the Administration's priorities and reflects agency planning.

The 2015 Budget supports the goals set forth in USGCRP's 2012-2021 strategic plan, which include: advancing scientific knowledge of the integrated natural and human components of the Earth system; providing the scientific basis to inform and enable timely decisions on adaptation and mitigation; building sustained assessment capacity that improves the United States' ability to document changes on the regional, landscape, and local level in order to understand, anticipate, and respond to global change impacts and vulnerabilities; and advancing communications and education to broaden public understanding of global change. The 2015 Budget also supports an integrated suite of climate change observations; process-based research; and modeling, assessment, and adaptation-science activities that serve as a foundation for providing timely and responsive information—including technical reports, impact and vulnerability assessments, and adaptation response strategies to a broad array of stakeholders. All of these activities are essential elements of the USGCRP 2012-2021 strategic plan and support the President's Climate Action Plan.

Advanced Manufacturing R&D

To support investment and accelerate innovation in U.S. manufacturing, the President has called for the creation of a national network of manufacturing innovation institutes across the country. Leveraging the strengths of a particular region, each institute will bring together companies, universities and community colleges, and government to co-invest in the development of world-leading manufacturing technologies and capabilities that U.S.-based manufacturers can apply in production. Last year, OSTP and Federal agency partners released a Preliminary Design report for the National Network for Manufacturing Innovation (NNMI), which provides greater detail on the proposal. The Government-wide advanced manufacturing effort is supported by the NIST-hosted interagency Advanced Manufacturing National Program Office (AMNPO). In August 2012, the Administration launched a pilot institute in Youngstown, Ohio, and in January 2014 the President announced a second institute in North Carolina. Last month, the President announced two more institutes in Michigan and Illinois, the competition for a fifth institute, and a commitment to fund four more institutes. Overall, the 2015 Budget provides a Federal government-wide \$2.2 billion investment in advanced manufacturing R&D, an increase of 12 percent over the 2014 enacted level. The 2015 Budget builds on this foundation by providing additional funds through the Opportunity, Growth, and Security Initiative to support the Administration's vision of a National Network for Manufacturing Innovation.

Science, Technology, Engineering, and Mathematics (STEM) Education

I want to make particular note of the Administration's ongoing commitment within the Budget not just to science and technology but also to the educational expertise and infrastructure that will support the development of the next generation of doers and makers—everything from teachers, to training, to the growing number of technologies that can help teachers and students excel. Supporting this educational expertise and infrastructure is the Federal investment in STEM education.

President Obama strongly believes that the United States must equip many more students to excel in science, technology, engineering, and mathematics (STEM). That's why the President's 2015 Budget invests \$2.9 billion, an increase of 3.7 percent over the 2014 enacted level, in programs across the Federal Government on STEM education. Details of these investments are provided in the STEM education report I am delivering to the Committee shortly, as required by the America COMPETES Reauthorization Act of 2010.

Last year, I testified before the Committee on the STEM education proposals in the 2014 Budget. I'd like to update the Committee on what has happened since last year's hearing and on how the 2015 Budget proposal differs from last year's proposal.

First of all, in May of last year OSTP released, through the Committee on STEM Education (CoSTEM) of the National Science and Technology Council (NSTC), a Federal STEM Education 5-Year Strategic Plan to guide Federal efforts in STEM education. The strategic plan outlines a path to increased coordination and collaboration among the Federal agencies that invest in STEM education, with the aim of increasing the efficiency and impact of the Federal portfolio of STEM-education programs. I'm pleased to report that CoSTEM agencies have made significant progress in working together to implement the strategic plan over the past year.

The President's 2015 Budget maintains a strong commitment to STEM education and supports key principles from the 2014 Budget proposal and the goals of the Five-Year Strategic Plan, while making important changes that reflect input from the STEM education community and from the Committee. One change is that the Administration is not requesting a transfer of funding between agencies. As a result, some agencies have had a portion of their STEM education funds partially restored compared to the 2014 Budget proposal. This means, for example, that funding is provided to NASA, NIH, and NOAA to ensure that the STEM-education community can take advantage of these agencies' respective areas of expertise.

Agencies will focus on internal consolidations and eliminations, while funding their most effective programs. As a result, the 2015 Budget continues to reduce fragmentation, building on the substantial number of internal consolidations and eliminations that agencies began implementing in 2013 and 2014.

Going forward, agencies will coordinate their STEM education investments through implementation of the Federal STEM Education Five-Year Strategic Plan, looking for opportunities to build the evidence base, share what works, and leverage each other's expertise and resources. Federal agencies, working together through CoSTEM, have convened working groups focused on each of the five priority areas identified in the Five-Year Strategic Plan: K-12 instruction; undergraduate education; graduate education; broadening participation in STEM education and careers by women and minorities traditionally underrepresented in these fields; and

education activities that typically take place outside the classroom. They are working to develop joint pilot projects, joint administration of programs, and common data-collection strategies. Recent examples are NASA's partnership with Department of Education's 21st Century Learning Centers program and the Department of Education's and NSF's common guidelines for education research.

To support these and related activities, the Budget provides tangible support for the work agencies are doing to implement the Five-Year Strategic Plan, with a focus on building and using evidence-based practices and developing new interagency models for leveraging assets and expertise.

In sum, the 2015 Budget proposes a fresh reorganization of Federal STEM education programs to enable more strategic investment in STEM education and more critical evaluation of outcomes. This proposal reduces fragmentation of STEM education programs across Government, and focuses on efforts around the five key areas identified by the Federal STEM Education 5-Year Strategic Plan.

I would like to discuss the critical investments in the 2015 Budget that are designed to make progress on these five key areas.

For P-12 instruction, the President's 2015 Budget includes investments to improve STEM education in P-12 schools, with a priority on excellent teachers, rigorous courses, and regional partnerships that enable school districts to partner with local employers, museums, universities, and others. The Department of Education (ED) will lead this effort with \$320 million for new inter-related investments that include: \$110 million to help school districts, individually or in consortia, build strategic partnerships – STEM Innovation Networks – with businesses, universities, museums, Federal science agencies, skilled volunteers, and other educational entities to transform STEM teaching and learning; \$40 million in the 2015 Budget to support evidence-based STEM teacher preparation programs to recruit and train effective STEM teachers for high-need schools; \$20 million to launch a pilot of the National STEM Master Teacher Corps, a new effort enlisting some of America's best and brightest science and math teachers who will help improve instruction in their schools and districts, and serve as a national resource for best practices in math and science teaching; and \$150 million in continued support for the Math and Science Partnerships program. ED also proposes \$150 million for a new program to redesign high schools to focus on providing students with challenging, relevant learning experiences that include partnerships with colleges, employers, and other entities designed to enhance instruction and deliver opportunities students need to gain the knowledge and skills that will help them succeed in today's economy, including in key STEM fields.

At NSF, the Administration proposes over \$100 million to support Discovery Research K-12, which supports research on teaching and learning STEM. The Budget also dedicates a portion of ED's Investing in Innovation (i3) program to developing, validating, or scaling effective interventions or strategies with promise in STEM education. In addition, in coordination with the Department of Education, the National Institutes of Health (NIH) will invest \$15 million in the Science Education Partnership Award (SEPA) program, leveraging the expertise of the biomedical research community to support K-12 STEM teaching.

For undergraduate education, the focus of the Budget is on investments to support the President's goal to increase the number of well-prepared graduates with STEM degrees by one

million over the next 10 years. The Budget proposes \$118 million at NSF for a consolidated program to implement evidence-based instructional practices, expand the evidence base, and support research on how new technologies can facilitate adoption and use of new approaches to instruction. The Budget also proposes \$75 million for NSF's Research Experiences for Undergraduates (REU) program to provide early opportunities to conduct research, which can be especially influential in maintaining a student's interest in science, engineering, and mathematics.

In graduate STEM education, the focus of the 2015 Budget's investments is on preparing highly-skilled scientists and engineers who will support American innovation. Key investments in this goal include: \$333 million for NSF to support thousands of outstanding graduate-student researchers who will be tomorrow's leaders in the innovation economy in a range of careers; \$7 million at NSF for a new program to spark innovation in graduate education by providing awards to universities to explore new approaches to training graduate students; and continuing support for major graduate training programs, including NIH's Ruth L. Kirschstein National Research Service Award Institutional Research Training Grants, which provide funding to prepare individuals for careers in the biomedical, behavioral, and social sciences. In addition, the DOD will invest over \$80 million in the Science, Mathematics and Research for Transformation (SMART) Scholarship and the National Defense Science and Engineering Graduate (NDSEG) programs to meet key national-security workforce needs.

For STEM-education activities that typically take place outside the classroom—informal STEM education—the Budget proposes \$55 million for NSF's Advancing Informal Science Learning program, focusing on the research and model-building contributions of the program to better understand effective means and innovative models for engaging today's young people and adults in science outside of school settings. In addition, ED will identify further opportunities to leverage the 21st Century Community Learning Centers program to bring more students access to effective and engaging STEM activities outside of the traditional school day. The Budget provides \$10 million to the Smithsonian Institution to improve the reach of informal STEM education by ensuring that materials are aligned with what students are learning in the classroom. And the Budget supports NASA's efforts to internally restructure and better integrate its STEM-education program to reach more students and teachers, with \$26 million for the STEM Education and Accountability Projects program to fund the most effective agency education projects and a complementary \$15 million for NASA's Science Directorate to competitively fund the best application of NASA Science assets to STEM-education goals.

The Budget also sustains support for key programs that broaden participation in STEM education and careers, including by women and minorities traditionally underrepresented in these fields. NSF proposes \$32 million for the Historically Black Colleges and Universities Undergraduate Program (HBCU-UP); \$46 million for the Louis Stokes Alliances for Minority Participation (LSAMP); and \$13.5 million for the Tribal Colleges and Universities Program (TCUP). NSF also continues to support the ADVANCE program to increase the representation and advancement of women in academic science and engineering careers, and also supports research on the science of broadening participation. NASA's budget provides \$30 million, the same as the FY 2014 enacted funding level, for the Minority University Research and Education Program, or MUREP, which strives to ensure that underrepresented and underserved students participate in NASA education and research projects and to assist more of these students in their pursuit of STEM careers. In addition, the White House Initiatives (supporting tribal, Hispanic, African-American and Asian-American educational excellence) are working together, along with

the Department of Education, to promote advocacy and awareness of federally-supported opportunities for minority communities in STEM.

As always, OSTP looks forward to working with this Committee on our common vision for improving STEM education for all of America's students.

Conclusion

The Administration's 2015 Budget reflects the President's appreciation of the profound importance of continued progress in science and technology for advancing the well-being of all Americans, even as we work to ensure fiscal responsibility.

As this Committee has long emphasized, the best approach to supporting across-the-board innovation and long-term economic growth and opportunity is to invest in a broad and balanced research portfolio—one that will produce not just the planned-for and predictable benefits to the Nation but also the entirely unexpected windfalls for society and the world. This country's overall prosperity in the last half century is due in great measure to America's pursuit of this formula and its commitment to a three-way partnership including academia, industry, and government. The 2015 Budget for science, technology, and STEM education continues this approach.

The Obama Administration recognizes that leadership across the frontiers of scientific knowledge is not merely a cultural tradition of our Nation; it is an economic, environmental, and national-security imperative. This Administration is committed to ensuring that America remains at the epicenter of the global revolution in scientific research and technological innovation—a revolution that promises to generate new knowledge, create new jobs, build new industries, and propel the Nation to a vibrant future.

I look forward to working with this Committee to make the vision of the President's 2015 Budget proposal a reality. I will be pleased to answer any questions the Members may have.