A REVIEW OF THE PRESIDENT'S FISCAL YEAR 2015 BUDGET REQUEST FOR SCIENCE AGENCIES

HEARING

BEFORE THE

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
HOUSE OF REPRESENTATIVES

ONE HUNDRED THIRTEENTH CONGRESS

SECOND SESSION

MARCH 26, 2014

Serial No. 113–69

Printed for the use of the Committee on Science, Space, and Technology

Available via the World Wide Web: http://science.house.gov

U.S. GOVERNMENT PRINTING OFFICE
88–139PDF WASHINGTON : 2014

For sale by the Superintendent of Documents, U.S. Government Printing Office
Internet: bookstore.gpo.gov Phone: toll free (866) 512–1800; DC area (202) 512–1800
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March 26, 2014

A REVIEW OF THE PRESIDENT'S FISCAL YEAR 2015 BUDGET REQUEST FOR SCIENCE AGENCIES

WEDNESDAY, MARCH 26, 2014

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

The Committee met, pursuant to call, at 10:04 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Lamar Smith [Chairman of the Committee] presiding.

LAMAR S. SMITH, Texas
CHAIRMAN

EDDIE BERNICE JOHNSON, Texas
RANKING MEMBER

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House of Representatives
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A Review of the President's Fiscal Year 2015 Budget Request for Science Agencies

Wednesday, March 26, 2014
10:00 a.m. to 12:00 p.m.
2318 Rayburn House Office Building

Witness

The Honorable John Holdren, *Director, Office of Science and Technology Policy, Executive Office of the President*

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

HEARING CHARTER

A Review of the President's FY 2015 Budget Request for Science Agencies

Wednesday, March 26, 2014
10:00 a.m. – 12:00 p.m.
2318 Rayburn House Office Building

Purpose

On Wednesday, March 26, 2014, the House Committee on Science, Space, and Technology will hold a hearing to review President Obama's proposed fiscal year 2015 (FY15) budget request for programs and science agencies under the Committee's jurisdiction.

Dr. John P. Holdren, Assistant to the President for Science and Technology and Director of the Office of Science and Technology Policy (OSTP), will review the proposed budget in the context of the President's overall priorities in science, space, and technology and will describe how the Administration determined priorities for funding across scientific disciplines and agencies.

Witness

Dr. John P. Holdren is the Assistant to the President for Science and Technology and Director of the Office of Science and Technology Policy. He also serves as Co-Chair of the President's Council of Advisors on Science and Technology (PCAST). Prior to joining OSTP, Dr. Holdren was the Teresa and John Heinz Professor of Environmental Policy and Director of the Program on Science, Technology, and Public Policy at Harvard University's Kennedy School of Government, as well as Director of Woods Hole Research Center.

The following web links are highlights of the President's FY 2015 budget request:

http://www.whitehouse.gov/sites/default/files/microsites/ostp/Fy 2015 R&D.pdf

The following web links provides highlights U.S. Global Change Research Program, clean energy programs, and climate change initiatives in the President's FY 2015 budget request:

http://www.whitehouse.gov/sites/default/files/microsites/ostp/FY 2015 Climate.pdf

http://www.whitehouse.gov/sites/default/files/omb/budget/fy2015/assets/fact_sheets/building-a-clean-energy-economy-improving-energy-security-and-taking-action-on-climate-change.pdf

The following web link provides highlights of the Administration's STEM education programs in the President's FY 2015 budget request:

http://www.whitehouse.gov/sites/default/files/microsites/ostp/fy_2015_stem_ed.pdf

The following web link provides highlights of the Administration's proposals for investing in American Innovation in the President's FY 2015 budget request:

http://www.whitehouse.gov/sites/default/files/omb/budget/fy2015/assets/fact_sheets/investing-in-american-innovation.pdf

Chairman SMITH. The Committee on Science, Space, and Technology will come to order.

Welcome to today's hearing entitled "A Review of the President's Fiscal Year 2015 Budget Request for Science Agencies." I am going to recognize myself for an opening statement and then the Ranking Member for her opening statement.

The topic of today's hearing is the President's budget request for the coming year. This is the first of several hearings to examine over $40 billion in annual federal research and development spending within the Science Committee's jurisdiction.

Unfortunately, this Administration's science budget focuses, in my view, too much money, time, and effort on alarmist predictions of climate change. For example, the Administration tried to link hurricanes, tornadoes, floods, and droughts to climate change. Yet even the Administration's own scientists contradicted the President.

The Administration also has not been as open and honest with the American people as it should. When the Committee asked the EPA for the scientific data being used to justify some of the costliest regulations in history, their response was that they didn't have it even though they were using it. When we asked the National Science Foundation last year for their justification in funding numerous research grants, the NSF refused to provide a response.

All government employees and their agency heads need to remember they are accountable to the American taxpayer who pays their salary and funds their projects. It is not the government's money; it is the people's money.

Further, an estimated $300 million was spent in building the website Healthcare.gov prior to its public rollout last October. Secretary Sebelius rightly called this "a debacle." In its haste to launch the Healthcare.gov website, it appears the Obama Administration cut corners that left the site open to hackers and other online criminals. According to experts who testified before the Science Committee, millions of Americans are vulnerable to identity theft from this website.

For this reason, the Science Committee has twice asked the White House's Chief Technology Officer, Todd Park, to testify about his role in the development of the Healthcare.gov website. Rather than allow him to testify before Congress, the White House instead chose to make Mr. Park available for interviews with Time magazine. So much for accountability and transparency.

The Administration's willful disregard for public accountability distracts from the important issues of how America can stay ahead of China, Russia, and other countries in the highly competitive race for technological leadership.

Perhaps the greatest example of the White House's lack of leadership is with America's space program. The White House's approach has been to raid NASA's budget to fund the Administration's environmental agenda. In the last seven years, NASA's Earth Science Division has grown by over 63 percent. Meanwhile, the White House budget proposal would cut NASA by almost $200 million in Fiscal Year 2015 compared to what Congress provided the agency this year.

And the White House's proposed asteroid retrieval mission is a mission without a budget, without a destination, and without a launch date. Rather than diminish NASA's space exploration mission, President Obama should set forth a certain, near-term, realizable goal for NASA's space exploration.

Many experts believe that a Mars Flyby mission launched in 2021 is a potentially worthy near-term goal. A human Mars mission would electrify the American public, excite American scientists, and inspire American students.

Our leadership has slipped in areas such as space exploration where we currently rely on Russia to launch our astronauts into space; supercomputing where China currently has the lead; and even severe weather forecasting where European weather models routinely predict America's weather better than we can. We need to make up for lost ground.

These budget hearings are about something far more important than simply numbers on a ledger. They are about priorities. And the Administration should reevaluate its priorities if we want to continue to be a world leader in science, space, and technology.

That concludes my opening statement.

[The prepared statement of Mr. Smith follows:]

PREPARED STATEMENT OF CHAIRMAN LAMAR S. SMITH

The topic of today's hearing is the President's budget request for the coming year. This is the first of several hearings to examine over $40 billion in annual federal research and development (R&D) spending within the Science Committee's jurisdiction.

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These budget hearings are about something far more important than simply numbers on a ledger. They're about priorities. And the Administration should reevaluate its priorities if we want to continue to be a world leader in science, space, and technology.

Chairman SMITH. And the Ranking Member, the gentlewoman from Texas, Ms. Johnson, is recognized for hers.

Ms. JOHNSON. Thank you, Chairman Smith, for holding this hearing and welcome, Dr. Holdren. It is always good to have you before our Committee.

The Fiscal Year 2015 budget request makes it clear that the President remains committed to prioritizing investments in science and innovation. While limited by last year's two-year budget agreement, the President is proposing to identify new sources for research and development funding, including through much-needed tax reform. This new funding will also make a big difference for some of our top economic development and national security priorities. I welcome discussion on the Opportunity, Growth, and Security Initiative and I hope that my colleagues across the aisle will do the same before they outright dismiss it. For if we continue to flat-fund or cut our investments in science and innovation under the guise of fiscal constraint, our nation will suffer the consequences for many decades to come.

Under flat and often uncertain budgets, we are not just ceding leadership in some areas of science and engineering; we are losing the next generation of discoverers and innovators. Early career scientists and engineers, even those in the top of their class, have increasingly come to believe that the Nation is unwilling to invest in them and their talents. If nothing changes, we will continue to experience a brain drain that will have profound implications for our country's ability to innovate and compete in the global economy.

I will make just a few specific comments about the Fiscal Year 2015 budget proposal under discussion today. I am pleased with the Administration's continued commitment to advanced manufacturing R&D, and workforce development. I hope we can find a path forward for Congress to enact the bipartisan bill that would codify the national network for manufacturing innovation.

I also support the increased funding for climate change research and mitigation. Climate change is real and its consequences are real, even if some uncertainties remain. It might be easy for the most privileged among us to sit back and say we will be fine regardless of the severity of the impacts, but the vulnerable among us are already hurting and scientists and economists predict it will get much worse. I am saddened that we keep debating this at all.

I still hope we act before it is too late to direct our Nation's great brainpower to developing solutions to reduce the warming and mitigate the impacts in our most vulnerable communities.

It is also why—this is also why I am pleased to see the Administration's strong budget proposal for the Department of Energy's Office of Energy Efficiency and Renewable Energy, as well as ARPA–E, which will go a long way toward building and capturing the jobs of a growing sustainable energy sector.

At the same time, I have some questions and concerns about the budget proposal, including with respect to other parts of the DOE budget. I am also disappointed that once again we have a NASA budget request that would cut funding for the Nation's human exploration program even as the Space Launch System and Orion development projects are building hardware and getting ready for flight tests.

In addition, the Administration's budget request inexplicably would cut funds for science, one of the most exciting and productive of NASA's enterprises.

I also want to learn more about the new scaled-backed proposal to overhaul federal investments in STEM education. Now that we have the federal STEM education five-year strategic plan, I hope we can have a more productive discussion about how the budget proposal is aligned with the goals of the strategic plan and how experts in the stakeholder community are being engaged in major discussions.

The truth is we all have things to be concerned about in this budget, but the root of the problem is that there isn't enough money to go around to adequately fund all of our priorities. The President and the agencies had to make some very tough choices. Some of our own choices may be different and Congress will have this opportunity to express those choices in our authorization and appropriations bills.

But today, I look forward to hearing more from Dr. Holdren about the President's choices. As we move forward to reauthorize several of the agencies and programs within the Committee's jurisdiction, we need to give due consideration to the President's own proposals. Most importantly, I hope that any legislation that we bring to the Floor of the House reflect both the needs to invest in our future and our faith and integrity and potential of our nation's STEM talent.

Thank you, Dr. Holdren, for being here today and thank you for your continued contributions to ensuring continued U.S. leadership in science and innovation.

I yield back.

[The prepared statement of Ms. Johnson follows:]

PREPARED STATEMENT OF RANKING MEMBER EDDIE BERNICE JOHNSON

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At the same time, I have some questions and concerns about the budget proposal, including with respect to other parts of the DOE budget. I am also disappointed that once again we have a NASA budget request that would cut funding for the nation's human exploration program, even as the Space Launch System and Orion development projects are building hardware and getting ready for flight tests. In addition, the Administration's budget request inexplicably would cut funding for science, one of the most exciting and productive of NASA's enterprises.

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As we move forward to reauthorize several of the agencies and programs within this Committee's jurisdiction, we need to give due consideration to the President's own proposals. Most importantly, I hope that any legislation that we bring to the Floor of the House reflects both the need to invest in our future and our faith in the integrity and potential of our nation's STEM talent.

Thank you, Dr. Holdren for being here today, and thank you for your continued contributions to ensuring continued U.S. leadership in science and innovation.

Chairman SMITH. Thank you, Ms. Johnson.

Let me welcome Dr. Holdren back to the Committee and we appreciate his being here today. He is our only witness.

Dr. Holdren serves as the Director of the Office of Science and Technology Policy at the White House where he is both the Assistant to the President for Science and Technology and Co-Chair of the President's Council of Advisors on Science and Technology.

Prior to his current appointment by President Obama, Dr. Holdren was a professor in both the Kennedy School of Government and the Department of Earth Science at Harvard. Previously

he was a member of the faculty at the University of California Berkeley where he founded and led a graduate degree program in Energy and Resources. Dr. Holdren graduated from MIT and Stanford with degrees in aerospace engineering and theoretical plasma physics.

Dr. Holdren, welcome, and we look forward to your testimony.

TESTIMONY OF JOHN HOLDREN, DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY, EXECUTIVE OFFICE OF THE PRESIDENT

Dr. HOLDREN. Well, thank you very much, Chairman Smith, Ranking Member Johnson, Members of the Committee. I am pleased to be here to discuss the civilian science and technology components of the President's Fiscal Year 2015 budget.

I want to start by observing that science and technology as a whole do better in this budget than might be expected given the stringent caps that apply. Under those caps, we are not able to propose as much for R&D and for STEM education as the challenges and opportunities warrant, but the priority that the President places on these domains is evident in the fact that the 1.2 percent increase for R&D in his budget over Fiscal Year 2014 enacted is six times bigger in percentage terms than the 0.2 percent increase in discretionary spending overall set by Congress in the bipartisan budget act last December. And STEM education in the President's budget is up 3.7 percent over Fiscal Year 2014 enacted.

While the base budget in the President's submission for Fiscal Year 2015 comports with the caps in the bipartisan budget act, he has also put forward in his submission a vision for stronger investments in America's future in the form of a supplementary $56 billion Opportunity, Growth, and Security Initiative. While requiring additional Congressional action, it would be fully paid for by spending reforms and closing tax loopholes and would come close to restoring Fiscal Year 2015 discretionary spending to the level originally planned in the Budget Control Act of 2011. The $56 billion would be divided equally between the defense and nondefense categories and $5.3 billion of it would support research and development. This would take the $135.4 billion for R&D in the regular budget up to $140.7 billion, which would be a 5.2 percent increase over Fiscal Year 2014 enacted. And that supplement would include nearly $900 million for NASA.

In my written testimony I describe some of the other supplementary R&D investments proposed in the initiative. I just want to mention here a few other points in my written testimony that I think deserve particular emphasis.

First of all, within the spending caps, the budget provides for a 1.2 percent increase in the combined budgets of the National Science Foundation, the Department of Energy's Office of Science, and the National Institute of Standards and Technology labs to $13 billion. These three agencies were last authorized in the America COMPETES Reauthorization Act of 2010. I look forward to working with the Congress on reauthorizing the COMPETES legislation and its support for these three crucially important science agencies.

The President's budget for NASA within the spending caps is $17.5 billion. Consistent with the provisions of the NASA Author-

ization Act agreement between the Congress and the Administration, the budget funds continued development of the Space Launch System and the Orion multi-purpose crew vehicle to enable human exploration missions to new destinations. It funds the continued operation and enhanced use of the International Space Station, which the Administration recently announced its commitment to extend through at least 2024.

It funds the further development of private sector systems to carry cargo and crew into low-Earth orbit thus reestablishing a cost-effective U.S. capability for these missions and shortening the duration of our sole reliance on Russian launch vehicles for access to the Station.

It funds a balanced portfolio of space and Earth science, including a continued commitment to new satellites and programs for Earth observation. It funds a dynamic space technology development program and it funds a strong aeronautics research effort. I look forward to continuing to work with Congress and with this Committee on reauthorizing NASA.

The budget requests $5.6 million for OSTP, my office, the same as Fiscal Year 2014 enacted, to support OSTP's diverse missions in overseeing and coordinating science and technology efforts across the Executive Branch, including efforts that Congress asked us to undertake in the two COMPETES Acts, the NASA Authorization Act, and other legislation.

As a final point, I want to emphasize the Administration's ongoing commitment within the President's science and technology budget not just to R&D but also to STEM education to better prepare the next generation of discoverers, inventors, high-skilled workers, and science-savvy citizens. As I noted earlier, the budget's $2.9 billion for STEM education programs is a 3.7 percent increase over Fiscal Year 2014 enacted.

My written testimony and the STEM Education Report I delivered to Congress this week update the Committee on how the 2015 budget proposal for STEM education differs from last year's. To summarize, the 2015 budget makes important changes that reflect input from the STEM education community and from the Committee. This budget continues to reduce fragmentation of STEM education programs across government but it does not transfer functions and the associated funding between agencies and it focuses strongly on the five key areas identified by the federal STEM education five-year strategic plan released last May.

In closing, I look forward to continuing to work with the Committee to strengthen the Nation's science and technology portfolio and to achieve the economic and other societal benefits it underpins. I will be happy to try to answer any questions the Members may have.

[The prepared statement of Dr. Holdren follows:]

Statement of Dr. John P. Holdren
Director, Office of Science and Technology Policy
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
March 26, 2014

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.

Director John P. Holdren

Dr. John P. Holdren is Assistant to the President for Science and Technology, Director of the White House Office of Science and Technology Policy, and Co-Chair of the President's Council of Advisors on Science and Technology (PCAST). Prior to joining the Obama administration Dr. Holdren was Teresa and John Heinz Professor of Environmental Policy and Director of the Program on Science, Technology, and Public Policy at Harvard University's Kennedy School of Government, as well as professor in Harvard's Department of Earth and Planetary Sciences and Director of the independent, nonprofit Woods Hole Research Center. Previously he was on the faculty of the University of California, Berkeley, where he co-founded in 1973 and co-led until 1996 the interdisciplinary graduate-degree program in energy and resources. During the Clinton administration Dr. Holdren served as a member of PCAST through both terms and in that capacity chaired studies requested by President Clinton on preventing theft of nuclear materials, disposition of surplus weapon plutonium, the prospects of fusion energy, U.S. energy R&D strategy, and international cooperation on energy-technology innovation.

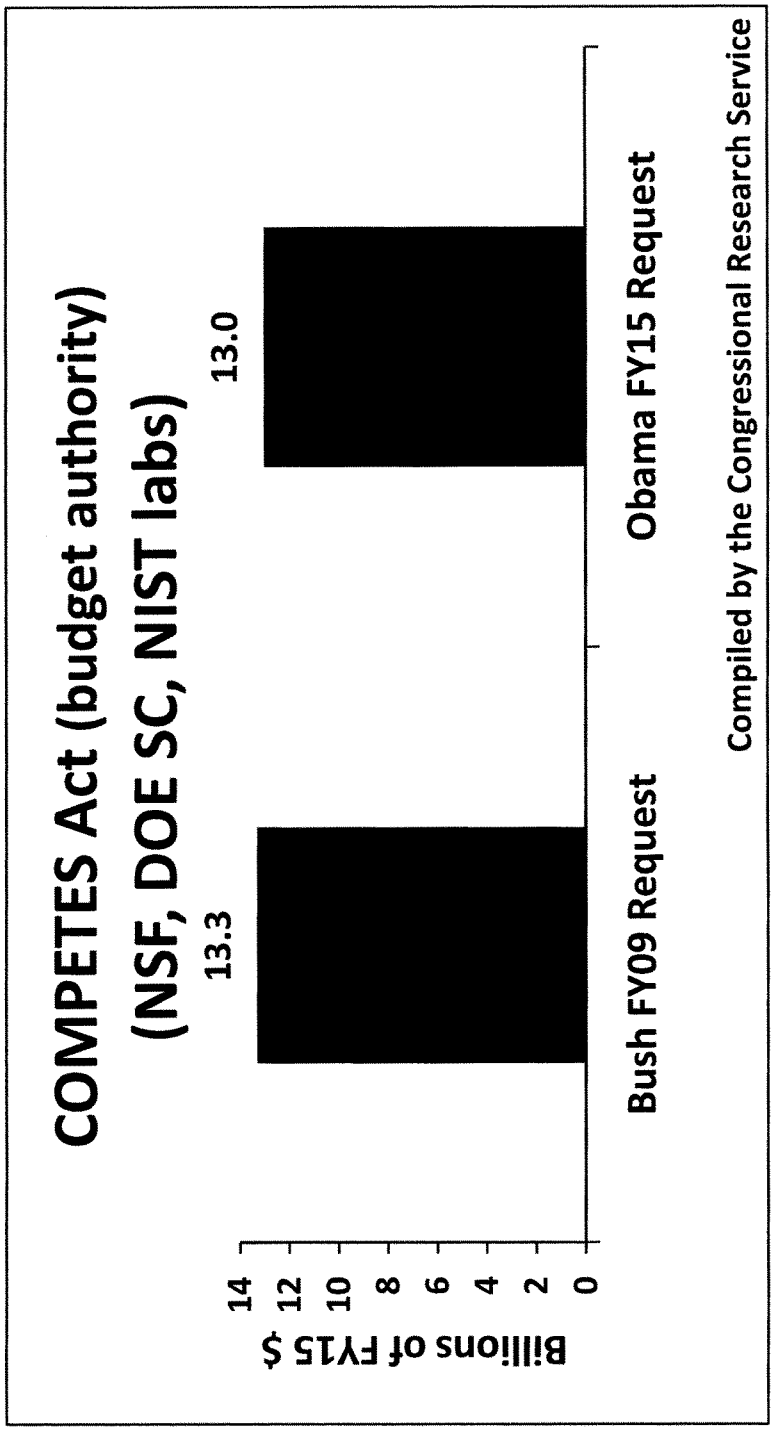
Dr. Holdren holds advanced degrees in aerospace engineering and theoretical plasma physics from MIT and Stanford. He is a member of the National Academy of Sciences, the National Academy of Engineering, and the American Academy of Arts and Sciences, as well as a foreign member of the Royal Society of London and former president of the American Association for the Advancement of Science. He served as a member of the MacArthur Foundation's Board of Trustees from 1991 to 2005, as Chair of the National Academy of Sciences Committee on International Security and Arms Control from 1994 to 2005, and as Co-Chair of the independent, bipartisan National Commission on Energy Policy from 2002 to 2009. His awards include a MacArthur Foundation Prize Fellowship, the John Heinz Prize in Public Policy, the Tyler Prize for Environmental Achievement, and the Volvo Environment Prize. In December 1995 he gave the acceptance lecture for the Nobel Peace Prize on behalf of the Pugwash Conferences on Science and World Affairs, an international organization of scientists and public figures in which he held leadership positions from 1982 to 1997.

Chairman SMITH. Okay. Thank you, Dr. Holdren.

I will recognize myself for five minutes for questions.

My first one goes to the budget, and in your testimony you cite three agencies: the National Science Foundation, the Department of Energy's Office of Science, and the NIST labs as having been identified as especially important to the nation's continued scientific and economic leadership, and I agree with you. But the last budget request by President Bush in 2008 was higher in real spending terms for those three agencies than President Obama's current budget.

[Chart:]


COMPETES Act (budget authority)
(NSF, DOE SC, NIST labs)
13.3
13.0
Billions of FY15 $
0
2
4
6
8
10
12
14
Bush FY09 Request
Obama FY15 Request
Compiled by the Congressional Research Service

Chairman SMITH. And on the screen to our left and right you will see a chart that shows that in equivalent 2015 dollars, President Bush's Fiscal Year 2009 COMPETES request was about $300 million more than that of President Obama. This will surprise a lot of people who may have read otherwise. My question is fairly simple. Why is the Administration's budget request, at least in my view, going in the wrong direction?

Dr. HOLDREN. Well, first of all, I will agree with Ranking Member Johnson in her opening statement that there simply is not enough money to fund all of the Administration's priorities. We are suffering through an era of very difficult choices. The essence of the matter I think is the President's proposal for the supplementary initiative—the Opportunity, Growth, and Security Initiative—which would boost the funding of NIH by almost $1 billion, boost the funding of NASA by nearly $900 million, boost the funding of NSF by half-a-billion dollars, and so on.

So what we are hoping is that the vision of the President for science and technology as embodied not just in the base budget but in the Opportunity, Growth, and Security Initiative will be welcomed by the Congress and will lead to funding levels that more adequately address the challenges and the opportunities.

Chairman SMITH. And, Dr. Holdren, as I mentioned in my opening statement, it really comes down to a matter of priorities, and in this instance, as I also emphasized, I think the Administration needs to perhaps reevaluate its priorities when we had the Bush Administration spending more on those nondefense research and development than the current Administration.

Let me go to a question about the National Science Foundation. When you testified last year, you agreed that there was room for improvement as to how the National Science Foundation prioritizes grants.

[Chart:]

Questionable NSF Grants

- Studying fishing practices around Lake Victoria in Africa, $15,000;
- Archiving lawsuits in Peru from 1600-1700, $50,000;
- Study of the ecological consequences of early human-set fires in New Zealand, $340,000;
- A 3-year study of the Bronze Age in Cyprus and elsewhere in the Mediterranean, $200,000;
- Causes of stress in Bolivia, $20,000; and
- A climate change musical, $700,000

Chairman SMITH. On the screen now are six NSF-funded studies out of many dozens that to me are questionable. You have studied fishing practices around Lake Victoria in Africa, $15,000; $340,000 to study the ecological consequences of early human-set fires in New Zealand; a three-year, $200,000 study of the Bronze Age on the island of Cyprus; surveying lawsuits in Peru from 1600 to 1700, $50,000; the Climate Change Musical that was prepared for Broadway but I am not sure ever was actually produced, $700,000; and causes of stress in Bolivia, $20,000. Well, what causes a lot of the stress is studying stress in Bolivia.

My question is this: Do you think the National Science Foundation should in fact provide the public—it is their taxpayers' dollars that are paying for these—with justification for why the research grants they choose are worthy of funding?

Dr. HOLDREN. Let me make a couple of comments to that question. First of all, I did say improvement was possible at the NSF with respect to transparency, effectiveness, and so on. I think improvement is possible in virtually every human institution, and I think the NSF has improved in the intervening time. They have issued new guidelines both to their grantees and to their employees about transparency and explanations of the importance and relevance of the research that they fund. These are posted on the NSF website. I am not in a position to address on the fly individual grants.

Chairman SMITH. I understand that.

Dr. HOLDREN. I suggested in the last time I testified here I am not sure any of us in this room are as good a judge of the relevance of research projects and social——

Chairman SMITH. Dr. Holdren, excuse me for interrupting you but I want to finish up one more question in a second. But I think my question really went to whether you feel that the National Science Foundation should justify these grants one way or the other? And I know they—as you say, they have been making some changes. So far, all we have heard is that words; we haven't actually seen these changes implemented yet and I know you are going to help us with that. But don't you feel that NSF should justify these grants to the American taxpayer?

Dr. HOLDREN. I believe they do justify the grants to the American taxpayers in what they post on their site about the evaluations, but I would also note that the Organic Act, the National Science Foundation Act of 1950, says that what the Foundation is supposed to do starts with promoting the progress of science and then it goes on to say "to advance the national health, prosperity, and welfare to secure the national defense——

Chairman SMITH. Right.

Dr. HOLDREN. —and other purposes." Funding basic research is in the NSF's mission. It is our most important funder of basic research. We should let it continue to do that.

Chairman SMITH. We are going to have to agree to disagree perhaps. I do not think that they have justified these grants, at least in what they have publicly posted. And as I mentioned to you earlier, I wrote a letter almost a year ago to the head of the National Science Foundation and I am still waiting for justification on a

number of grants, and I think you are going to try to help me get those justifications.

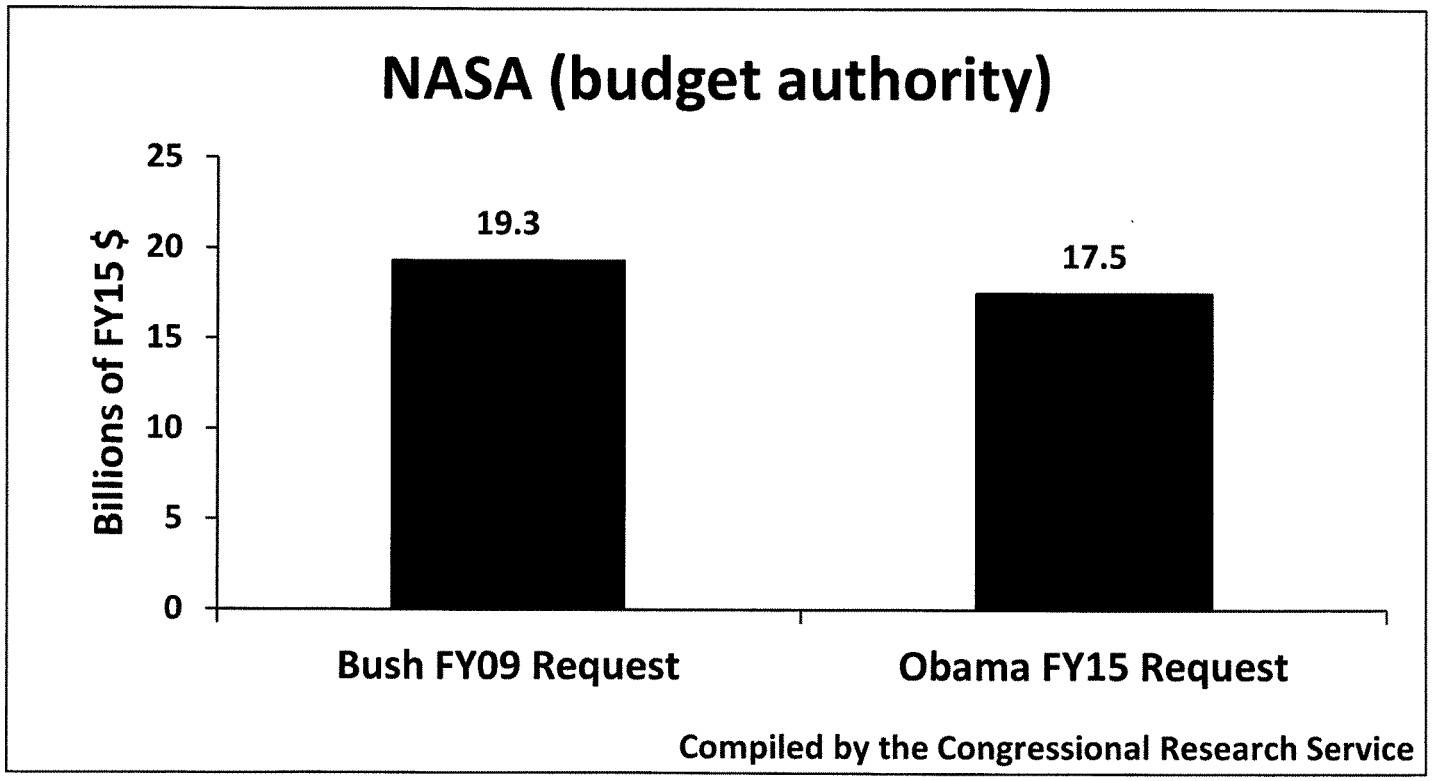
Dr. HOLDREN. I will try to help.

Chairman SMITH. Okay. Let me yield myself an additional minute, and I don't do that very often but I would like to squeeze in one more question and this goes to NASA.

In December 2012 the National Academy of Sciences released a report about NASA's strategic direction. That report stated that "the committee has seen little evidence that a current stated goal for NASA's human spaceflight program—namely, to visit an asteroid by 2025—has been widely accepted as a compelling destination by NASA's own workforce, by the nation as a whole, or by the international community."

NASA's own advisory group found the asteroid retrieval mission "to be very interesting and entertaining," but "it was not considered to be a serious proposal." Combine the asteroid retrieval mission with the Obama Administration's track record of canceling space exploration programs, first the Constellation program, then a joint robotic mission to Mars, and now SOFIA, an infrared telescope that flies aboard a Boeing 747, and then add in the Administration's proposed budget which cuts NASA by $186 million, and you have to wonder if the Administration is really committed to space exploration.

[Chart:]


NASA (budget authority)
Billions of FY15 $
25
20
15
10
5
0
19.3
17.5
Bush FY09 Request
Obama FY15 Request
Compiled by the Congressional Research Service

My question is this: As we can see from this chart, the Administration's budget request is down nine percent in real dollars compared to the last year of the Bush Administration. Is there a good explanation for this?

Dr. HOLDREN. First of all, Mr. Chairman, the last Bush Administration was not laboring under the budget caps that we are laboring under now.

Chairman SMITH. As I said a while ago, it is a matter of priorities.

Dr. HOLDREN. It is a matter of priorities. There is not enough to go around, and if we get the Opportunity, Growth, and Security Initiative, it will enable boosting NASA very substantially.

Chairman SMITH. But meanwhile, the Administration doesn't give as great a priority to NASA as it does to a lot of other programs. Obviously, that is the result.

Dr. HOLDREN. Let me address your comment about the asteroid mission. The quote you mentioned was two years old. The asteroid mission has been reformulated and better explained and now has a strong buy-in, not only from NASA staff——

Chairman SMITH. They still don't have a budget and they still don't have an asteroid and they still don't have a launch date. That doesn't sound to me like a very serious program.

Dr. HOLDREN. There is a budget. There is a target in time for achievement of the mission, and it uses—one of the great attractions of the asteroid mission is it uses capabilities we are already paying for. It will use the SLS, it will use the Orion, it will use an electric propulsion——

Chairman SMITH. And other missions would use those same—use the same equipment I think much sooner. And you had the Administration actually cutting SLS and Orion. Again——

Dr. HOLDREN. Not a bit.

Chairman SMITH. —I don't agree with their priorities.

Dr. HOLDREN. They are going to stay on schedule. We will have SLS. We will have Orion——

Chairman SMITH. Right.

Dr. HOLDREN. —and we will use them for the next space exploration.

Chairman SMITH. And again, it appears by the cuts that the Administration's priorities do not coincide with this Committee's priorities, but I thank you for your answers.

The gentlewoman from Texas, Ms. Johnson, is recognized for her questions.

Ms. JOHNSON. Thank you very much.

Dr. Holdren, a number of my colleagues continue to question the value of the federal investments in social, behavioral, and economic sciences. In the most recent effort among many, the FIRST Act, as introduced, proposed to cut NSF's modest investment in social sciences by 40 percent. And my colleagues seem unable to connect the dots between human sciences and our national interest. Can you please remind us once again both how small our social science budget is relative to our overall R&D budget, and more importantly, what we lose in terms of benefits to society when we arbitrarily cut and restrict support for competitively awarded social science research?

Dr. HOLDREN. Okay. Let me start with the Social, Behavioral, and Economic Sciences line within NSF. It, in the Fiscal Year 2015 request, is $272 million out of a total research sum of $5.8 billion, so it is a very, very modest proportion of the NSF budget.

The second thing I would say is there has been abundant documentation of the benefits to society of NSF's investments in this domain. Those fall in the categories of making our democracy work better, including work on the conduct of elections, management of common property resources without regulation, decision-making under uncertainty, understanding negotiation and compromise, and more. Tracking and improving economic and social well-being, economic and social databases and statistics, understanding poverty, understanding what works in teaching, improving public health and safety, risk communication, what causes people to get out of the way of hurricanes and tornadoes, what works, optimizing disaster response, controlling the spread of infectious diseases through social behavior, reducing human trafficking, understanding the patterns of crime enabling us to map crime, allocate law enforcement resources better, national defense and international relations, understanding the conduct of other nations, understanding the effectiveness of sanctions, nonverbal communication which helps our troops function in environments where other languages are spoken, interdisciplinary work involving social and economic sciences in cybersecurity, in geographic information systems, in neuroscience, psychology, language learning, decision processes.

I think we are getting a lot of bang for the buck out of social, behavioral, and economic sciences in NSF.

Ms. JOHNSON. Thank you very much.

In the FIRST Act, some of my colleagues are proposing to move the interagency STEM education coordinating committee, known as CoSTEM, from the National Science and Technology Council to NSF. CoSTEM was created at the NSTC in response to a requirement that we put in the 2010 COMPETES Act. I have a few concerns about this, including taking resources out of other important NSF programs and also the decreased stature of the Committee if we move it out of the White House. What are your thoughts on moving CoSTEM's responsibilities to NSF?

Dr. HOLDREN. Well, thank you for that question. I think the CoSTEM, the Committee on STEM education, should stay where it is in the National Science and Technology Council. The reason for that is the NSTC is the body that was set up to coordinate and oversee STEM-related activities that cross agency and department boundaries.

And of course, as further discussion will doubtless illuminate and as this Committee knows, the STEM education function is spread across many different departments and agencies in this government, harnessing the special capabilities of NASA, of NIH, the Department of Education, the NSF, the Smithsonian Institution. And it is obviously in the interest of coordination and efficiency that the oversight of that operation be in a place that includes all of the stakeholders, all of the participants as the NSTC CoSTEM does.

Ms. JOHNSON. Thank you very much. Well, I have 15 more seconds.

Many of us have concern about some of the numbers in the President's R&D budget request. For example, the request for NSF is below inflation, but the President is also proposing R&D funding as part of the Opportunity, Growth, and Security Initiative. How does this initiative fit into the President's commitment to continue our investments in science and innovation?

Dr. HOLDREN. Well, as I said in my testimony, we think the base budget doesn't have enough room for all of the priorities of the President and what we think should be the priorities of the Nation, and that is why that supplemental Opportunity, Growth, and Security Initiative was devised, to provide an opportunity for the President to say what he thinks we really need and to provide the Congress an opportunity to provide it.

Ms. JOHNSON. Thank you very much.

I yield back.

Chairman SMITH. Thank you, Ms. Johnson.

The gentleman from California, Mr. Rohrabacher, is recognized for his questions.

Mr. ROHRABACHER. Thank you very much.

And Dr. Holdren, thank you very much for being with us today.

We have heard the word prioritize a lot here, and in order to prioritize of course we have to make sure that judgments are being made and priorities are being made based on accurate information and especially when we are talking about major energy and environmental decisions that would have amazing costs to society, as well as jobs and reflect the standard of living of our people.

The Acting Assistant Administrator of EPA Janet McCabe was here just a short time ago and I had to ask her a question five times before I got an answer, and then she really didn't answer it at that point. So I would kind of like to ask you if I could get an answer to this question from the Administration.

We keep seeing this being presented to us as a fact saying that global warming is being caused by human activity and that 97 percent of all the scientists believe that global warming is caused by—that there is global warming and it is caused by human activity. When I am looking at where they get the information and as you look very closely at this, you find out that invitation was sent out to 10,000 Earth scientists. Less than 1/3 responded, and of those, the pool is narrowed down and this turns out to be 97 percent of 77 scientists who were selected. And we have even heard this figure repeated here in this chamber and in our debates.

Now, let me just ask you now. Do you believe that 97 percent of the scientists believe that global warming is a product of human behavior?

Dr. HOLDREN. I wouldn't put a lot of stock in any particular number to two significant figures. I believe that the vast majority of scientists who are actively working in the domain of climate science take it as the established consensus view——

Mr. ROHRABACHER. Right.

Dr. HOLDREN. —that global warming is real, it is happening, it is caused in substantial part by human activity——

Mr. ROHRABACHER. So you agree—-

Dr. HOLDREN. —and it is already doing harm.

Mr. ROHRABACHER. All right. But you agree that this is a bogus figure?

Dr. HOLDREN. No, I wouldn't say it is a bogus figure. I would just say that there are considerable uncertainties around an exact figure. But the fact is, for example, that the National Academies——

Mr. ROHRABACHER. Mr. Holdren, I am asking——

Dr. HOLDREN. If I may finish——

Mr. ROHRABACHER. —you a direct question. Why can't anybody admit that you have got a group of people reading out a bogus theory here?

Dr. HOLDREN. This was published in a peer-reviewed article. It was based on generally accepted social science practices for doing polling where you never get a complete response. I am not going to defend 97 percent as accurate to the two significant figures that provided——

Mr. ROHRABACHER. Okay. That is good.

Dr. HOLDREN. —but I would remind you——

Mr. ROHRABACHER. Okay. So that——

Dr. HOLDREN. —that every National Academy of Sciences in the world, including all of the National Academies of the G8+5——

Mr. ROHRABACHER. Yes.

Dr. HOLDREN. —or what is now the G7+5——

Mr. ROHRABACHER. Yes.

Dr. HOLDREN. —have agreed and issued a joint statement that climate change is real, largely caused by humans, dangerous, and we need to take action——

Mr. ROHRABACHER. And does the Russian Academy of Sciences agree with that?

Dr. HOLDREN. Yes.

Mr. ROHRABACHER. Then why did the head of the Russian Academy of Sciences tell me just the opposite?

Dr. HOLDREN. I have no idea——

Mr. ROHRABACHER. All right.

Dr. HOLDREN. —about a conversation——

Mr. ROHRABACHER. All right.

Dr. HOLDREN. —that you might have had with the president of the Academy. They signed the statement.

Mr. ROHRABACHER. All right.

Dr. HOLDREN. I can provide it to you for the record.

Mr. ROHRABACHER. Okay. Well, let me just note——

Dr. HOLDREN. I would be happy to do so.

Mr. ROHRABACHER. Well, let me note for the record that I had a meeting with a large number of the scientists in Russia and the head of the Academy of Sciences said just the opposite to me.

Let me ask this—about this. Do you believe that tornadoes and hurricanes today are more ferocious and more frequent than they were in the past?

Dr. HOLDREN. There is no evidence relating to tornadoes, none at all, and I don't know of any spokesman for the Administration who has said otherwise.

With respect to hurricanes, there is some evidence of an increase in the North Atlantic, although not in other parts of the world.

With respect to droughts and floods, which were mentioned in an earlier statement, there is quite strong evidence that in some regions they are being—some regions——

Mr. ROHRABACHER. Right.

Dr. HOLDREN. —they are being enhanced if you will——

Mr. ROHRABACHER. Right.

Dr. HOLDREN. —by climate change, not caused by climate change but influenced by climate change.

Mr. ROHRABACHER. All right. Well, I note all of the—I don't want to sound pejorative but there are weasel herds what I used to call it when I was a journalist that in some areas—globally, it is—there is not more droughts. Globally, there are not more hurricanes and they are not more ferocious, is that correct?

Dr. HOLDREN. If you want to take a global average, the fact is a warmer world is getting wetter. There is more evaporation so there is more precipitation, so on a global average, there are unlikely to be more droughts. The question is whether drought-prone regions are suffering increased intensity and duration of droughts, and the answer there is yes.

Mr. ROHRABACHER. So we actually have more water and more drought. Okay. Thank you very much.

Dr. HOLDREN. Absolutely.

Chairman SMITH. Thank you, Mr. Rohrabacher.

The gentlewoman from California, Ms. Lofgren, is recognized for her questions.

Ms. LOFGREN. Well, thank you very much.

And thank you very much, Dr. Holdren, for being here today and also for your tremendous service to our nation and your leadership in science generally. I am so pleased by the efforts that you have made.

And I want to discuss in particular just a couple of things where I hope that we can have some—a different outcome than in the proposed budget. First, the reduction—SOFIA is something that has produced terrific results, and I realize that the—it is kind of ironic to hear people who voted for the sequester question the amount of budget available for science, but we do have a tight budget.

But to me it is a problem to reduce when you have spent so much to get the results. And so I won't get into it. I will just say I do not believe that the Congress is going to accept the elimination of SOFIA. There will be a bipartisan effort to change that and I hope to be and plan to be part of that bipartisan effort.

I wanted to raise the issue of the budget for fusion. As you know, last year, the National Academies released a report which found that several inertial fusion concepts, including the approaches taken by the National Ignition Facility and the Z Pulsed Power Facility have enough technical promise to justify dedicated federal support for inertial fusion R&D relevant to energy, not just the weapons reliability. However, there is no program currently in the federal government which directly officially supports inertial fusion research and technology development activities as it relates to energy production.

Now, we have discussed this—I know Congressman Swalwell will probably have his own set of questions—with the Department of Energy and the new Secretary, but it—I would like to ask you to—

whether you and the Secretary of Energy have had an opportunity to discuss the National Academy report and whether a collaboration might be in order to actually bring that National Academy suggestion into reality?

Dr. HOLDREN. Well, let me start by saying, Congresswoman Lofgren, that the 2015 budget does provide $329 million for the continued operation of the National Ignition Facility and the Inertial Confinement Fusion program at Livermore, and I believe, and I think the Secretary of Energy would probably say the same, that the energy goal at NIF is served by the continuing effort to achieve ignition. The principal challenge with NIF is to get to ignition.

Ms. LOFGREN. Right.

Dr. HOLDREN. There have been important steps forward but we are not there yet, and until NIF can get to ignition, there won't be a basis for figuring out how to turn it into an energy source. And we got $329 million that is going to that facility in continued pursuit of that goal.

Ms. LOFGREN. If I may, Dr. Holdren, and I do appreciate that you have been out there and certainly have boosted morale considerably by your visit to Sandia and Livermore. We have lost hundreds of employees at Lawrence Livermore lab and the 80 scientists, and I was actually out at the lab a few weeks ago and the attrition rate is about 1–1/2 scientists a week.

And here is my concern, that unless we can give some assurance as to stability, I mean Livermore is not in my district but it is an hour's drive from Silicon Valley and we have competition for these scientists and they are looking—they are leaving. And so I want to make sure that we have the capacity to actually pursue. We have had some tremendous successes in the last few months. Obviously, we don't know, but recently one of the top scientists there said we don't have ignition yet but we have a lit match. And so we want to make sure that we get this done and I will just leave it at that.

I wanted to touch on the open access issue. You have just given us the update, which I appreciate so very much. As you know, we had a little disagreement here in the Committee, the Subcommittee recently, and I just wanted to thank you for your efforts and to make sure that you are aware we are going to do our best that that does not go off the rails. I think it is essential that when the taxpayers pay for research, that scientists get access to that research, and I wanted to commend your efforts in that regard.

And with that, I would yield back.

Chairman SMITH. Thank you, Ms. Lofgren.

The gentleman from Texas, Mr. Neugebauer, is recognized.

Mr. NEUGEBAUER. Thank you, Mr. Chairman.

Dr. Holdren, thank you for being here this morning. Two years ago in April of 2012, the President signed an Executive Order announcing the formation of an interagency working group led by the White House to coordinate and plan agency activities for hydraulic fracturing research. I think that was composed of the Department of Energy, EPA, the U.S. Geological Survey. It committed to developing this interagency plan. And I think at that time the Administration told Congress that they would see the research plan January of last year, and so that would have been January of 2013. That date came and went and January of 2014 has come and gone.

And it has been two years and we haven't seen anything from the report. Dr. Holdren, where is the plan?

Dr. HOLDREN. Congressman, I will have to get back to you on exactly where the plan is. We certainly have been looking at the issue of fracking and with an eye to making sure that the very important resource represented by the gas and oil that can be produced in this way continues to be available to the American people by virtue of ensuring that the practices continue to warrant the confidence of the public that this is being done in a way that is not imperiling groundwater, that is not aggravating air pollution, and so on.

As to the exact fate of this report, I would propose to get back to you for the record.

Mr. NEUGEBAUER. Well, I think I am troubled by a couple of things. One is that there was really not a lot of evidence to really justify, you know, moving down this road. You know, I am from Texas and we have been doing hydraulic fracturing in Texas for a very, very long time. And it appears that this Administration is on some kind of a witch-hunt trying to find some example somewhere, but unfortunately—or fortunately for the industry is that, you know, there has never been any evidence. But then we are going to go spend a bunch of money and promise, you know, that we are going to do this study, two years come and go, there is no study, yet the Administration still continues to take, in my opinion, a very negative, slanted view towards that technology.

And so I have a couple questions that—if—while you are going to do a little research on there, I would like to know when we are going to see the report and——

Dr. HOLDREN. I will be happy to let you know as soon as I find out when the report will be available, but I want to emphasize this is not a witch-hunt. It is not spending much money. But the point is there is widespread concern in the American public at least in some parts of the country that we have to make absolutely sure that this is done safely. I don't want and the President doesn't want to lose access to this natural gas and this oil because we have messed it up, and our intention is to maintain access to this economically—and in terms of security also very important—set of resources by making sure that the country does it right.

Mr. NEUGEBAUER. And while you are doing your research, it would be interesting to see, you know, how much money has been spent by the various agencies on this and how much time has been devoted to it. And I guess the other question is when the report is completed, you know, how will it be distributed?

Dr. HOLDREN. Well, of course all of these reports that we produce end up being posted on the website of the relevant agency. Many of them end up being posted on the White House website. I will be happy to make sure that you personally get a copy when the report is ready, and I will again, as I have said for the record, provide you with an answer on the pace of development of this report, how much money has been spent, and so on.

Mr. NEUGEBAUER. Thank you.

Mr. Chairman, I yield back.

Chairman SMITH. Thank you, Mr. Neugebauer.

The gentleman from Illinois, Mr. Lipinski, is recognized.

Mr. LIPINSKI. Thank you, Mr. Chairman.

First of all, Dr. Holdren, thank you for your leadership at OSTP and for the Administration's commitment to advanced manufacturing. It is big area of focus for me and something that I believe is a big need for the country and looking to what our future is going to be in terms of economic growth and job creation.

Institutes like the recently announced Digital Manufacturing Design Innovation Institute in Chicago which utilizes high-performance computing and digital tools to help industries make products better, faster, and more profitably are vital to reinvigorating our manufacturing base. And I think we should be doing more of those, as the Administration has been proposing.

I also would like to thank you for your strong support for social science at NSF in the President's budget request. I know that Ranking Member Ms. Johnson had raised this issue and I just wanted to say I am glad to see healthy increases in spending for SBE for next Fiscal Year in the request, as you had mentioned in—earlier in answering the question.

The first question that I wanted to raise addresses the future of exascale computing. I greatly appreciate the Administration's leadership on high-performance computing. In Illinois we are blessed to have two of the fastest supercomputers in the world with Mira at Argonne and Blue Waters at the University of Illinois. These two supercomputers make the DMDI Institute possible, make the—what is going to be done there and make Illinois a great place to put that institute.

Unfortunately, the rest of the world is catching up to us and we need to continue making strides towards exascale computing. Could you give your thoughts on the future of the federal high-performance computing projects and how the budget helps us push the boundaries towards exascale?

Dr. HOLDREN. Well, let me start by saying that the Obama Administration shares your view of the importance of high-performance computing, which includes but is not limited to getting to the exascale. It also includes capabilities relating to handling very large, very high-velocity flows of data for those high-performance computers to use. It involves advances in software so that the capabilities of these multiple processor machines can be effectively utilized.

We are currently engaged in a review of the whole high-performance computing program, which OSTP is leading, along with all of the relevant departments and agencies with an aim toward ensuring that United States' capabilities in this domain remain the best in the world.

And I would note that although it was pointed out earlier that the fastest computer in the world is currently a Chinese computer, its capabilities when one takes into account the data-handling capabilities and software performance capabilities, the United States is still in the lead in terms of real capacity of our high-performance computers.

Mr. LIPINSKI. Any idea of when that review is going to be—that you are conducting is going to be completed and——

Dr. HOLDREN. I think a matter of months, not weeks but—well, within a few months.

Mr. LIPINSKI. All right. My next question focuses on STEM education. I recently learned that a new study will be released tomorrow on a Chicago-based STEM teacher professional development program at the Museum of Science and Industry. I am told the study will confirm the museum's innovative approach increases teacher knowledge and achieves higher rates of student growth. One-third of Chicago Public K–8 schools are involved with this program. I think this is an excellent example of the value that museums and science centers bring to the table not just for student learning but for teacher professional development.

A lot of museums and science centers like MSI are looking at declining funding from federal programs, particularly with the proposed elimination of the competitive Education Grant program at NOAA and the lack of a line item for the program for science museums and planetariums at NASA. The Administration reorganized—reorganization proposal is somewhat changed from last year including 10 million for the Smithsonian rather than last year's 25 million. Can you give your thoughts on the value of the informal science education that museums and science centers provide and tell the Committee how this new proposal would fund STEM education broadly but also support these informal types of activities?

Dr. HOLDREN. Well, to make this relatively brief, the proposal, as it has emerged in the Fiscal Year 2015 budget, does take account of the value of informal education, and that happens not just through what the Smithsonian does but it happens through what agencies like NASA and NOAA and NIH do in partnership with museums around the country. There are a lot of these partnerships; there are a lot of joint efforts which also involve the Department of Education.

I happened to speak with NASA Administrator Bolden yesterday about NASA's STEM education programs and what they plan to do under the Fiscal Year 2015 budget, as well as what they are doing in Fiscal Year 2014, and he stressed, as I expect he will in his testimony tomorrow before the Space Subcommittee of this Committee, that NASA is working in close collaboration with a number of departments, the Department of Education and with a number of entities around the country, on this continuing use of NASA's extraordinary resources for inspiration and instruction to reach the wider community.

Mr. LIPINSKI. I ran out of time. I yield back. Thank you.

Chairman SMITH. Thank you, Mr. Lipinski.

The gentleman from Mississippi, Mr. Palazzo, is recognized.

Mr. PALAZZO. Thank you, Mr. Chairman.

Dr. Holdren, I heard SOFIA mentioned a little while ago, and could you kind of explain for this Committee why NASA invested about $1.1 billion and has been working on this project for over 23, 24 years; it just became operationally capable I believe 11 days before the President's proposed budget decided to eliminate this project and no longer invest in it leaving basically our German partners who have been a partner of NASA on this for over 20 something years; can you tell us a little bit about the project and why it was so important 20 years ago but it is no longer, I guess, relevant to our space program today?

Dr. HOLDREN. I wouldn't say, first of all, that it is not relevant, but its high operating costs are very difficult to accommodate within the current budget caps. Just to explain to the group what it is, SOFIA stands for Stratospheric Observatory for Infrared Astronomy. It has been a joint project of NASA and the German Aerospace Center. It is an airborne observatory based on a Boeing 747 SP wide-body aircraft. It has a 2.5 meter diameter telescope, which accesses the sky through a special door built into the airplane. That telescope has particularly attractive capabilities because the Boeing 747 is flying above most of the water vapor in the atmosphere which would interfere with the infrared capabilities of the telescope and it is an attractive project——

Mr. PALAZZO. So you——

Dr. HOLDREN. —but it was ranked behind other projects——

Mr. PALAZZO. Who ranked——

Dr. HOLDREN. —by the Decadal Survey——

Mr. PALAZZO. Okay.

Dr. HOLDREN. —conducted by the National Academy of Sciences——

Mr. PALAZZO. Right.

Dr. HOLDREN. —which we rely on very heavily in making these——

Mr. PALAZZO. Was an internal review done? I mean you——

Dr. HOLDREN. Oh, absolutely.

Mr. PALAZZO. Okay. And an external review? You are taking the Decadal report and saying it was a lower priority——

Dr. HOLDREN. We are taking the Decadal report——

Mr. PALAZZO. Did you do a senior review, which is of course the process of where you have the community come in and actually analyze it for, you know, its benefit to the program?

Dr. HOLDREN. I would have to defer to Administrator Bolden. You may want to ask him this tomorrow.

Mr. PALAZZO. Can we see a copy of this? I mean you said a report——

Dr. HOLDREN. I say I will defer to Administrator Bolden. I know the issue was reviewed within NASA; I don't know that there was an external review beyond the Decadal Survey, which, as I say, ranked it behind other projects that we are continuing.

Mr. PALAZZO. I understand that, Dr. Holdren, but, you know, we invested $1.1 million in this project, been working on it for over 23, 24 years. It comes—it came operationally capable 11 days before the President's budget was announced that it was no longer going to fund this project. So I mean we have to understand why we had invested American taxpayer dollars in something that apparently was extremely important to NASA and just as a—you know, a wave of a wand it is no longer important. The American taxpayer deserves this. Congress deserves an answer as well.

And just real quick, I mean we understand that the Chinese are cultivating, you know, relationships in Europe a lot. You know, they are very aggressively pursuing our European friends. And so when this Administration just unilaterally cancels a project with one of our strong European partners, what kind of message does this send to the international community?

Dr. HOLDREN. It is not a message I relish sending, but again, I would emphasize that there is not enough money to go around, and if the Congress will pass the President's proposed Opportunity, Growth, and Security Initiative, there will be nearly another $1 billion for NASA, and that SOFIA decision can be revisited.

Mr. PALAZZO. Well, I agree. There is—you know, we continue to fight over shrinking discretionary pots of money, and until this Administration and our colleagues get serious about addressing the number one drivers of our deficits and our debt, we are going to continue to have these issues where we are not going to be able to fund not only just NASA priorities, we are not going to be able to fund our Armed Forces. And, you know, at a time when the world has become a lot more dangerous, not safer, we are skirting our responsibilities. And I hope this President, I hope this—his Administration and future Congresses will address that serious issue in the future.

I yield back.

Chairman SMITH. Thank you, Mr. Palazzo.

The gentlewoman from Maryland, Ms. Edwards, is recognized.

Ms. EDWARDS. Thank you, Mr. Chairman.

And I would just like to say to my colleagues on the other side of the aisle I would be happy to work with them and I know the Members on the side would be if we are talking about increasing budgets that NASA would have, whether it is for SOFIA or other priorities so that those priorities meet the needs of the American people, but we haven't seen that kind of cooperation frankly.

Dr. Holdren, I wanted to give you a chance to respond to how some Members use the titles—and we have heard it today—of a few National Science Foundation grants to imply that the research that was funded by the grant wasn't necessary or it wasn't of national interest. We have heard that this morning and I think it is fairly easy to imply that research may not be in the national interest by only giving the title, but when you really look into these studies—and I would urge my colleagues to do that before just reading the title—you realize their importance.

For example, some Members have questioned grants studying stress in Bolivia. Well, if someone looked into the research and not just the title, what they would find is that this study was investigating a relatively isolated group of people who were remarkably resilient. Understanding a group like that and comparing it to the U.S. population, which is less resilient in some cases, could be helpful to understand the link between behavioral and social factors and diseases like cardiovascular disease that we are seeing in the U.S. population.

Other grants that have been mentioned are similar, and once you look into the research, you actually read, you understand its importance.

And so I wanted to give you a chance to respond to that and if you could leave me some time so that I can ask you about NASA.

Dr. HOLDREN. I get the impression some of my answers have been a little long. I apologize.

I would just point out that NSF, with the help and encouragement from this Committee, has taken steps to make more transparent and accountable their whole process. They have established

an internal transparency and accountability working group, they have sent out instructions to all of their staff on standards for transparency and accountability in describing grants, and I think that is already showing up in the detail being provided in the justifications for grants on the NSF website. And I emphasize that that information is available on the NSF website, and people who are interested can take a look and find out whether the justifications for these awards are in fact persuasive.

My own view is that NSF has done a great job with the peer review on these grants. Some of the funny-sounding titles, as you point out, when you look into them do make a lot of sense. And, you know, I just don't feel that I am well-qualified or that most people in this room are well-qualified to second-guess NSF's superb peer-review committees. And the one place where improvement has been made is in the transparency of those justifications available to the Congress and available to the public.

Ms. EDWARDS. Well, thank you very much. And I mean I will go to the NSF website and I would encourage my colleagues to do the same.

Dr. Holdren, I wonder when we talked about SOFIA—and you can get back to the Committee about this and I know that we will be exploring it even more—it would be helpful to know the process that the Administration and that the Agency uses in justifying a cut to a program or eliminating a program. I think that is always difficult to absorb because programs aren't just programs; they are jobs and they are science and they are investments that have been made. But every once in a while, you know, you do have to kind of, you know, cut. And we understand that.

But I would like to know with respect to SOFIA at some later point as we continue to examine the budget what the rationale was, what are the steps, the internal processes within the Administration to make a determination that SOFIA had to go. And if we were to restore SOFIA, wouldn't that mean adding another $83 to $85 million into the budget in order to restore that? And I just hope our colleagues understand that that is what the choice is.

Dr. HOLDREN. Thank you. I will provide more information on SOFIA.

I would note that NASA is looking at the possibility of other potential partners in the international community to defray those costs because, again, precisely the problem is there is just not enough money in the current budget to support the operating costs of that mission with just the partnership of the Germans. But if we can expand that partnership, that is one avenue, and another avenue of course is finding more money, which the Opportunity, Growth, and Security Initiative would do.

Ms. EDWARDS. Great. Thank you very much and I yield back.

Chairman SMITH. Thank you, Ms. Edwards.

The gentleman from Illinois, Mr. Hultgren, is recognized.

Mr. HULTGREN. Thank you, Mr. Chairman. Thank you, Dr. Holdren, for being here.

From our previous discussions, I hope you know that I do appreciate you and appreciate the critical role that the Office of Science and Technology Policy can have in ensuring a competitive future for our children.

That being said, it is hard for me to understand the misaligned science priorities this President has put forward in his budget yet again. Whether it is the federal government getting involved with things best handled at the state and local level or this Administration's focus on applied research and subsidies for favored industries that I see as crowding out the basic scientific research needed to bring about the next great technology, invention, or cure. This Administration does not seem to have its priorities in the proper place.

I am a staunch supporter of STEM education and have been greatly impressed by the student-led robotics team in my district. Some of them guided me to complete an Hour of Code, programming a computer game through computer coding.

The federal government has been funding STEM education for decades. Every year, a larger emphasis is placed on the subject and every year we hear how America is falling behind other countries in math and science.

Dr. Holdren, do you get the sense of that the real problems with America's science education cannot simply be solved with more federal spending? Do you think there are larger societal issues to address that would place more value in spurring our kids to study math and science?

Dr. HOLDREN. The short answer is, Congressman, that it is a larger societal issue. And one of the things we discovered going to other countries and the President has discovered talking to other heads of state in places where kids do better than our kids on the standardized tests is they are feeling more pressure from parents to do well in education. We need to get parents more involved in the importance of the education their kids are getting——

Mr. HULTGREN. I agree.

Dr. HOLDREN. —and it is not just a matter of federal spending.

Mr. HULTGREN. I have seen it really with our robotics teams, the amazing commitment of the parents and mentors being engaged in this as well.

There is a raging debate in my home State and across the country about the adoption of the Common Core State Standards and whether or not they are wise and sufficient to bring up the level of competitiveness of our country—that our country is pursuing. I would like to know what the role OSTP has had in consultation with stakeholder communities, federal agencies, and the States in developing curriculum for Common Core?

Dr. HOLDREN. OSTP, to my knowledge, has not had a role in that Common Core process so I would need to look into whether there has been such a role in earlier times.

Mr. HULTGREN. If you could check, that would be great. You know, these standards are purported to be state-led efforts for Common Core. This is a—was through the action of the States and not coercion by federal government that they adopted these standards. But when I talk to my educators and local officials back in my district, they are only seeing this as a top-down initiative. Now, it is getting to the point where our schools are feeling as if they are being coerced into adopting these standards or their funding will get cut off. That kills the ability to collaborate and focus our education system on our kids.

I want to switch subjects a bit. I would like to talk about federal R&D funding, one of my favorite subjects, especially in basic research where government does play a key role. The President has tried to turn science into a political wedge issue, which it is not and should never be. So I would like to clear up what his budget actually does to science and his precedents. Your budget provides $135.4 billion for federal investment in R&D. Do you know what the previous Administration proposed, Dr. Holdren?

Dr. HOLDREN. Well, it would depend on which year they proposed it.

Mr. HULTGREN. Well, what I saw is $147 billion, which was 20 percent more funding than we use in constant Fiscal Year 2015 dollars. This certainly does not seem to match with the President's rhetoric, but what I find most alarming are the cuts in basic scientific research. Your proposal has $32.1 billion going to basic research, is that correct?

Dr. HOLDREN. I think that is right.

Mr. HULTGREN. When we are talking about budgeting, we are really talking about priorities and that is really what all this is about. There are limited resources. Families in our district are having to tighten their belts. We have to have priorities here as well.

Under President Bush, the request was $32.2 billion in constant dollars but the basic R&D share was much higher. Under the current proposal, basic research will be at .8 percent of the federal budget. The previous Administration had it at 1.1 percent, significantly higher. I know that you may try to justify these overall cuts by singling out the defense R&D cut; non-R&D was still a high priority during the Bush Administration. We need to get our priorities right or we will not continue to have the best research universities and in fact facilities available to our kids moving forward.

In our constrained budgetary environment, we need to be sending clear signals to our kids as well as the increasingly international scientific community that science is important to us. The President's budget, I believe, fails to set this message—send this message, and I want to see that changed.

So my time is expired. I yield back, Chairman.

Chairman SMITH. Thank you, Mr. Hultgren.

The gentleman from Massachusetts, Mr. Kennedy, is recognized for his questions.

Mr. KENNEDY. Thank you, Mr. Chairman. Mr. Holdren—Dr. Holdren, it is good to see you again. Thank you for being here. Thank you for spending the time.

I want to start, Doctor, by going back to an issue that I know you know is important to me and one that we have discussed at length on a number of occasions and I appreciate your followup and your advocacy on these.

As you know, STEM education has been an issue that has been very important to me and important to Massachusetts and my district. The area of particular interest to me and I wanted to push on with you a little bit is middle-skilled jobs in coordination with community colleges and vocational schools.

There is a report from the Brookings Institution—or Institute that came out about a year ago that highlighted facts that I am sure you are very familiar with, but that 26 million of all jobs—

or, excuse me, 26 million U.S. jobs, 20 percent of all jobs require high knowledge in any one STEM field. Half of all STEM jobs, though, are available to workers without a four-year college degree and those jobs pay on average $53,000 a year, about ten percent higher than jobs with similar educational requirements. STEM jobs that require high level of knowledge or high—over at least a bachelor's degree are clustered in certain Metropolitan areas that we all know—Silicon Valley; Cambridge, Massachusetts; San Jose—but other STEM-based economies like—require—jobs are available for those that require less than a bachelor's degree. There are robust economies in Baton Rouge, Louisiana, and Birmingham, Alabama, and Wichita, Kansas, as well.

And I guess my question for you, Doctor, is through much of the report that I have reviewed, there seems to be an absence of focus on community college, vocational schools, vocational training, technical training, and I want to get your thoughts as to 1) where the Administration is on this and 2) how we can be helpful and supportive.

Dr. HOLDREN. We are aware of the gap in high skills worker education short of four-year colleges. Just a couple of months ago we brought a large number of community college Presidents into the White House to discuss what they are doing and how we can be more helpful in what they are doing to link up with manufacturing firms in their regions to create curricula that match training to the jobs that are actually available in those regions.

The National Science Foundation's budget in the President's Fiscal Year 2015 proposal has something over $60 million for NSF's Advanced Technological Education program, the ATE program, which centers on education of technicians for high technology fields. So this is something we are working on.

Mr. KENNEDY. And what—and I appreciate that, Doctor.

I visited a number of vocational schools and technical training schools in my district. These kids are coming out excited about math, excited about engineering, excited about science, building things that I certainly never built when I was in high school. I was—I still know the quadratic equation. I don't know what good that is doing me. These kids are building things that actually can work, and when their plumbing gets backed up, they can fix it and I have got to call one of them to come fix it.

So I guess my point is these are jobs that aren't going to get outsourced. These are jobs that, as studies have shown, are—have a high earning capacity, and there are jobs that are available today that are going to be available in the future. And I would just ask that the Administration continue to focus on this, and if there are ways that we can be helpful on it, we certainly would like to be as well.

Dr. HOLDREN. Thank you. And we will keep focused on it.

Mr. KENNEDY. Thank you. And one other issue that I just—I know my time is running short, but I wanted to see if you could comment on there has been a couple of articles of late, even just in the past couple of weeks, about the prevalence or increasing prevalence of private philanthropy to take over some of the—or to fill the need—the gap if you will from some of these—from the retraction in the government funding for basic research. Much of this

philanthropy is obviously very well-needed and we should encourage it and I certainly encourage it.

The issue with it is that it is often pinpointed or—to a specific target by the donor, which is great and it is their money; they should do what they want with it. But do you see any long-term challenge with relying more and more on private philanthropy to fill the need here if we are not making the—there seems to be broad-based support for this idea that this is one of the essential areas of basic responsibilities of government, yet an unwillingness to make that commitment.

Dr. HOLDREN. I don't like the idea of calling it reliance on the philanthropic sector. I think we should welcome the engagement of the philanthropic sector and funding research in general and basic research in particular. And there is a new consortium of major private foundations which is working together to try to boost funding for basic research rather than, as you note, targeted research.

There is a lot of the latter. We have some very important philanthropic support for the BRAIN Initiative——

Mr. KENNEDY. Um-hum.

Dr. HOLDREN. —that this Administration has launched from a number of private foundations, but we are getting support as well for increased philanthropic funding of basic research. But that does not mean that the country can rely on that. It is not going to be big enough. The government needs to continue to meet its fundamental responsibility to support basic research in this country. We would like to be able to support more of it in this budget, and again, we will support more of it in this budget if we get the Opportunity, Growth, and Security Initiative supported by Congress.

Mr. KENNEDY. Thank you, Doctor.

Mr. Chairman, thank you for the extra time.

Chairman SMITH. Thank you, Mr. Kennedy.

The gentleman from Florida, Mr. Posey, is recognized.

Mr. POSEY. Thank you, Mr. Chairman.

Dr. Holdren, always a pleasure to have you here.

I wonder if you could give us a status on the supply, availability, inventory of Pu-238 and any other nuclear fuel we may need to travel in space?

Dr. HOLDREN. My understanding is that there is a new agreement between NASA and the Department of Energy on producing plutonium-238 for our space missions, and I believe that that agreement will be to meeting the needs that we foresee.

Mr. POSEY. How much do we have in stock now?

Dr. HOLDREN. I would have to get back to you on what is actually in the stockpile at this moment.

Mr. POSEY. Are you aware that they are getting rid of anything that we have in inventory now?

Dr. HOLDREN. I am not sure what you mean by "getting rid of."

Mr. POSEY. That there may be plans to eliminate part of the inventory that we now have.

Dr. HOLDREN. I am not aware of any such plans, but I will look into it. This is something I would have to explore with the Department of Energy.

Mr. POSEY. Okay. Do you have a pretty good idea of how long it takes to purify this plutonium and how much it costs to do that?

Dr. HOLDREN. Not off the top of my head. I would expect that in terms of production, we are talking about a timescale of six months to a couple of years I would guess.

Mr. POSEY. And a whole bunch of money, but if you would check on that and seriously get with me and let me know the status of it——

Dr. HOLDREN. Happy to do that.

Mr. POSEY. We had somebody here from the National Science Foundation, who had actually—who said she wasn't a scientist and so couldn't answer any questions. And I was just curious. I asked her how many Ice Ages she thought that this Earth had been through. I mean everything I can gather a minimum of three, a maximum some say from five to seven, but I just want to know how many Ice Ages you think we have gone through?

Dr. HOLDREN. Well, again, I don't remember off the top of my head. I think the numbers you mentioned are in the ballpark but I would have to look at the record. The Earth has undergone climate changes throughout its entire history. The difference is that for most of that history there weren't seven billion people on the planet who needed to be fed, clothed, and kept prosperous, and the other difference is——

Mr. POSEY. Okay.

Dr. HOLDREN. —that the pace of change was generally much slower.

Mr. POSEY. I am running out of time. I am running out of time. I am aware of that.

You know, obviously we have had global warming for a long time. You can't have one seamless Ice Age that encompasses three Ice Ages. We had to have warming periods between each one of those. And so it is a natural phenomenon and, you know, just because we are alive now, the tectonic plate shifts aren't going to stop, the hurricanes and tsunamis aren't going to stop, the asteroid strikes aren't going to stop. These things have gone on for eons and they are going to continue to go on for eons.

What do you think the temperature was on Earth before the disappearance of the dinosaurs?

Dr. HOLDREN. There have been periods when the temperature was three, four, five degrees Celsius warmer than it is now, and the difference between the circumstances you are describing and the circumstance we are in now is the changes that are being imposed on the climate, in substantial part as a result of human activity, are faster than the ability of ecosystems to adapt and maybe even more importantly faster than the ability of human society to adapt. There are a lot of stresses, as you point out, that we can't control, but the stresses we can control that are imposing burdens on our society we ought to think about controlling.

Mr. POSEY. No doubt about that. And I don't think there is anyone—I haven't heard anyone say ever from either side of the spectrum that there is no such thing as climate change. I mean it is—we have had climate change since the day the Earth was formed, whenever that was depending on how—whatever you believe, and we will have climate change until the day the Earth implodes, whenever that is.

The question is how much of the climate change do you think is influenced by human behavior?

Dr. HOLDREN. The climate change we are experiencing now, the climate change we have been experiencing for the last several decades is, according to the Academies of Science, according to the Intergovernmental Panel on Climate Change, according to the view of most of the scientists who work on this, largely due to human activity. We are superimposing on a slow natural climate change a rapid human-induced climate change.

Mr. POSEY. But as a percentage, like you anticipate the climate would change X amount in a year without the existence of humans on it, how much more do you think as a percentage of the change is influenced by human behavior?

Dr. HOLDREN. The natural changes which we understand and which are underway on a long-term basis as we speak would, if they were the only influences, be cooling the planet rather than warming it. We would be in a long-term cooling trend as a result of the natural forces affecting climate that we understand. We are instead in a warming trend which suggests that human activity is overwhelmingly responsible for the difference. We would be having cooling based on natural forces. We are having warming.

Mr. POSEY. I remember in the '70s that was a threat. We are going to have a cooling that is going to eventually freeze the planet and that was the fear before Gore invented the Internet, or the other terms.

I had read that during the period of the dinosaurs, the Earth's temperature was 30 degrees warmer. Does that seem fathomable to you?

Dr. HOLDREN. Thirty degrees sounds like a stretch to me but I will review the literature and get back to you.

Mr. POSEY. Thank you, Dr. Holdren, very much.

I yield back, Mr. Chairman. Thank you.

Chairman SMITH. Thank you, Mr. Posey.

The gentleman from Washington, Mr. Kilmer, is recognized for his questions.

Mr. BERA. Mr. Kilmer is not here so——

Chairman SMITH. Dr. Bera for his questions, the gentleman from California.

Mr. BERA. Great, thank you, Mr. Chairman. And thank you, Dr. Holdren, for being here.

Obviously, we are in a very competitive global environment. We are in a very competitive global economy and, you know, that is not going to change in the near future. The one area that we do have a very competitive advantage over the rest of the world is in innovation. And clearly, we are still the most innovative country in the world; we are still the most innovative economy in the world, but we also recognize that we are starting to lose that advantage by not making the necessary investments to continue to move things forward.

We also recognize that many of my colleagues have touched on the importance of training scientists and engineers to continue that economic advantage. Recently, I had a town hall at Intel with—Intel has a major presence in my district and I had the chance to meet with their leadership to talk about their future investments

but also talk about their challenges. And clearly, one of the challenges that their leadership brought up was the lack of availability of engineers and also the lack of availability of folks that know how to write code. On this Committee we have also had a hearing on that as well and it is—you know, we have the folks from code.org testify.

There are two things that really jump out in my mind. One, they said, you know, it can't happen at the college level. If we actually want to start our kids on coding and teach them those skills, it has to happen at the elementary school level. And, Dr. Holdren, I would be curious about your comments. Within the President's budget, within the STEM budget, if we truly want to have our kids not just learn reading, writing, and arithmetic but also have them learn the language of the future, which, you know, increasingly appears to be coding, are there initiatives both to put that into part of the Common Core as well as one of the challenges that repeatedly comes up is the lack of educators who actually know how to teach that coding as well and if there is funding to train the trainers or train the teachers?

Dr. HOLDREN. Well, I would make—sorry. I would make a couple of comments on that. One, there is certainly funding in the President's budget for recruiting, preparing, and supporting more outstanding teachers in the STEM fields, which would include teachers who know how to code and who know how to teach coding. There is $40 million in the budget to support the goal of preparing 100,000 excellent STEM teachers over the next decade. There is $20 million to launch a pilot STEM master teacher corps.

In addition, I would note that we have a problem with inadequate exploitation of the talent pool. Women are drastically underrepresented in engineering and in computer science. African-Americans and Hispanics are drastically underrepresented in these fields, and we have a series of programs aimed at improving inclusion opportunities for girls and women in STEM fields, opportunities for other underrepresented groups, including minorities. We have had a lot of effort on that front just in the last couple months in connection with Black History Month and then Women's History Month. And tapping a larger fraction of the Nation's talent pool for these purposes is going to be a very important part of the solution.

Mr. BERA. Dr. Holdren, I am glad that you brought that up. I think the statistic that was quoted to me last week was it is less than 20 percent of all of our engineers are women at this juncture, the ones that are graduating. If you were to recommend to—again I think this committee has a desire to train those folks to fill those future jobs. What recommendations would you have for us as a body in getting more girls to think about engineering futures and careers, as well as some of the minority groups that are certainly underrepresented?

Dr. HOLDREN. Well, this will seem very self-serving but I would hope that the Committee will support the President's budget in this domain because it has a lot of focus on those issues.

Mr. BERA. Great. Last question. In my remaining time, the other area that I have focused on certainly is—as research budgets get tighter and so forth, one area that, you know, coming out of a background in higher education as an associate dean in a public univer-

sity, research funding is becoming increasingly tight and we have talked a little bit about what we can do to enhance technology transfer and so forth. Do you have any recommendations that are both within the President's budget to allow the private sector to come in at an earlier phase?

Dr. HOLDREN. Well, the President has been a strong advocate from the outset of his Administration of strengthening partnerships between the private sector, the academic sector, and including the national laboratories in that. The National Network for Manufacturing Innovation is a good example of that. The Energy Hubs that the DOE has set up are great examples of that. They are bringing private sector enterprises together with folks from research universities and national labs to build partnerships to grease the tracks if you will between discovery in the laboratory and a productive application in society. And we want to continue to do that and there is substantial support for that in the President's Fiscal Year 2015 budget.

Mr. BERA. Well, fabulous. We look forward to supporting those investments.

I yield back.

Chairman SMITH. Thank you, Mr. Bera.

The gentleman from New York, Mr. Collins, is recognized.

Mr. COLLINS. Thank you, Mr. Chairman.

I wasn't attempting to go down this road, Dr. Holdren, but you stated really twice today that SOFIA would be a priority under OGSI with increased funding, certainly implying very directly that SOFIA is an Administration priority. I would like to direct your attention to statements by NASA that actually brags about cutting SOFIA's budget to fund other programs.

And I have here a letter, a document from OGSI that specifically states how they would spend the extra money, the $187 million. SOFIA is not listed there twice. I would like to ask you very directly why you have left this Committee with the impression, very direct impression, that SOFIA is a priority for the Administration where clearly it is not?

Dr. HOLDREN. What I have said is SOFIA was ranked behind several other——

Mr. COLLINS. Okay. So what you are admitting is it is not a priority.

Dr. HOLDREN. —but——

Mr. COLLINS. Is it or is it not a priority?

Dr. HOLDREN. In better financial times——

Mr. COLLINS. I am asking a direct question.

Dr. HOLDREN. In better funding times——

Mr. COLLINS. Would you answer the question, sir?

Dr. HOLDREN. —we would support SOFIA——

Mr. COLLINS. Is it a priority or not?

Dr. HOLDREN. It is a lower priority than the things——

Mr. COLLINS. Okay. Thank you, sir——

Dr. HOLDREN. —that we are funding.

Mr. COLLINS. —because you have implied it differently today and I don't appreciate the implication. It is hypocritical and disingenuous to leave this committee with the impression SOFIA was a priority and it is clearly not.

So my next line of questions concerns security on Healthcare.gov. I Chair the Subcommittee on Healthcare and Technology in Small Business. We have had folks here on both sides of the aisle testify. Healthcare.gov was not secure when it was launched, is not secure today, and we have been attempting to get Mr. Todd Park to testify in front of this Committee on three occasions. The Administration has refused to make him available, and yet clearly Mr. Todd Park has had involvement in Healthcare.gov, and certainly with his background and his position now as an advisor to the President would and should have been involved with the security issues.

So, you know, I guess, you know, I can read all the times Mr. Park has been involved, his involvement with CMS, his involvement with various meetings, his attendance at all these meetings and just have to ask you once again, in light of all the information and all the meetings and all the involvement of Mr. Park, how can your office state, which they have done just again recently with a letter to Chairman Smith, that none of your personnel have been involved with Healthcare.gov? Pretty bold statement.

Dr. HOLDREN. We have not said that none of our personnel have been involved with Healthcare.gov. Mr. Park in particular was asked by the President—after the problems with Healthcare.gov materialized after its rollout, he was asked to become heavily involved. He has been very heavily involved in trying to address the problems of the website since that time.

Mr. COLLINS. So you are implying——

Dr. HOLDREN. We never said no——

Mr. COLLINS. —he had no involvement prior to the launch?

Dr. HOLDREN. We said his involvement has not been primarily associated with the security of the site. He is not a cybersecurity expert and the responsibility for the security of the site rested with CMS and with the interacting activities of CRS, the IRS, and the Social Security Administration.

Mr. COLLINS. So you are suggesting that he was blindsided by the problems in this, had no knowledge of this as the advisor to the President, and all of a sudden when all of the problems, including experts who said this website should never have been launched, it was not secure the day it was launched, it is not secure today, Americans' privacy is in danger, their identity theft is real, and so you are saying this Mr. Park—and that is why we want him to testify here. So let me just cut to the chase. Why won't you allow him to testify?

Dr. HOLDREN. It has been the practice of this Administration from the beginning that assistants to the President who are not Senate-confirmed do not testify. We have other people who are experts in cybersecurity who are willing to testify before this Committee on cybersecurity issues. Mr. Park is not an expert in the cybersecurity aspects of the Healthcare.gov website and he is a direct report to the President of the United States. I can't compel him to come and testify. He doesn't report to me. I am not sure what else you want for an answer.

Mr. COLLINS. Well, you know, much like SOFIA, I would like a more direct answer, not a dance like you have been dancing today. And the fact is the experts have testified that the website was not secure the day it was launched, it is not secure today, and yet, your

office and others within your office are now just claiming ignorance; you had no idea this was coming. You woke up one day, oh my goodness, it is not secure. I think you—again, today, I have been very disappointed in your testimony, disingenuous, not direct, and I think deliberately misleading to this Committee.

And with that, Chairman, I yield back.

Chairman SMITH. Thank you, Mr. Collins.

The gentlewoman from Connecticut, Ms. Esty, is recognized.

Ms. ESTY. Thank you, Mr. Chairman. And thank you, Dr. Holdren, for your many decades of service to this country and your willingness to serve in this challenging time.

I wanted to briefly touch on three topics: first, STEM education, which I think you have now gathered is an extremely high priority of this Committee; secondly, the regional innovation initiatives; and third, climate change resiliency.

I am very glad to hear that you mentioned the importance of including and reaching out to young women and to children of color. We cannot be competitive in the 21st century, globally competitive if we are leaving 60 percent of our workforce out of the STEM fields. So if you can elaborate on that aspect of how exactly you plan to do that. I would also recommend to you and ask you how you are reaching out to local stakeholders.

I come from Connecticut. We have local companies like Stanley Black & Decker who are partnering with places like the Connecticut Science Center as well as our local community colleges, like Naugatuck Valley Community Colleges. They are working together with our local manufacturers to try to design some of these programs. I brought astronauts into the inner-city to meet with middle school students to inspire them about the opportunities that are available.

Can you talk a little bit with us about what efforts, going forward, the Administration is going to utilize to engage these local stakeholders to make sure that our programs actually will work on the ground?

Dr. HOLDREN. Sure. Let me mention a couple of elements of the Fiscal Year 2015 budget proposal that address those issues. One is the STEM Innovation Networks. There is $110 million to help school districts individually and in consortia build partnerships, STEM Innovation Networks that would be partnerships with businesses, universities, museums, federal science agencies, and other entities to basically transform STEM teaching and learning and, I would add, inspiration by developing coordinated plans to do that in the STEM fields.

There is $150 million in the budget in a program to redesign high schools to teach real-world skills basically relating to the earlier point that Congressman Kennedy was making as well to rethink the high school experience, challenging schools to scale up innovative models that provide rigorous and relevant education including for folks that are not going to go on to college but are going to go into high skills careers.

The Network of Manufacturing Innovation Institutes will also be obviously a regionally focused set of efforts to link up schools, universities, national labs, businesses to the ends of that you are discussing.

Ms. ESTY. That is a great point to segue to the regional innovation centers, strong—I am strongly supportive of the efforts to expand those centers. I think they are going to be critically important to have this sort of innovation and linkage we need from basic research in our high-tech research universities, places like UConn whose medical center is in my district, Yale, which is right nearby, with our local communities, community colleges, high schools, elementary schools——

Dr. HOLDREN. Um-hum.

Ms. ESTY. —as well, and our manufacturers. So I am strongly supportive of efforts to expand those efforts.

Dr. HOLDREN. Right.

Ms. ESTY. And one thing I would like to flag that we have learned since this is a real passion of mine and very important to my district, it is going to be really important to engage the private sector in providing internship possibilities for students. Many of the—and this goes back to the inner cities in part and to girls. They need to have the opportunity to work and see in environments where they are actually doing this during the summer in a workplace setting where they understand the soft side skills as well as the culture, and that is critically important to inspire them and encourage them to pursue these fields, which are often very tough. So I just want to make a plug for that.

Coming from the Northeast, living through this extremely challenging last couple of years, I would like quickly with the time I have remaining your thoughts about the climate resiliency—climate change resiliency theme in the budget through NOAA and EPA about the development of a climate change resilience toolkit and web portal? And how will improved access for this data help protect our communities on the impacts of climate change? And it seems more focused on attention to understanding and mitigating regional impacts. And can you sort of describe the reason to take that approach?

Dr. HOLDREN. Okay. And very quickly, before I answer the last question, I do want to mention that the *America COMPETES Act* in 2010 authorized a number of Department of Commerce programs focused on regional innovation, and the President has proposed those. The Congress has funded them. They have created a variety of regional innovation clusters and partnerships of the sorts I described, so I think that is something we remain committed to in partnership with the Congress.

We just rolled out last week the first tranche of the Climate Data Initiative, which is one of the elements of the President's Climate Action Plan. That Climate Data Initiative is being led by NOAA and NASA but has participation from a wide variety of other departments and agencies. The aim of it is to provide data that is transparent and informative and rigorous that local and regional decision-makers, communities, businesses, farmers, fishermen, individual citizens can use to better anticipate what climate change will be doing in their regions or their localities and to be better able to take steps to prepare for it and to minimize the damages that result from it.

The first focus of the Climate Data Initiative is on sea level rise and coastal flooding. The next phase will be looking at agriculture.

The phase after that I think will be looking at impacts on health. It will be followed by a resilience toolkit that provides a variety of applications which will make it easier for people to make use of these data, understanding what they mean, and applying them to their local needs.

Climate change obviously is a problem that is global in its origins and in its dynamics but its effects are local, and that is why the focus of the Climate Data Initiative and the whole resilience and preparedness approach is local and regional, because climate change is not uniform and people in different regions and localities need to be prepared for what is going to happen there.

Ms. ESTY. Thank you. And I appreciate your indulgence, Mr. Chairman, in letting him finish the answer to that question. Thank you.

Chairman SMITH. Thank you, Ms. Esty.

The gentleman from Arizona, Mr. Schweikert, is recognized.

Mr. SCHWEIKERT. Thank you, Mr. Chairman.

Professor, I have got to tell you, out of all the positions in government, you actually I think may have one of the most interesting jobs but you also have an interesting effect on what the future, long after you and I are probably gone, will have.

I will do my best here to sort of have a linear thought in these questions. The—in your discussions with the Administration—and the first one I am going to ask you about is the ICANN decision recently. I am a great believer that sort of egalitarian access, you know, crowdsourcing of information and data being available is crucially important and it is also sort of the ultimate vetting of what is out there in science. Has there been any discussion of protocols of what will be done to make sure that if we have given up dominance of sort of internet policy, that that dominance won't be taken by whether it be the U.N. where the majority of member states are not, you know, free democracies, how do we make sure that the world has sort of an open free speech environment on the internet?

Dr. HOLDREN. There has of course been discussion of that. It is a focus of ours. We are certainly not giving up influence and it is not our intention to allow the internet to go in a direction that imperils free speech.

Mr. SCHWEIKERT. One of my real concerns here is that, you know, as Americans we are all free speech advocates but I believe the head administrator of ICANN now has often spoken that he would like a U.N. body. Well, you and I know the majority of member states in the U.N. aren't anywhere near where we are culturally in the protection of free exchange of speech. So it is just—it is a real concern. Has this at least hit a high level of discussion?

Dr. HOLDREN. It has. We are concerned about it, too, and we are determined to hold the line.

Mr. SCHWEIKERT. Why would we have made sort of the statement that we are going to walk away from sort of our managerial control until that sort of underlying agreement was designed?

Dr. HOLDREN. This is not my field of expertise and I am not sufficiently familiar with the arguments that were gone through. I know they were intensive. As in many other domains, this is an area where globalization has been going on and it is sometimes dif-

ficult to retain a position of absolute dominance over time when that is happening. But I would be happy to get back to you——

Mr. SCHWEIKERT. It is just——

Dr. HOLDREN. —with more information about that process.

Mr. SCHWEIKERT. —as you know, for many of us who are, you know, free speech advocates, we always have a concern that we are paying for NSA sin in perception, so just where that may be.

Science advisory body, the advice, the information that is often given to agencies that are asking for direction and modeling, this Committee is dominant in the statute that actually creates. What do you think your obligations are or the advisory board—or body's obligation is to respond to our inquiries? Because my fear is there is advice being given to agencies and we say tell us—you share with us the direction you are going there and we get stonewalled.

Dr. HOLDREN. Well, I am not sure what in particular you are referring to. My office—the White House Office of Science and Technology Policy is of course responsible for providing above all science and technology advice to the President and his other senior advisers——

Mr. SCHWEIKERT. Well, but if——

Dr. HOLDREN. —but I testify regularly before Congress and our reports, which embody the bulk of our advice, are available on our website——

Mr. SCHWEIKERT. Well, but no. We had already had several occasions on this Committee where we have reached out to—is it ERDDA—and said share with us the advice you are giving to certain agencies and we don't get it back.

And let me sort of do a hop-skip and we can—and I will even follow up with this one in writing. Congressman Neugebauer was asking a question about within the budget line, the study of hydraulic fracturing horizontal drilling, correct?

Dr. HOLDREN. Yes, he was asking.

Mr. SCHWEIKERT. And within that, part of his question he was trying to ask is you have designed budget line items but yet you apparently haven't actually designed what the study is going to look like.

Dr. HOLDREN. Oh, the study is underway.

Mr. SCHWEIKERT. Then when we had asked for how are you doing your sample set, are you reviewing the literature? Are you sending people out to do actual, you know, hard samples? How come we are having trouble getting that information delivered to us?

Dr. HOLDREN. I had not been aware that you were having trouble but if you direct that inquiry to me, I will provide you with answers.

Mr. SCHWEIKERT. So could you at least commit to myself or more importantly the Chairman, could we have the design plan? I have a fixation on baseline data sampling because I believe it often ends up—you know, we often talk about the modeling that you and I know your first sin is always—or your first cornerstone is in how you choose to collect the data. So if you would be willing to provide us a plan on how the study is built and obviously that would be reflected in the budget request, that will go a long way for confidence in this Committee.

Dr. HOLDREN. Good. I will try to do that.

Mr. SCHWEIKERT. Last two things, and I know I am way over time, there is some complement out there, but I also think we need to make sure our friends on both sides understand some of the groups you oversee have protocols on blinding personal data. We do it in the census; we do it in medical research. And so there is sort of a national standard for doing that. I do a sample set. I have individual personal data. If that data is going to be made public, you have a way of doing placeholders, correct?

Dr. HOLDREN. Correct.

Mr. SCHWEIKERT. So—because we had sort of a bizarre conversation in this Committee about six weeks ago where there seemed to be a misunderstanding that there is—it is standard protocol on how to blind individual data.

The last thing, do—who in your organization sort of watches peer-review publications because I now have a binder on my desk in my office now of articles where we are realizing how much—I am uncomfortable using the word fraud but how many outliers we are finding where really bad data is being used in peer-reviewed studies, publications, grants, and how do we fix that? And I am a believer that, you know, the crowd putting things out in the internet and having lots of voices talk about it will help us find where we are funding studies that the underlying data sets either were grossly misinterpreted or actually outright fraud.

Dr. HOLDREN. This is a really important issue. We devoted a public session of the last meeting of the President's Council of Advisors on Science and Technology to it. We invited the editors-in-chief of both Nature and Science, the two most important science journals in the world, plus a number of experts on data and the pitfalls that occur. Within my organization, the Associate Director for Science currently awaiting confirmation is the person who has the most direct oversight of that set of issues, but we are concerned about it. We are interested in it—

Mr. SCHWEIKERT. Professor——

Dr. HOLDREN. —and we will look at it.

Mr. SCHWEIKERT. I am elated to hear that it is—because as you know, so often we base public policy and spending and then later find out there was something horribly wrong in that model or the underlying samples or just outright fraud to get the grant.

Can I beg of you, send me a note—send me something in writing of who I should reach out to because I——

Dr. HOLDREN. Sure.

Mr. SCHWEIKERT. —actually have a powerful interest in this——

Dr. HOLDREN. Yes.

Mr. SCHWEIKERT. —because of my concern that resources may be going askew because of bad acts.

Dr. HOLDREN. I would be happy to respond to you——

Mr. SCHWEIKERT. And with that, I know I am way over time. Thank you for your patience, Mr. Chairman.

Chairman SMITH. Thank you, Mr. Schweikert.

The gentlewoman from Oregon, Ms. Bonamici, is recognized.

Ms. BONAMICI. Thank you, Mr. Chairman.

Dr. Holdren, welcome back. Thank you so much for your testimony and for your work. I want to start by saying I am glad to

see the Administration acknowledged the importance of the Manufacturing Extension Partnership program. That was several companies in Oregon who have benefited from the MEP program so—through NIST. Thank you very much.

I am also encouraged to see the Administration focusing resources on innovative energy projects at ARPA–E, specifically the potential of battery technology. I recently spoke with someone from a utility in Oregon, Portland General Electric, and they recently installed a 5 megawatt lithium ion battery-powered energy storage facility. It happens to be on top of the Kettle brand facility rooftop, so we can think about that whenever we are eating Kettle chips.

So that is in Salem, Oregon, and it is partially funded by the Department of Energy's Pacific Northwest Smart Grid Demonstration Project, but they have learned an immense amount about how efficient battery technology can help the grid integrate renewable energy resources, so more R&D in battery technology I see as a win-win. Really a common goal and what we have been talking about throughout this hearing and all the disciplines is how we keep our country competitive, how do we have an innovative workforce.

I want to mention the Innovation Corps program with NSF to commercialize university research, which you mentioned in your testimony. I was wondering how that program will be structured and I encourage you to look at the Oregon ONAMI, Oregon Nanoscience and Microtechnologies Institute. They are doing great work with commercialization of materials science and systems technology.

I want to follow up on the STEM education discussion as well. You referenced the 21st century community learning centers, a way to bring STEM education outside the traditional school day. I recently met with students at the Forest Grove, Oregon, high school who are part of the 4–H Tech Wizards afterschool program. That is a great opportunity for students to engage outside of the school day.

And on that note, we have had great discussion already, Dr. Bera and Representative Kennedy, and Representative Hultgren mentioned the FIRST robotics program. Hands-on learning is so important.

And I wanted to follow up on that. You may recall I am the Co-Chair of the bipartisan STEAM Caucus, integrating arts and design broadly defined into STEM learning. There is plenty of research to show that educating and exercising the right brain helps to educate creative and innovative students who become innovators and entrepreneurs, and simply put, we want people who cannot just answer questions but also know what questions to ask.

So you talked about the updates to the STEM reorganization plan for the Fiscal Year budget, and on the Hill we have witnessed a growing consensus about how do we expand STEM education. You mentioned reaching out to underrepresented populations. So can you expand on whether that plan acknowledges the benefit of including alternative approaches to STEM education?

Dr. HOLDREN. Well, first of all, I commend your interest in the STEAM approach and the progress being made with it. I think it is important to remember the relevance of the humanities and the arts as we think about our education portfolio overall. And I think

some of the kinds of activities that are in the various programs listed under STEM undoubtedly are including these other dimensions as well. I think many of the outreach and the community-based programs are doing that, so basically, I could only agree with your comments.

Ms. BONAMICI. Well, thank you. The more we learn about the parallels between the science and art—and the last time I asked this question I mentioned a study that was done about the number of Nobel laureates in sciences who also engage in arts and crafts is phenomenal and they recommend that students studying in the STEM disciplines also have art and crafts experience. It really is hands-on learning but again leads to that creativity and innovation that we want in our workforce.

And could you follow up a little bit about the Innovation Corps and how that program will be structured through NSF to help commercialize research?

Dr. HOLDREN. Well, that is a program that has already been going on in NSF, and my understanding is that it is already successful in basically including, in a number of the activities that NSF funds, training on how to be an entrepreneur, how to translate discoveries in the laboratory into practical applications that can become the basis of businesses and social good. So I think it is a great program. I think it is working and we should continue to support it.

Ms. BONAMICI. Thank you very much. My time is expired. I yield back.

Thank you, Mr. Chairman.

Chairman SMITH. Thank you, Ms. Bonamici, appreciate that.

The gentleman from Texas, Mr. Weber, is recognized.

Mr. WEBER. Thank you, Mr. Chairman, and welcome, Dr. Holdren. Appreciate you being back again.

I don't remember if it was Mark Twain or Will Rogers or Ambrose Bierce or somebody like that that said all scientists are only sure about one thing and that is that all scientists before that were wrong. Have you ever heard that comment?

Dr. HOLDREN. I have heard of versions of it.

Mr. WEBER. Okay. Well, who was it that said that? No idea.

So when you guys do your research you start with the scientific—what do they call it—postulate or theory and you work from that direction forward, is that right?

Dr. HOLDREN. It depends on what sort of science that you are talking about, but the notion of posing a hypothesis and then trying to determine whether it is right is one of the tried-and-true approaches in science, yes.

Mr. WEBER. So I am just wondering how that related to like, for example, global warming and eventually global cooling? And I may want to get your cell phone number because if we do go through a couple cycles, global warming and then back to global cooling, I will need to know when to buy my long coat on sale. So I just don't know how you all prove those hypotheses going back 50, 100, you know, what you might say is thousands of if not even millions of years and how you postulate those forward. But we will get into that in a little bit.

The Keystone pipeline I am very, very interested in because it comes into my district, delivers 840,000 barrels of oil a day. It will help get us off oil from the Middle East or Venezuela and produce jobs over here. And the State Department actually came out with a finding and said—it was one of those scientific hopefully findings I guess—that "the approval or denial of any one crude oil transport project, including the proposed project, is unlikely to significantly impact the rate of extraction in the oil sands or the continued demand for heavy crude oil at refineries in the United States." Do you agree with that statement from the State Department?

Dr. HOLDREN. Well, I would say, number one, I have not done a review——

Mr. WEBER. Okay.

Dr. HOLDREN. —at this point of the State Department's analysis of that——

Mr. WEBER. Okay.

Dr. HOLDREN. —and not having looked at the analysis, I don't want to say whether I agree with it or not——

Mr. WEBER. Okay.

Dr. HOLDREN. —but it is a respectable position. There are others.

Mr. WEBER. So they are from the government and they are here to help.

So looking at your budget as you have put it forward in the different areas there is one, like Congressman Neugebauer said, on fracking where that study has never been done. Do you know if there is any plans—in Texas—one of my other colleagues—and maybe it was Congressman Neugebauer—refer to the fact that we have been in fracking since 1945, which if my high school math holds up would be 65 years.

Do you all ever think about perhaps getting with the agencies in Texas that actually have that experience and that deal with it every day? And in fact in Texas we would say we have been doing it longer than anybody else. Any plans to get with the TCEQ and those that have experience?

Dr. HOLDREN. I suspect that that outreach has happened as part of the study——

Mr. WEBER. Could that help your budget—would that help your budget numbers go down because you could rely on their experience?

Dr. HOLDREN. I suspect the budget numbers take into account the fact that we have been reaching out to the constituencies that do this.

Mr. WEBER. Okay. Do you think that it is possible that if we had more manufacturing jobs based on this energy renaissance that we are about to experience if the government will get out of the way—that if we had more manufacturing jobs, that we could take more Americans off of the unemployment rolls and welfare so to speak and that we could actually get more taxpayers on the rolls and then we could actually have more money for the budget to do the very thing you want to do, which would be more research and to put more money into an all-of-the-above energy program? Does that make sense to you?

Dr. HOLDREN. Absolutely it makes sense and the Administration is all in favor of increasing the number of manufacturing jobs, and we have been trying to do that in a number of ways.

Mr. WEBER. Well, they keep saying that, but looking at the energy renaissance and the war on coal plants and the—I mean I don't think that is deniable, war on coal plants and war on fossil fuels and the dragging of the Keystone pipeline permit, which has been now five years, five years.

Do you have any plans—do you weigh in with the President? Do you say, Mr. President, in our—from our vantage point if you would approve the permit, as the State Department said, using the State Department language—it was an amendment I got on a bill in the—through the House taking the permitting process away from the President, do you have any—can you say to the President, Mr. President, the State Department is saying it is a go. What is the holdup?

Dr. HOLDREN. As I understand it, the ball on that issue is still in the State Department's court. That was an analysis. The Secretary of State has not made a national interest determination at this point and so we are awaiting that.

Mr. WEBER. But you are the scientist. You have the budget—you are putting together the budget. You want more research, you want more money to do these kinds of things, and if we can get more taxpayers, we can increase the budget, right?

Dr. HOLDREN. Absolutely. As I have said, we are in favor of increasing manufacturing jobs in this country and it would bring many benefits.

Mr. WEBER. Well, I hope when you leave here you will call the President and tell him you and I had this conversation and I am recommending approval of the Keystone pipeline.

Thank you, Dr. Holdren.

Chairman SMITH. Thank you, Mr. Weber.

The gentleman from California, Mr. Swalwell, is recognized.

Mr. SWALWELL. Thank you, Mr. Chairman, and thank you, Dr. Holdren.

And, Dr. Holdren, I have to say I am disappointed that many of my colleagues across the aisle have used this hearing, titled key issues for the President's Fiscal Year 2015 research and development budget, to re-litigate whether climate change is happening and whether it is manmade, and at this rate, frankly, I have to say you should be prepared to address whether the Earth is round or flat; that might come up, or whether indeed gravity is happening. You never know what can fly at you from what we have seen already.

And I have to say that with 97 percent of the scientists stating, and as you pointed out that that is an approximation based on statistics, that climate change is manmade, I am encouraged to see that some of my colleagues across the aisle have been a voice for the minority, three percent of scientists today.

This is encouraging for other minorities that my colleagues across the aisle have not helped out, including immigrants who are waiting for comprehensive immigration reform, minorities like women who have not received equal pay for equal work, minorities who are affected by the Voting Rights Act where action has not

taken, as well as gay and lesbian minorities who have been oppressed by some of the policies that my colleagues across the aisle have put in place.

So the colleagues who are standing up for the three percent scientists who do not believe in climate change, I am encouraged that they are now a voice for the minority.

But you are here to discuss the President's Fiscal Year 2015 budget, and I have a question first about the National Ignition Facility, which is in my district in Livermore, California. And I want to know, in light of the recent alpha heating phenomenon that occurred there, do you still believe that that fusion project is near the goal line and that ignition is near achievement and what that means for future rounds of funding?

Dr. HOLDREN. Well, first of all, I applaud the advances that have been made at NIF over the past year. I think they are important. I think it is still quite some distance from the finish line. When you look at the energetics every step of the way, there is considerably more progress that needs to be made before we can say we actually have ignition, and there would be more progress beyond that that would be needed to convert that achievement into a workable fusion reactor. But the project is well worth pursuing. The 329 million in the budget for pursuing it should enable a good deal of further progress and I look forward to seeing that.

Mr. SWALWELL. I also wanted to talk a little bit about the inertial fusion research that is in the budget, and particularly that the National Ignition Facility and the Z Pulsed Power Facility have enough technical promise to justify dedicated federal support for inertial fusion R&D relevant to energy, not just weapons reliability, as Ms. Lofgren pointed out.

However, there is currently no program in the federal government which directly officially supports inertial fusion research and technology developments activity for energy production purposes. Rather, the Administration is proposing to eliminate all of the activities in the Fusion Energy Sciences program that could make important contributions to fusion research, including an experiment at Lawrence Berkeley National Laboratory that is only beginning to operate this year.

So my question is do you believe that the Department should address the findings of this National Academies report, which found that these concepts have technical promise and at least find a way to allow strong merit-reviewed proposal for inertial fusion energy research to be eligible for federal support?

Dr. HOLDREN. Let me make a couple of quick comments. We of course are aware of the National Academies report. We recognize the progress that has been made in inertial confinement fusion in a number of different ways, with the lasers, with pulse power, with ion beams. Those approaches of course have not yet demonstrated the level of performance that would be needed to convert them into an energy source. They are in fact still well short of the performance of the magnetic confinement approach, which is being pursued in parallel.

Under the budget restraints we face, we think the most important thing to continue funding in the inertial confinement space is the NIF and its progression toward ignition.

The experiment you mentioned at the Lawrence Berkeley Lab is a small one completed at a cost of about $11 million. It began operating two years ago but it has fallen far short of its design specifications and so it is hard to keep it near the top of the priority list given the tight budget and the performance shortfalls in that particular device.

Mr. SWALWELL. Thank you, Dr. Holdren. Thank you for your service to our country, for your belief in science, and for now knowing what to be better prepared to discuss next time you come back, including whether gravity is really occurring and whether our Earth is flat or round.

Thank you and I yield back.

Chairman SMITH. Thank you, Mr. Swalwell.

Dr. Holdren, thank you for your testimony today. We appreciate that very much.

Our record will stay open for a couple of weeks in case Members have additional questions to submit. And with that, we stand adjourned.

[Whereupon, at 12:08 p.m., the Committee was adjourned.]

Appendix I

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Dr. Holdren

HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

"A Review of the President's FY 2015 Budget Request for Science Agencies"

Questions for the Record, The Honorable John P. Holdren,
Director, Office of Science and Technology Policy

Questions submitted by Rep. Lamar Smith, Chairman, Committee on Science, Space, and Technology

1. Based on your knowledge and experience of risk assessments performed by U.S. government agencies:

a. How often are underlying raw data for the most critical studies made available to those who conduct a regulatory risk assessment? (Never, Rarely, Sometimes, Often, or Always)

Risk assessors often access and utilize tabulated and curated data sufficient to reproduce and evaluate published results, but it is less frequent that agency risk assessors specifically attempt to obtain the "underlying raw data." This is consistent with *OMB Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by Federal Agencies*, which state that an agency:

> **"...should consider the types of data that can practicably be subjected to a reproducibility requirement given ethical, feasibility, and confidentiality constraints. In making this determination, the [assessor] should hold analytical results to a higher standard than original data. ...When the ... information it will disseminate is influential scientific, financial, or statistical information, it should assure reproducibility according to commonly accepted scientific, financial, or statistical standards. In situations where public access to the data will not occur, the [assessor] should apply rigorous robustness checks to analytic results and document what checks were undertaken."**

Looking forward, both my February 2013 memorandum *Increasing Access to the Results of Federally Funded Scientific Research* and OMB/OSTP's May 2013 memorandum *Open Data Policy - Managing Information as an Asset* clearly emphasize the importance of making Federally-funded publications and research data openly available "to the greatest extent and with the fewest constraints possible." [1] Both of these memoranda specifically acknowledge the need to conduct a full analysis of privacy, confidentiality, and security risks into each stage of the information lifecycle to identify information that should not be released.

b. How often are underlying raw data for the most critical studies made available to those who peer review a regulatory risk assessment? (Never, Rarely, Sometimes, Often, or Always)

The provision of information to peer reviewers is guided by an understanding of the extent to which such data are commonly accepted in the scientific community as necessary to validate research findings (see above), and is also guided by Federal policy frameworks designed to protect privacy, confidentiality, and security.

[1] http://www.whitehouse.gov/sites/default/files/omb/memoranda/2013/m-13-13.pdf

OMB's *Information Quality Bulletin for Peer Review*[2] directs Agencies "...to choose a peer review mechanism that is adequate, giving due consideration to the novelty and complexity of the science to be reviewed, the relevance of the information to decision making, the extent of prior peer reviews, and the expected benefits and costs of additional review." Furthermore, in the case of highly influential scientific assessments, the Bulletin directs agencies to:

> **"....provide the reviewers with sufficient information -- including background information about key studies or models -- to enable them to understand the data, analytic procedures, and assumptions used to support the key findings or conclusions of the draft assessment."**

c. How often are standardized search protocols used and described for collecting all available data/studies and assuring full acquisition of relevant data/studies? (Never, Rarely, Sometimes, Often, or Always)

The response to this question is case specific. From my recent experience, the search protocols used in the Third National Climate Assessment, for instance, were very rigorous and identified all the relevant data/studies, supplemented by open public-comment processes to elicit any additional information not available on the routine search protocols.

d. Should the criteria for evaluating the quality and reliability of all studies be the same, regardless of their origin (academia, government, industry, contract labs, etc), when used in a regulatory risk assessment? (Yes or No)

***OMB Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by Federal Agencies* do not distinguish the source of the information, only the context in which the Federal government uses that information. Rather than focusing on who generated the information, the Guidelines lay out a higher standard of reproducibility for information that "...the agency can reasonably determine that dissemination of the information will have or does have a clear and substantial impact on important public policies or important private sector decisions."[3]**

e. When the weight of evidence indicates a non-mutagenic mode of action, should a non-linear (threshold) model or a linear (no-threshold) model be used to estimate the risk to humans from substances that cause cancer at high doses in lab animal studies? (Non-Linear or Linear)

This important risk-assessment question is more complex than indicated in the question and has been the subject of a number of reports by the National Academies. There is no scientific consensus on the dose-response modeling (linear vs. non-linear) of chemicals operating via a non-mutagenic mode of action for cancer endpoints. This issue is discussed in the National Research Council's *Science and Decisions: Advancing Risk Assessment* (2009; http://www.nap.edu/catalog.php?record_id=12209) and the EPA's *Guidelines for Carcinogen Risk Assessment* (2005;

[2] http://www.whitehouse.gov/sites/default/files/omb/memoranda/fy2005/m05-03.pdf
[3] http://www.whitehouse.gov/omb/fedreg_reproducible/

http://www.epa.gov/cancerguidelines/). Although it is important to understand the mode of action (MOA) of a chemical or physical agent, along with considerations of dose-response and exposure, decisions on risk cannot necessarily be dichotomized in the manner implied in the question and should be conducted as a part of a comprehensive risk assessment process.

f. How often do current peer review processes provide sufficient opportunity for input from all interested stakeholders on the charge questions assigned to the peer review panels? (Never, Rarely, Sometimes, Often, or Always)

OMB's *Information Quality Bulletin for Peer Review* requires that agencies "...establish a mechanism for allowing the public to comment on the adequacy of the peer review plans." Independent peer reviews conducted under the Federal Advisory Committee Act (FACA) provide an opportunity for written and oral public comment by stakeholders prior to consideration by the expert review panel. In many Federal peer review situations, particularly those conducted under FACA, stakeholders are accorded means by which they can identify issues for peer reviewers, whether through written public comments or during oral question periods.

2. You previously testified in response to a question about transparency and EPA regulations that "absolutely, the data on which regulatory decisions and other decisions are based should be made available to the Committee and should be made public." Do you still agree with this view?

a. Do you believe that the data and scientific information on which regulations are based should be reproducible?

b. In the peer review process, are peer reviewers always provided access to the underlying and raw data behind a study?

The science and data upon which regulations are based should be reproducible. This is both a fundamental tenet of science and a concept that has been incorporated in *OMB Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by Federal Agencies.* Specifically, those guidelines state that "reproducibility means that the information is capable of being substantially reproduced, subject to an acceptable degree of imprecision." In the scientific community, this does not necessarily imply access to the original raw data from another researcher, but rather that further experimentation either using similar methods or an alternative approach can reproduce the results of the initial study, leading to independent confirmation and weight-of-evidence support to a concept. This understanding of reproducibility is reflected in the OMB Guidelines which state, as examples, "it may not be ethical to repeat a "negative" (ineffective) clinical (therapeutic) experiment and it may not be feasible to replicate the radiation exposures studied after the Chernobyl accident." The Guidelines also address the evaluation of individual study data in government decision-making, noting that "Agencies may identify, in consultation with the relevant scientific and technical communities, those particular types of data that can practicably be subjected to a reproducibility requirement, given ethical, feasibility, or confidentiality constraints. ... OMB urges caution in the treatment of original and supporting data because it may often

be impractical or even impermissible or unethical to apply the reproducibility standard to such data." (http://www.whitehouse.gov/omb/fedreg_reproducible)

My full statement at the June 2012 hearing was: "*I think the principle is*—absolutely the data on which regulatory decisions and other decisions are based should be available to the Committee and should be made public *unless there is a classification reason*." I agree that scientific data on which regulatory and other decisions are based should be made publicly available where possible so that results can be reproduced but, as I stated then, classification on national-security grounds is one reason it may not be possible, and other reasons that I should have added include patient-privacy concerns and business proprietary information. My February 2013 memorandum, *Increasing Access to the Results of Federally Funded Scientific Research*, elaborates at greater length on the factors that bear on the stated condition, "to the greatest extent and with the fewest constraints possible." Thus, peer reviewers are not always provided access to the full underlying and raw data behind a study.

3. One of the three models relied upon for the Administration's "Social Cost of Carbon" estimate is proprietary and not public. Similarly, the model used in the Administration's proposed power plant regulations for carbon dioxide - known as the Integrated Planning Model - is also proprietary and not public. Is this practice consistent with the Administration's Scientific Integrity policies?

With regard to the Social Cost of Carbon, the three Integrated Assessment Models (IAMs) used to develop the SCC estimates (DICE, FUND, PAGE) are documented and detailed in the published peer-reviewed literature, and the source code is available on the developers' websites or upon request from the relevant developer.

The Integrated Planning Model (IPM®) platform is a product of ICF Resources, LLC, an operating company of ICF International, Inc., and is used in support of its public and private sector clients. It is proprietary in that ICF charges for its use, with clients including utilities, government agencies, and non-government organizations. EPA uses IPM to analyze the projected impact of environmental policies on the electric power sector in the 48 contiguous states and the District of Columbia. IPM is a multi-regional, dynamic, deterministic linear programming model of the U.S. electric power sector. It provides forecasts of least-cost capacity expansion, electricity dispatch, and emission control strategies for meeting energy demand and environmental, transmission, dispatch, and reliability constraints. IPM can be used to evaluate the cost and emissions impacts of proposed policies to limit emissions of sulfur dioxide (SO2), nitrogen oxides (NOx), carbon dioxide (CO2), hydrogen chloride (HCl), and mercury (Hg) from the electric power sector.

These practices are consistent with the Administration's Scientific Integrity policies, both because ICF provides its proprietary access for a fee – a situation applicable to most software including MS Word used for word processing – and because EPA, for instance, provides its coding inputs back to ICF for use by other organizations wishing to reproduce EPA's model analyses.

4. The President's executive order on regulations says that regulations must be "based upon the best available science." In your view, are non-public or non-reproducible data or models considered the "best available science"?

In addition to saying that our regulatory system "must be based on the best available science," Executive Order 13563, *Improving Regulation and Regulatory Review*, also states that, "Consistent with the President's Memorandum for the Heads of Executive Departments and Agencies, *Scientific Integrity* (March 9, 2009), and its implementing guidance, each agency shall ensure the objectivity of any scientific and technological information and processes used to support the agency's regulatory actions."[4] This latter statement speaks more directly to the question posed, and is consistent with *OMB Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by Federal Agencies.*

Limited public access to underlying data does not inherently limit reproducibility, including the ability to reproduce research findings in other study populations. My February 2013 memorandum *Increasing Access to the Results of Federally Funded Scientific Research*, in conjunction with OMB and OSTP's May 2013 memorandum *Open Data Policy - Managing Information as an Asset*, are designed to promote access to research data, recognizing that some types of data include personal medical and similar private information of study participants that is subject to appropriate protections. These memoranda clearly emphasize the importance of making Federally-funded publications and research data openly available "to the greatest extent and with the fewest constraints possible."

5. In 2012, you testified before this Committee that hydraulic fracturing has not produced any documented cases of groundwater contamination. Do you still agree with that statement?

a. Do you agree with the statement that the states have unique expertise in regulating oil and gas production within their borders?

There are some cases that are at least ambiguous. One recent peer-reviewed survey[5] mentioned one documented case of direct groundwater pollution resulting from injection of hydraulic fracturing chemicals. This case was documented by the EPA in 1987 in a report to Congress. That report contains an account of a vertical well in West Virginia from 1982 that was hydraulically fractured at a shallow depth. Fracturing fluid is suspected to have migrated to groundwater sources through nearby old natural gas wells.[6] Another recent review article[7] provides no additional evidence suggesting that hydraulic fracturing directly results in groundwater contamination but discusses various other pathways (e.g.

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[4] http://www.gpo.gov/fdsys/pkg/CFR-2012-title3-vol1/pdf/CFR-2012-title3-vol1-subjectgroup-id154.pdf

[5] Vidic, R.D., et al., *Impact of Shale Gas Development on Regional Water Quality.* Science, 2013. **340**(6134).

[6] U.S. Environmental Protection Agency, *Report to Congress: Management of wastes from the exploration, development, and production of crude oil, natural gas, and geothermal energy*, Office of Solid Waste and Emergency Response, Editor. 1987: Washington, DC.

[7] Vengosh, A., et al., *A Critical Review of the Risks to Water Resources from Unconventional Shale Gas Development and Hydraulic Fracturing in the United States.* Environmental Science & Technology, 2014.

stray gas migration, failed well casing) and documents cases where groundwater sources have been affected by other natural gas production activities.[8] [9] [10] [11] [12]

Regulatory requirements established by states overseeing exploration and production of oil and natural gas resources vary between states in order to address geologic, environmental, and legislative requirements specific to each state. Organizations such as the Federal-state-industry public private partnership in the State Review of Oil and Natural Gas Environmental Regulations (STRONGER) represent collaborative efforts to ensure that state regulations protect environmental and groundwater resources. STRONGER leverages unique experiences and technical skills across industry and state partners to develop guidelines and provides voluntary regulatory review process to help states improve their oil and gas regulatory programs. [13] [14]

6. Do you think it is appropriate to set pollution standards that are below naturally occurring background levels?

A variety of parameters must be considered when evaluating alternative pollution standards. It is not possible *a priori* to reject a given standard without understanding the risk at hand. For example, in the U.S. background ozone (O_3) concentrations can include those concentrations resulting from natural sources everywhere in the world plus anthropogenic sources outside the U.S. If natural concentrations of a substance are already believed to be causing harm, even modest additions to those concentrations may be considered problematic.

7. Do you believe that any of the criteria air pollutants under the Clean Air Act (ozone, lead, sulfur dioxide, nitrogen oxide, carbon monoxide, particulate matter) have a threshold below which they are not harmful to human health (or may be beneficial)?

As a general matter for the health-relevant endpoints associated with the criteria air pollutants, there may be concentrations below which no population-level adverse health effects would be evident; however, at this time the available scientific evidence does not indicate a population-level threshold for any criteria air pollutant. As a practical matter, it is sometimes very difficult to determine with confidence whether such thresholds exist for a population and what their magnitude is, taking into consideration the uncertainty inherent in signal-to-noise levels in the data, variability with respect to individual

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[8] Osborn, S., et al., *Methane contamination of drinking water accompanying gas-well drilling and hydraulic fracturing.* Proceedings of the National Academy of Sciences, 2011. **108**(20): p. 8172-8176.

[9] Darrah, T.H., et al. *Constraining the Source and Migration of Natural Gas in Shallow Aquifers within Active Shale Gas Production Zone: Insights from Integrating Noble Gas and Hydrocarbon Isotope Geochemistry*. in *Insights from Integrating Noble Gas and Hydrocarbon Isotope Geochemistry; Geological Society America Annual Meeting*. 2012. Charlotte, NC.

[10] Jackson, R.B., et al., *Increased stray gas abundance in a subset of drinking water wells near Marcellus shale gas extraction.* Proceedings of the National Academy of Sciences, 2013. **110**(28): p. 11250-11255.

[11] Kissinger, A., et al., *Hydraulic fracturing in unconventional gas reservoirs: risks in the geological system, part 2.* Environmental Earth Sciences, 2013. **70**(8): p. 3855-3873.

[12] Flewelling, S.A., M.P. Tymchak, and N. Warpinski, *Hydraulic fracture height limits and fault interactions in tight oil and gas formations.* Geophysical Research Letters, 2013. **40**(14): p. 3602-3606.

[13] National Energy Technology Laboratory and Groundwater Protection Council, *State Oil and Natural Gas Regulations Designed to Protect Water Resources*, Department of Energy, Editor. 2009.

[14] State Review of Oil & Natural Gas Environmental Regulations (STRONGER). *State Review of Oil & Natural Gas Environmental Regulations*. 2014 [cited 2014 May 18]; Available from: http://www.strongerinc.org/.

thresholds that can result in linear dose-response relationships in the population (NRC 2009), and other complications. The language of the Clean Air Act (CAA), requiring that primary National Ambient Air Quality Standards be set "which in the judgment of the Administrator, based on such criteria and allowing an adequate margin of safety, are requisite to protect the public health," allows for consideration of such issues.

8. Is there a social benefit to carbon?

CO2 is a plant nutrient that also plays important roles in determining ocean chemistry and the energy-balance of the Earth atmosphere system. At the atmospheric CO2 concentrations that prevailed for some centuries before the last one, all of these influences could be considered benefits inasmuch as they contributed to maintaining environmental conditions that allowed for a highly productive biosphere and the rise of a flourishing human civilization dependent on it. It is true for CO2, however, as for many other chemical compounds and elements in the environment, that what is "good" within a particular range of concentrations can be "bad" when the concentrations are considerably higher. The human-driven increase of the atmospheric CO2 concentration to more than 40 percent above its pre-industrial value is demonstrating that proposition by causing changes in global climate that, on the whole, are proving harmful to human health, safety, comfort, property, and a good many of the agricultural and forest ecosystems upon which society depends. In addition, absorption by the ocean of part of the excess CO2 that humans have added to the atmosphere through fossil-fuel burning and land-use change has led to a significant increase in the ocean's acidity, which together with ocean warming is imperiling corals and many other organisms that build their shells or skeletons from calcium carbonate.

It is true that, all else being equal, higher CO2 concentrations increase plant growth; but, offsetting that, there is evidence that the nutritional content of many plants goes down under increased CO2, and the climate changes resulting from the CO2 buildup are likely to offset the CO2-fertilization effect through damage from geographically varying combinations of heat stress, drought, saltwater intrusion, and intensification of pest and pathogen threats. Similarly, although there is an economic benefit of a warming climate in reducing heating expenses and cold weather-related mortality, these effects have been evaluated and found to be smaller than the countervailing impacts of increased air-conditioning expenses and heat-related mortality.

9. If a regulation has no costs and no benefits, do you think it should be proposed and finalized?

Benefit-cost analysis in the Federal Government is conducted consistent with Executive Order 12866, which directs agencies, to the extent permitted by law, to assess both the costs and benefits of an intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs. In many cases not all the benefits and costs of a rule can be quantified and/or monetized.

10. In a September 2013 hearing before this Committee, when asked about to comment on the severity of potential for a satellite data gap, with 10 being the worst, Mr. David Powner, the Director of Information Technology Management at the Government Accountability Office

responded with a 10, stating that, "we are predicting a 17-month gap... Having no gap at all I think is highly unlikely, so I would put it at 10."

a. In light of this answer, do you agree that our Nation is facing an unprecedented gap in satellite data?

The potential gap in polar-orbiting weather satellites for civil forecasting needs is unprecedented but not unmanageable. It is true that NOAA's legacy POES programs and the GOES and future GOES-R programs are more robust than the JPSS program; the best way to mitigate a gap in the current and future polar orbit is to focus on making JPSS more robust.

b. Do you agree that we should be pursuing all opportunities to mitigate the gap, including hosted payloads, and the purchase of commercial satellite data?

NOAA is exercising all due diligence in pursuing opportunities and pathways for mitigating the gap. The most important step is improving the robustness of the JPSS program. The FY 2015 President's Budget allows NOAA to do that in three ways:

- **First, the budget provides sufficient funds to ensure the primary satellite providing operational weather data in the afternoon polar orbit, Suomi NPP, is operated and managed to maximize the length of its mission life.**
- **Second, the budget keeps the JPSS -1 spacecraft on track to launch no later than the second quarter of FY 2017.**
- **Finally, the budget allows the JPSS program to purchase additional, critical long-lead sub-assemblies and parts to support the build of spare ATMS (Advanced Technology Microwave Sounder) and CrIS (Cross-track Infrared Sounder) instruments, while also protecting the accelerated JPSS-2 schedules. These two instruments – ATMS and CrIS – are the most critical to the National Weather Service (NWS).**

In addition, thanks to funding in the Sandy Supplemental, NOAA is testing and evaluating means to mitigate the impact of the gap on NWS forecasts through non-satellite means. This effort includes augmentation of NOAA's operational and research high-performance computing, testing UAVs, and improving data assimilation techniques. This group of projects currently under evaluation and testing were independently verified in the Riverside Report to be of the highest-merit ways to mitigate an impact of a gap in polar weather data.

c. Do you agree that it is better to rely on commercial U.S. satellite data rather than foreign governments?

There is no foreign or commercial source of data that can replace the satellites in afternoon orbit. The mitigation of the gap should be pursued from all available sources that have the potential to mitigate the potential loss of data. All else being equal, commercial U.S. satellite data sources are preferable to foreign sources of data, though I note we currently rely on free and open weather data from polar orbit every morning provided our trusted allies in Europe.

11. Could you describe any unofficial advice or guidance that you or your office provided to the President or the Administration's science agencies in their review of the Keystone pipeline?

a. Do you share the perspective of the State Department report on the Keystone pipeline that net greenhouse gas emissions would be essentially unaffected regardless of whether the project goes ahead, because China and other countries would simply buy the shale oil from Canada instead of the United States?

b. Do you have any reason to dispute the key scientific findings that the pipeline can be built and operated in an environmentally sound manner?

c. Do you agree that transmission of oil and gas is more efficient by pipeline compared to shipment by train or tanker? Have you considered the environmental and safety implication of relying on rail and road in the absence of adequate pipeline infrastructure?

d. Do you agree that approval of the Keystone XL pipeline would lead to real wealth creation by signaling to developers that this Administration supports the build-out of critical infrastructure in America and a true "all-of-the-above" energy strategy?

As I stated at the hearing, I have not done a review of the State Department's analysis of the Keystone XL Pipeline project, and not having reviewed the analysis, I am not in a position to offer any judgments on the State Department analysis or on the proposed project. As was the case at the time of the hearing, the Secretary of State is still reviewing public comments on its draft supplemental Environmental Impact Statement, preparatory to issuing a final version.

12. Two years ago, in April of 2012, President Obama signed an Executive Order announcing formation of an interagency working group led by the White House to coordinate and plan agency activities for hydraulic fracturing research. The Department of Energy, EPA, and US Geological Survey committed to developing an interagency research plan. At the time, the Administration told Congress that we would see this research plan in January of 2012. As a key White House office leading this interagency task-force:

a. What is the reason for the extended delay in producing the interagency plan?

b. When will the plan the submitted to Congress?

c. How much has the President requested - across all Agencies – for these efforts?

Please: 1) outline the total request; 2) detail the Agency by Agency requests that make up this total; 3) explain the specific activities that will be funded; and 4) detail the goals of those initiatives.

d. How does the Administration come up with a budget request without having first come up with a plan of action? In other words, if you don't know what you are going to do-how do you justify the expense?

e. Can you speak more generally to what you and the federal government are doing to ensure research undertaken to inform potential regulatory actions is done openly and in a balanced manner?

f. What steps are you taking to ensure that Agencies aren't duplicating efforts of States . or other Agencies and thereby wasting tax-payer money in the process?

g. What steps are you taking to ensure that the federal government does not infringe on areas of traditional State and Tribal sovereignty?

The Department of Energy (DOE)-Department of the Interior (DOI)-Environmental Protection Agency (EPA) Multiagency Collaboration on Unconventional Oil and Gas Research focuses on identifying research opportunities for Federal agencies to provide timely science and tools to support sound policy. The tri-agency team is nearing completion of a research strategy that describes each agency's core competencies and coordinates research budget requests along topics of scientific relevance to prudent development of oil and gas resources. Beginning in 2012, the interagency steering committee convened a technical subcommittee composed of Federal subject matter experts on an array of technical issues associated with oil and natural gas production in a manner that is environmentally sound and protective of human health and safety. The technical subcommittee reviewed scientific, nongovernmental organization (NGO), and state literature on scientific and research needs to address the consequences of unconventional oil and gas production, which is informing the drafting of the interagency research strategy. In addition to the literature review conducted by the technical subcommittee, the multiagency steering committee conducted a series of stakeholder outreach webinars in July 2012 to solicit feedback from states and tribes, NGOs, academia, and industry stakeholders. Preparation of this interagency strategy is in its final stages, although a specific release date has not been determined.

13. For the first time ever, the President's budget request included $25 million to fund CCS projects for natural gas power plants. Likewise, the $77 million for other carbon capture projects (see DOE FY 15 Budget Request, vol. 3, p. 551) requests "support for up to 3 pilot scale projects testing advances carbon capture technologies from natural gas power systems."

a. Please provide details of these programs and the rationale behind this change in direction.

In its Climate Report to the President, the President's Council of Advisors on Science and Technology (PCAST) emphasized the need to accelerate deployment of carbon capture and storage (CCS) for coal and also emphasized that CCS will also eventually be necessary for other large, stationary sources of carbon dioxide pollution, including natural-gas power plants and other industrial sources. Indeed, many of the advanced technologies for CCS have broad applicability across coal, integrated gasification "syngas," and natural gas. In many instances, advanced technologies are initially tested using natural gas due to its ease of up-front management compared to the infrastructure necessary for coal conversion to syngas and removal of pollutants. Congress has recognized this synergy in the 2014 Consolidated Appropriations Act report language, which states: "The Department [of Energy] is further directed to use funds from CCS and Power Systems for both coal and natural gas research and development as it determines to be merited, as long as such research does not occur at the expense of coal research and development." One such example is oxy combustion, where burning natural gas (or coal syngas) with pure oxygen leads to a stream of steam and CO_2, and hence does not require expensive post-combustion separation and capture. The 2015 Budget includes a $25 million competitive solicitation to

support a demonstration project to capture and store >75 percent of the carbon emissions from a natural gas power system of at least 25 MW capacity. This will advance technologies for both natural gas and coal-syngas CCS technologies. For the future, the United States looks to even cleaner power generation through capturing the carbon emissions from coal and natural-gas power plants and using the CO_2 for enhanced oil recovery or sequestering it underground. The funding request continues support for carbon capture technologies to meet the endpoint goal of $40/ton of CO_2 captured and does not represent a change in DOE program objectives.

b. What is the total request for carbon capture related activities? Please detail:

1) the specific fuel type; and 2) capture method of each project DOE was previously, is currently, or will be considering involvement with in any capacity. Further, identify the specific federal involvement and any federal funding utilized.

c. For future projects, what metrics will be used in selecting projects? Has this changed in any way from previous selection criteria?

Beyond the information included in the President's Budget request and associated explanatory materials, full elaboration on this question would best be addressed to the Department of Energy. My understanding is that the total request for activities relating to carbon capture in the DOE Coal Program includes:

- **$25 million in CCS Demonstrations, specifically focused on carbon capture and storage for natural-gas applications.**
- **$77 million in Carbon Capture for fossil fuel fired plants, with the primary focus on post- and pre-combustion capture for coal-fired power plants, including laboratory-, bench-, and small-scale pilot projects. The FY15 request would initiate one large-scale slipstream/pilot test (10+ MWe) of a second-generation carbon capture technology for a coal-fired power plant.**
- **$15 million in Advanced Combustion Systems supports research and development for oxy combustion and chemical-looping technologies for coal-fired applications.**

The funding would continue to support a variety of technologies, including advanced solvents, sorbents and membranes, novel equipment and process designs, new designs and concepts for oxy combustion, and chemical-looping cycles. Additionally, there is interest in transformational technologies and approaches such as electrochemical separation and non-aqueous and phase-change solvents. Details on project-selection methods would best be addressed to DOE; presumably those methods will continue to be in accordance with DOE and Federal guidelines for procurement and project management, based on scientific and technical merit, technical approach, and project-management planning and execution.

14. Earlier this year, the Administration announced that it would conduct a Quadrennial Energy Review (QER) to "provide an integrated view of, and recommendations for, federal energy policy in the context of economic, environmental, occupational, security, and health and safety priorities."

Please detail the specific steps being taken to insulate this review from political pressures and ensure that technical and economic experts are afforded the independence to make frank assessments.

In establishing the Quadrennial Energy Review (QER), the President, through his January 2014 Presidential Memorandum, required the QER Task Force to engage "State and local governments, tribes, large and small businesses, universities, national laboratories, nongovernmental and labor organizations, and other stakeholders and interested parties." The stated purpose for this engagement was not only to gather information, but "to provide for a transparent process in developing the Quadrennial Energy Review Report."

One important way in which the technical and economic experts who will be consulted through this process can make frank and independent assessments is through a series of formal, public, stakeholder meetings around the country, which began with a meeting in the Capitol Visitors Center on April 11 and will continue throughout the summer. These meetings are being organized by the Energy Policy and Systems Analysis Office of the Department of Energy (DOE), operating as the Secretariat for the QER. In both the presentations and discussion by panelists at these public meetings and in the portions of these events open for public comment, attendees are specifically asked for their personal professional opinions, so that the government can receive independent input from professionals in energy infrastructure and related fields in the areas of their expertise.

The public can be assured that this information has been provided in an open and transparent manner by examining the record that is being maintained on the QER website (www.energy.gov/qer). A transcript, meeting summary, and copies of all panelist presentations will be posted for each public stakeholder meeting. As other technical workshops are organized during the QER process, a workshop agenda, list of participants, workshop summary, and related documents will be posted for each workshop.

Finally, DOE has created e-mail portals to enable technical experts from across industry sectors and from all disciplines to offer whatever statements, reports, studies, and data sets they wish to the QER. Comments received through these portals will be made public, and all supplementary materials will become part of a virtual QER library to be maintained by the QER Secretariat. These portals are up and running— QERcomments@hq.doe.gov for general comments and materials commenters desire to be made public, and QERconfidential@hq.doe.gov for business-sensitive, proprietary, or other materials stakeholders want DOE and other agencies to have for analytical purposes, but wish to keep confidential—and comments are being reviewed as they come in.

15. Though you and your office refuse to admit the level of involvement of Todd Park with the Healthcare.gov website prior to its launch, the media has helped to characterize his involvement post October 1st. It is unfortunate that Todd Park refuses to testify before our Committee and is instead happy to discuss the website with the media; however, a recent Time Magazine article which features him as someone who became a self-proclaimed "full-time Healthcare.gov fixer" raises some new questions on OSTP's involvement with the website.

a. Please inform the Committee which OSTP personnel have been used in the attempted fixes of the functionality and security of the Healthcare.gov website post October 1st.

b. Was any OSTP funding used to pay OSTP personnel who worked on the website, or to fix the broken website?

OSTP has not refused to admit Todd Park's level of involvement with the Healthcare.gov website prior to its launch, but Mr. Park's involvement increased substantially post-launch. After October 1, 2013, Mr. Park worked with Centers for Medicare & Medicaid Services (CMS) staff on improving the site's stability, scalability, and functionality. Beyond Mr. Park, no OSTP-funded personnel had significant involvement with that work.

16. Please provide the Committee with details of all the trips you have taken to China while employed as director of OSTP.

a. Please explain to the Committee what tangible gains the U.S. has achieved from all of the time you have spent in China. Please be as specific as you can, including providing evidence of actions or steps that China has taken to honor any commitments made during your trips, or conversely not made despite assurances it would.

I traveled to China on four occasions since the beginning of the Administration: June 7-10, 2009; May 22-26, 2010; October 12-16, 2010; and April 29-May 4, 2012 (including travel time).

My trips to China have been to co-chair the U.S.-China Dialogue on Innovation Policy ("Innovation Dialogue") under the U.S.-China Strategic & Economic Dialogue (S&ED), to participate in the S&ED itself, and to co-chair the Joint Commission Meeting (JCM) on U.S.-China Science and Technology Cooperation under the U.S.-China Science and Technology Agreement. The April-May 2012 trip for the JCM was to conduct the 14th ministerial meeting since the signing of the STA in 1979 and highlighted the continued interaction between the United States and China on science and technology in ways that benefit both countries.

The results of the Innovation Dialogue meetings have been commitments from China that fit into the larger discussion conducted at the annual S&ED, U.S.-China Joint Commission on Commerce and Trade (JCCT), and high-level meetings between the President and Vice President with their Chinese counterparts. For example, after establishing the Innovation Dialogue at the S&ED meeting in May 2010 in Beijing, at the JCCT meeting in December 2010 China committed "not [to] adopt or maintain measures that make the location of the development or ownership of intellectual property a direct or indirect condition for eligibility for government procurement preferences for products and services." This was followed by a commitment from then-President Hu during his State Visit to the United States in January 2011 for China "not to link China's indigenous innovation policies to government procurement preferences." Finally, during the Innovation Dialogue and through the S&ED mechanism, China acknowledged that both our countries should adopt innovation policies that are consistent with four principles: non-discrimination; support for market competition and open international trade and investment; strong IP protection and enforcement; and leaving the terms and conditions of technology transfer, production processes, and other proprietary information to agreement between individual enterprises.

Working with our interagency colleagues and private-sector interlocutors, we have continuously monitored China's compliance with these commitments. Although the

commitments at these meetings do not end all discriminatory regulatory action by the Chinese government, they have provided the basis for improvements and provided the U.S. government with a tool to correct problems as they arise. In May 2014, the U.S.-China Business Council released its latest version of a report highlighting concerns over China's Innovation and Government Procurement Policies including those that it found inconsistent with this series of commitments on non-discrimination. The report documents the use of the specific commitments listed above and achieved in part through my own efforts as the key tool to convince Chinese government agencies and provinces to make changes that benefit American companies operating in China:

> **"19 provinces have released notices and announcements to comply with the central government requirements [proscribing measures that link innovation and government procurement]. Fourteen provinces...have complied to some degree after the November [2011] State Council notice [announcing the policy] was issued. An additional 4 provinces...did so before the notice was issued.... An additional 39 sub-provincial units...have issued notices and announcements to comply with central government requirements."**

The report also recognizes that twelve provinces have not released any measures to comply with the State Council Notice and that seven local regulations issued since November 2011 directly contradict the State Council Notice. I will continue to raise this issue with my Chinese interlocutors, along with my Cabinet colleagues, as a priority of the Administration.

17. The President's FY15 budget request for STEM education activities across 14 federal agencies is $2.9 billion. This budget proposes a "fresh reorganization" among these federal agencies. This year the "fresh" proposal would cut or consolidate 31 STEM programs at 9 agencies. NASA is targeted for the greatest number of cuts with 11 programs. How do these proposed cuts work within the cuts and consolidations that were proposed in FY14, are these new or additional cuts? How many of the proposed cuts from FY 2014 were actually made? What evaluation criteria did the Administration use to base its decisions for which agency's STEM education programs should be cut or changed in FY15? On what basis did you find NASA's STEM education initiatives to be ineffective and in need of cutting in both FY14 and FY15? Please provide the Committee with a detailed explanation of the program cuts and consolidations that were proposed last year, those made last year, and a detailed list of the programs targeted this year.

The week of the hearing, I delivered to the Committee a Progress Report on Coordinating Federal Science, Technology, Engineering, and Mathematics (STEM) Education. I am attaching a copy of the report to my responses. The report is a detailed explanation of the program cuts and consolidations that were proposed last year, those made this year, and a detailed list of Federal STEM education programs, including those proposed for elimination in the 2015 Budget. The 2015 Budget proposes to reduce the total number of STEM-education programs from an estimated 138 as reflected in FY 14 agency operating plans to 111 programs in FY 2015 from the creation of 6 new programs (including a new NASA program) and the elimination of 33 programs. Please see Table 2 in the report.

The report provides the program-level details for the substantial reduction in the fragmentation of the Federal STEM education portfolio that has happened in the last two

years, from 228 STEM-education programs in 2012 to an estimated 138 in 2014, as a result of the substantial number of internal consolidations and eliminations that agencies began implementing in 2013 and 2014.

With regard to NASA, the Administration's proposed consolidation of NASA's programs in FY15 is aligned with NASA's internal restructuring efforts already underway. The new structure for NASA's programs will improve the management of NASA education activities, allow NASA to reinvent its formal and informal education portfolios to better address the Administration's STEM goals, and help ensure that NASA is supporting the most effective STEM-education activities.

The Administration did review available evaluations of NASA programs. Those programs with demonstrated effectiveness through rigorous evaluations would be eligible for, and would likely do well in, competitions for funding within the Office of Education and within the Science Mission Directorate as proposed in the FY 2015 Budget.

18. The NASA budget request includes a $16 million cut to the National Space Grant College and Fellowship program, setting funding for the program at $24 million. Space Grant is at work in all fifty states and rated highly effective in many states. The Administration proposed similar cuts last year but Congress funded the program at $40 million. Why was Space Grant singled out again for such a large budget cut?

Tight fiscal constraints force the Administration to make many difficult choices throughout the 2015 Budget. Within these fiscal constraints, the 2015 Budget for NASA continues to support the National Space Grant College and Fellowship Program at $24 million, the same amount that was requested in last year's 2014 Budget.

19. In OSTP budget documents, $2.2 billion is listed as the FY15 request for "advanced manufacturing R&D". The President's budget for FY15 also notes support for the National Network for Manufacturing Innovation (NNMI). While the NNMI has not been authorized or funded by Congress, the Administration has already launched four institutes and announced five additional institutes. Are additional Innovation institutes planned? If so, how many will there be, what industries will they be for, and how will they be funded?

Utilizing already appropriated funds, the Administration has so far launched four manufacturing-innovation institutes. The President's 2015 Budget proposes expanding on these efforts with funding for 5 more institutes. The Budget's Opportunity, Growth, and Security Initiative would provide funding for additional institutes in support of the goal of creating a national network of up to 45 of these institutes over the next 10 years. The 9 institutes to be supported by already-appropriated funds and the proposed 2015 appropriations are or would be organized around topics that are of mission interest to the sponsoring agencies. As an example, the already-awarded institutes are for additive manufacturing, next-generation power electronics, lightweight and modern metals manufacturing, and digital manufacturing and design. Currently, the Department of Energy (DOE) is hosting a competition for an Advanced Composites Manufacturing Innovation Institute. If Congress appropriates funds for additional institutes as proposed in the Opportunity, Growth, and Security Initiative, the Administration anticipates that many of these institutes will be awarded through open competitions in which consortia will

propose combinations of industries and topics to meet national innovation needs related to advanced manufacturing.

20. One of the arguments for ending NASA's SOFIA airborne observatory is that it is no longer considered a scientific priority by the science community. However, SOFIA was ranked among the mostly highly recommended moderate-sized projects in the 1991 National Academies' decadal survey for astronomy and astrophysics.[15] The 2001 decadal survey stated that that the Astronomy and Astrophysics Survey Committee "reaffirms the recommendations of the 1991 Astronomy and Astrophysics Survey Committee (NRC, 1991) by endorsing the completion of...the Stratospheric Observatory for Infrared Astronomy (SOFIA)". [16]

SOFIA was not mentioned in the 2010 Decadal survey. Isn't it understandable that when the survey was written it was believed that SOFIA would be completed and fully operational by the Decadal's completion? If omitting SOFIA from the latest Decadal survey is indicative of it not being a scientific priority then what does that say about the omission of the Hubble Space Telescope from the 2001 and 2010 Decadal Surveys? Could the Hubble Space Telescope suffer the same fate as SOFIA?

SOFIA and the Hubble Space Telescope (HST) were not specifically addressed in the Decadal Survey, as during that period they were completing development and it was envisioned that they would be entering their operational phase. The decision to propose, as part of the FY 2015 NASA budget, to put SOFIA into storage was primarily a budgetary decision driven by the tight budget caps in the Bipartisan Budget Act of 2013. SOFIA's scientific priority relative to other projects within NASA's Astrophysics portfolio was a secondary consideration. The President's 2015 Budget and the notional outyear budgets accommodate HST. In addition, the recent Astrophysics Senior Review of operating missions confirmed continued operations of HST.

21. SOFIA is a joint project between the United States and Germany. Germany has contributed 20 percent of the cost to develop SOFIA. Germany built the telescope, and also contributed the engines and other components. Further, Germany contributes 20% of the cost to operate SOFIA. Why would the White House choose this moment to pull out of its commitment?

The Administration is aware that its budget decisions have major consequences to our science investments and to our domestic and international partners. Our partners are aware that in all instances our participation is based on the availability of appropriated funds, just as we are aware that their participation has similar funding constraints. SOFIA is only one among many U.S.-German cooperative programs in Earth and space science. Others still at the forefront of discovery, such as the Gravity Recovery and Climate Experiment (GRACE), the Fermi Gamma-ray Space Telescope, the Dawn mission now on its way to the dwarf planet Ceres, and the Mars Science Laboratory/Curiosity, are testimony to our long history of mutually beneficial collaboration. SOFIA's high operating cost was the primary factor in the decision to put SOFIA into storage, unless alternative

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[15] National Research Council Astronomy and Astrophysics Survey Committee. *The Decade of Discovery in Astronomy and Astrophysics* (Washington, DC: National Academy Press, 1991). p.5.

[16] National Research Council Astronomy and Astrophysics Survey Committee. *Astronomy and Astrophysics in the New Millennium*. (Washington, DC: National Academy Press, 2001). p.4

funding sources are found. SOFIA's scientific priority relative to other projects within NASA's Astrophysics portfolio was a secondary consideration.

22. What are the possible negative consequences for U.S.- German relations for cancelling SOFIA? Are you concerned that this makes the U.S. appear to be untrustworthy on it commitments, instead of a leader and friend to one of our closest allies?

As noted above, our partners are aware that in all instances our participation is based on the availability of appropriated funds, just as we are aware that their participation has similar funding constraints. The United States has a long history of successful scientific cooperation with nations around the world, but inevitably that history has also included occasional decisions by U.S. Federal agencies—and at other times decisions by our international partners to re-phase, redesign, or even terminate planned cooperative activities.

Some examples of NASA's rich and robust cooperation with the German space agency at the forefront of discovery include the Gravity Recovery and Climate Experiment (GRACE), the Fermi Gamma-ray Space Telescope, the Dawn mission now on its way to the dwarf planet Ceres, and the Mars Science Laboratory/Curiosity. Our history of mutually beneficial collaboration will continue in the future, bilaterally through missions such as InSight, and multilaterally through the European Space Agency (ESA) where our work in development extends to projects such as the James Webb Space Telescope and ExoMars/MOMA (Mars Organic Molecule Analyzer).

23. As you know, the Chinese are actively attempting to cultivate friendships and partnerships with Europe on future space projects. Is the White House concerned that backing out, unilaterally, on commitments such as SOFA will alienate our traditional partners and push them to form other partnerships?

Please see the answers to Questions 21 and 22. Now that two-thirds of NASA's space and Earth science flight missions involve international cooperation, it is practically inevitable that some of the difficult budget choices necessitated by current fiscal constraints will impact NASA's international partners. Nonetheless, these countries continue to work with NASA and with other Federal science agencies on a wide variety of international partnerships in science and technology, and we have not noticed any change in their willingness to work with the United States.

24. What would the total cost be to the U.S. space program, if our international partners no longer felt they could rely on our collaboration on space missions and withdrew their partnerships on current and future missions? Would that cost include the ramifications of losing U.S. leadership in space exploration?

Please see the answers to Questions 21, 22, and 23. NASA has a long history of very successful cooperation on science and in space with nations around the world. The Administration is confident that this long history of mutually beneficial collaboration will continue well in the future. Given that international cooperation has been a cornerstone of the US space program since its inception, it would be impossible to accurately assign a

cost to the cessation of all cooperative activities. In the absence of all international cooperation, the US space program would have to be different in ways that have not been analyzed in detail because the prospect is too improbable to warrant the effort.

25. Are you aware of the statement on March 14 by Jan Woerner, the head of the German Space Agency regarding the U.S. announcement on SOFIA? To translate one quote from Dr. Woerner:

"This would not only be a bitter blow for science, for which we had planned many interesting astronomical explorations for the coming years, it would also be a blow for the relationship between NASA and DLR."

Yes, I am aware of Dr. Woerner's statement.

26. What are the implications of the canceling SOFIA on future projects with Germany, or the European Space Agency, or the Japanese?

Please see the answers to the questions above. The United States has a long history of successful cooperation with nations around the world, and as part of that history there have been some decisions by U.S. Federal agencies and at other times some decisions by our international partners to re-phase, redesign, or even terminate planned cooperative activities. Some examples of the rich and robust NASA-DLR (the German space agency) cooperation at the forefront of discovery include the Gravity Recovery and Climate Experiment (GRACE), the Fermi Gamma-ray Space Telescope, the Dawn mission now on its way to the dwarf planet Ceres, and the Mars Science Laboratory/Curiosity. Our long history of mutually beneficial collaboration will continue in the future, bilaterally through missions such as InSight, and multilaterally through the European Space Agency (ESA) where our work in development extends to projects such as the James Webb Space Telescope and ExoMars/MOMA (Mars Organic Molecule Analyzer).

27. Since this hearing, you played in significant role in announcing the Administration's National Climate Assessment. You stated, "climate change isn't some distant threat-- it's affecting us now." If that is the case, why has the Administration determined not to follow OMB's guidelines regarding discount rates when developing a Social Cost of Carbon?

As detailed in the recently released Third National Climate Assessment, the effects of climate change are not a distant threat but are affecting this country and the world already. This finding does not conflict with, but rather supports, the technical and economic analyses that underpin the Social Cost of Carbon evaluation. Details on development of the Social Cost of Carbon are available on the White House website, along with the OMB Federal Register notice inviting public comment. OMB's Circular A-4 recommends that agencies generally conduct regulatory impact analysis using two discount rates, 3 and 7 percent. According to Circular A-4, the "7 percent rate is an estimate of the average before-tax rate of return to private capital in the U.S. economy," while 3 percent is the "rate at which society discounts future consumption flows to their present value."

Circular A-4 also notes that:

> **Special ethical considerations arise when comparing benefits and costs across generations. Although most people demonstrate time preference in their own**

> **consumption behavior, it may not be appropriate for society to demonstrate a similar preference when deciding between the well-being of current and future generations. Future citizens who are affected by such choices cannot take part in making them, and today's society must act with some consideration of their interest.**

For this reason, Circular A-4 acknowledges that consideration of lower discount rates may be appropriate in an intergenerational context, and notes that "Estimates of the appropriate discount rate appropriate in this case, from the 1990s, ranged from 1 to 3 percent per annum." Indeed, a recent *Science* publication by noted economists recommends a declining discount rate as appropriate for impacts that occur far into the future, which serves to raise emphasis on long term risks but in no way minimizes current or near term damages. The discount rates in the SCC (2.5%, 3%, and 5%) are well within the range of discount values in the literature and considered under OMB Circular A-4 guidance.[17]

28. Please identify all federal employees involved in the development of the National Climate Assessment who were also involved in the development or review of each of the following:

a. The Administration's Social Cost of Carbon.

b. EPA's Endangerment Finding.

c. The IPCC's Fifth Assessment Report.

a. The Technical Support Document lists the agencies that participated in the Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis. (http://www.whitehouse.gov/sites/default/files/omb/assets/inforeg/technical-update-social-cost-of-carbon-for-regulator-impact-analysis.pdf)

b. OSTP refers you to the Environmental Protection Agency (EPA) regarding its Endangerment Finding.

c. The IPCC authors are listed on its website. (http://ipcc.ch/pdf/ar5/ar5_authors_review_editors_updated.pdf)

Expert reviewers for each IPCC report are listed on these Working Group-specific web sites:
WG1: http://www.climatechange2013.org/images/report/WG1AR5_AnnexVI_FINAL.pdf
WG2: http://ipcc-wg2.gov/AR5/contributors/reviewers

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[17] http://www.whitehouse.gov/sites/default/files/omb/assets/inforeg/technical-update-social-cost-of-carbon-for-regulator-impact-analysis.pdf

https://www.federalregister.gov/articles/2014/01/27/2014-01605/technical-support-document-technical-update-of-the-social-cost-of-carbon-for-regulatory-impact

Arrow, K, et al., 2013. Determining Benefits and Costs for Future Generations *Science* 26 Vol. 341 no. 6144 pp. 349-350 DOI: 10.1126/science.1235665

WG3: http://mitigation2014.org/contributor/expert-reviewers/expert-reviewers#ab

29. The National Climate Assessment relies on scenarios and models from the Coupled Model Intercomparison Project (CMIP) Phase 3, which were development for the Fourth Assessment Report of the IPCC. However, the IPCC's Fifth Assessment Report used CMIP Phase 5.

a. Why does the National Climate Assessment not use the latest version?

In fact, the IPCC's Fifth Assessment Report and the National Climate Assessment (NCA) both used CMIP Phase 3 and Phase 5 results. The NCA predominantly uses results from CMIP3 as they were the only ones available at the time that scenarios and models were selected for the development of NCA. Later, as CMIP5 results became available, they were incorporated into the NCA where that could be done without starting over again at great cost (and delay).

b. What are the key differences between CMIP Phase 3 and Phase 5?

A greater number of models are included in CMIP5 vs CMIP3. In addition, the newer CMIP5 models generally employ greater spatial resolution and incorporate more physical processes than the older CMIP3 models. In addition, the newer models have improved representations of some physical processes. Studies comparing the results of CMIP3 vs. CMIP5 models have found only modest differences in large-scale projections of climate change, though the CMIP5 analyses reveal more detail on regional climate change associated with extremes, Arctic sea ice, and sea level rise.

30. Climate models are used to provide predictions of regional climate in the United States decades from now, with a great deal of money being spent on modeling and simulations.

a. What evidence do you have that these models can skillfully predict changes in regional climate statistics on multi-decadal time scales when the models are run for the last several decades without any observational data being used to constrain their forecasts?

According to the Third National Climate Assessment: "It is very clear that progress is being made in the accuracy of models in representing the physics of the climate system at smaller scales. This is demonstrated, for example, by the ability of these models to replicate observed climate… The breadth and depth of these analyses indicate that the modeling results in this report are robust… The new regional projections provided in this report represent the state of the science in climate change modeling."

This statement is consistent with those from the National Academy of Sciences, for example in its recent report *A National Strategy for Advancing Climate Modeling* (NRC, 2012): "Climate models have evolved into remarkably sophisticated tools for addressing a diverse range of scientific and societally relevant issues. Their fidelity can be assessed by comparing them statistically with such observations (Box 1.2) as the mean seasonal cycle, seasonal extremes of temperature, rain and snowfall, and other routinely measured quantities around the globe, as well as statistics of the El Niño-Southern Oscillation (ENSO) and other important forms of climate variability and the observed changes of climate over the past century and across previous eras."

b. How skillful are the multi-decadal climate model predictions of *changes* in major atmospheric and ocean circulations such as El Nino, La Nina, and the North Pacific Decadal Oscillation?

According to the IPCC, "Many important modes of climate variability and intraseasonal to seasonal phenomena are reproduced by models, with some improvements evident since the AR4." Regarding changes in the modes in response to human greenhouse gas emissions, the instrumental record is too short to allow, as yet, confident conclusions about model-based projections of the behavior of these modes in response to anthropogenic climate change.

31. Recent analyses have concluded that heating is going deeper into the ocean rather than remaining near and at the surface of the Earth. Since the global average surface temperature trend is being used as the primary metric to describe global warming, doesn't this removal of heat diminish the value of using the global average surface temperature trend? Would the ocean heat content changes be a more robust metric to monitor global warming?

Earth's surface temperatures are of societal relevance in areas including human health, crop production, and energy demands. Because of their societal relevance, reliable measurements of surface temperature have been collected across the globe for the last century, and in some places as long as three centuries. Surface temperature, thus, has a certain primacy in terms of longevity of the instrumental record and relevance to impacts on human well-being. Other kinds of measurement, however, are more suitable for answering certain questions. For instance, determining the net energy flowing into and out of the Earth-atmosphere system is better pursued using measurements of atmospheric radiation and ocean heat content. For these purposes NASA maintains the Clouds and the Earth's Radiant Energy System (CERES) and NOAA the Argo program that have been monitoring net radiation balance, respectively, at the top of the atmosphere since 1997 and ocean heat content since 2000. These measurements have been combined to estimate that there is an imbalance in the flow of Earth's energy, leading to an average heating of 0.5 plus or minus 0.43 Watts per square meter (90% confidence intervals). Of course, no single index or small set of indices is sufficient to capture all of the important characteristics of climate change, which is why a large diversity of types of monitoring networks—land-based, ocean-based, upper-atmosphere-based, and space-based—must be maintained in order to support adequate understanding of what is happening.

32. The National Climate Assessment states: "To meet the lower emissions scenario (B1) used in this assessment, global mitigation actions would need to limit global carbon dioxide emissions to a peak of around 44 billion tons per year within the next 25 years and decline thereafter." If all other nations continued with their current emissions, how much of a percentage reduction would be required of the United States to meet that level of 44 billion tons per year level within the next 25 years?

If all other nations continued with their <u>current</u> emissions, as the question postulates, the United States would not need to reduce its current emissions at all in order for the world to stay below 44 billion tons of CO2 per year 25 years from now or any time in between.

Total anthropogenic emissions in 2013 are estimated to have been about 36 billion metric tons of CO2 (or about 40 billion U.S. tons). If the intent was to ask what would happen if emissions from all other countries continued to grow for the next 25 years at the same rates of increase experienced in the recent past, the answer would be that no amount of emissions reduction by the United States would keep the global total below 44 billion tons of CO2 per year 25 years from now. The proposition that emissions from all other countries would continue to grow at recent rates for the next 25 years is unrealistic, however, as many of these countries are already taking significant actions to slow those growth rates and there is every reason to believe they will continue to do so as the damaging impacts of climate change become ever more evident.

33. Please identify all federal agencies currently providing climate decision support services, the amount dedicated to each of these activities in 2014 and the amount proposed to be spent on each of these activities in the President's budget request for FY2015?

The President's 2015 Budget does not specifically identify climate decision support services. Support services and the research that may inform their development are typically embedded within the project plans tied to specific programs across the R&D agencies. It is not practical to separate out and track the costs of support services across the agencies.

34. How much did the 3rd National Climate Assessment cost? Identify the contributions of each participating agency, as well as the remainder of their contributions to the U.S. Global Change Research Program since FY2008 that were not used as part of the National Climate Assessment development process.

The 3rd National Climate Assessment (NCA), which fulfills the legislated requirements of the Global Change Research Act of 1990, was a collaborative multiagency, multiyear effort of the member agencies of the U.S. Global Change Research Program (USGCRP). The NCA relied heavily on the work of volunteers from the U.S. science and engineering community and in-kind contributions from USGCRP agencies. There were some dedicated NCA resources provided to support the NCA Technical Support Unit (TSU), the director of the NCA, and expenses associated with the National Climate Assessment and Development Advisory Committee (NCADAC). These dedicated resources were provided mainly by the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) and totaled $29.5 million. The National Aeronautics and Space Administration (NASA) made dedicated contributions to the NCA of $0.9 million; and $0.4 million each came from the National Science Foundation (NSF), the Department of the Interior (DOI), the U.S. Department of Agriculture (USDA), and the Environmental Protection Agency (EPA).

In addition, a portion of the USGCRP Distributed Cost Budget (DCB) provided by USGCRP agencies each year to support centralized USGCRP activities was used to support NCA-related activities. Because these activities were integrated within the overall USGCRP effort, it is not possible to provide an exact, accurate breakdown of the NCA portion of the overall DCB funding; OSTP estimates that roughly $2.5 million of DCB funding was used to support the 3rd NCA. Details of overall DCB funding in support of the USGCRP, including each agency's contribution each year, are provided annually to the Congress by the Office of Management and Budget.

Although the 3rd NCA relies heavily on the results of research supported by USGCRP funding, all other USGCRP funding, totaling over $2 billion a year every year since FY 2009, was for USGCRP activities not specifically dedicated to the NCA.

HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

"A Review of the President's FY 2015 Budget Request for Science Agencies"

Questions for the Record, The Honorable John P. Holdren,
Director, Office of Science and Technology Policy

Questions submitted by Rep. Larry Bucshon, Chairman,
Subcommittee on Research and Technology

1. I appreciate your providing the Committee with an update of your progress working with the federal science agencies to improve access to the results of federally funded research. I share your goal of making sure that research outputs, including research publications reporting on the results of the research and the data collected during the conduct of the research, are made widely available. However, I do want to make sure that you recognize that there is a crucial partner in the enterprise, which is the publisher. In your February 2013 memo you explicitly note that OSTP "recognizes that publishers provide valuable services, including the coordination of peer review, that are essential for ensuring the high quality and integrity of many scholarly publications. It is critical that these services continue to be made available." However, OSTP's actions do not show they believe this to be the case. My colleague noted that "taxpayers pay for research," but she neglected to mention that taxpayers do not pay for the investments made to make sure that the high-quality peer-reviewed articles that report on that research so well are available in the first place. Would you agree that it would be a bad idea for the government to take over the role that publishers play in ensuring the quality, integrity and preservation of the scholarly record?

Publishers play a vital role in the scientific-research ecosystem. This role goes beyond the mere formatting and publishing of research articles and includes organizing the peer review of publications and providing space for robust discussions on issues of science. As you noted, the Memorandum I issued in February of 2013 reflects that sentiment. The policy strikes a balance between the need to maintain the vigor of the publishing industry and increasing access to the results of federally funded research results. The policy has been widely praised by both publishers and advocates for open access to scientific publications because the OSTP policy carefully strikes that balance. The American Association of Publishers praised the policy as "a reasonable, balanced resolution of issues around public access to research funded by federal agencies."

Increasing access to the results of federally funded research provides an opportunity to maximize the impact of public research investments by accelerating scientific breakthroughs and innovation. The public should know that taxpayer dollars don't just pay for scientific research, they pay for subscriptions to scientific journals as well as researchers' time to provide peer review for publications and prepare manuscripts. For that investment, the public will soon be able to read the results of such research for free after an embargo period that will allow publishers to remain vibrant businesses. The government will not be taking over the role of publishers as a result of this policy. Quite the contrary, under the policy publishers will continue to thrive and the public will get a better deal for its investment.

2. Neither I, nor my Committee staff, can locate a copy of Mr. Park's Form 278, his personal financial disclosure form. If he has filed this form, please attach the form to this response. If he is not required to file this form, could you please explain why?

Are you aware of any financial conflicts of interest in his current position as the Chief Technology Officer (CTO), related to his time as HHS's "Entrepreneur in Residence" or his time as a tech entrepreneur prior to this position? Have you asked him these specific questions, and what has he disclosed to you about any conflicts?

The Office of Government Ethics Form 201 (http://oge.gov/Forms-Library/OGE-Form-201--Request-to-Inspect-or-Receive-Copies-of-OGE-Form-278/SF-278s-or-Other-Covered-Records/) is used to request copies of the public financial disclosure reports for executive branch officials because the Ethics in Government Act of 1978 (5 U.S.C. app.-4 § 105) imposes requirements for access to and restrictions on the use of these records. You may file the OGE Form 201 with the Designated Agency Ethics Official for the agency that employed the filer during the time period in which you are interested. If you seek Mr. Park's current Form 278, you may file a Form 201 with OSTP. If you are requesting information from the period when Mr. Park entered government service with HHS in 2009, we refer you to that Department to address your request.

3. The Office of the Chief Technology Officer is located within OSTP; as Director of OSTP, do you have oversight and responsibility over this office? The office employs a senior health and health IT advisor. Please explain what specific health and health IT policy issues this office has been working on. What has prompted you to look into these specific issues?

As Director of OSTP, I am responsible for all components of OSTP, including the Office of the U.S. Chief Technology Officer. The Senior Health IT Advisor works with all US Agencies that are working on implementing health IT--from a policy or technical standpoint--to support national progress and alignment in implementing electronic health records for clinical care. We have a staff member working on these issues because they are technology-linked matters of crucial importance to the President's goal of making the delivery of healthcare more effective and efficient.

HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

"A Review of the President's FY 2015 Budget Request for Science Agencies"

Questions for the Record, The Honorable John P. Holdren,
Director, Office of Science and Technology Policy

Questions submitted by Rep. Bill Posey

1. Can you give us the status on the supply, inventory and availability of Pu-238, and any other nuclear fuel that may be needed for spaceflight?

The Department of Energy (DOE) has provided NASA with an identified allocation of Pu-238 available for NASA spaceflight use. The allocation identifies a total of 35 kg (77 lbs) of Pu-238 isotope. Of that quantity, 17 kg is within specifications needed to produce heat sources for NASA's spaceflight radioisotope power systems. DOE indicates the balance of the inventory available for NASA use could be blended to increase the net amount available. In addition to this existing allocation, the Department of Energy is currently conducting a project, funded by NASA, to re-establish a domestic Pu-238 production capability at an average rate of 1.5 kilograms of oxide (1 kg of isotope) per year.

2. How much Pu-238 do we currently have in stock right now?

The current supply of Pu-238 available for NASA space applications is 35 kilograms. See response to question 1.

3. How much time does it take to produce Pu 238? What are the costs associated with this production?

The Department of Energy is currently conducting a project, funded by NASA, to re-establish a domestic Pu-238 production capability at an average rate of 1.5 kilograms of oxide per year. The concept demonstration phase began in 2011, upon receipt of first funding by NASA. The project will be complete when a Pu-238 production capability meeting all requirements is in place and ready to begin operating. The preliminary project completion milestone has been set for fiscal year 2021. As stated in the *Report regarding U.S. Plutonium-238 Production Capability* requested within House Report 112-463, the preliminary estimate of the cost range to complete this project and initiate production is between $85 million and $125 million.

4. Is a Thorium Reactor currently being employed, or considered, to produce Pu238 from U233?

The DOE Plutonium Supply Project team performed an analysis of alternatives and chose mature, cost-effective, established processes, facilities, and technologies to produce Pu-238 based upon NASA's requirements and early need date. Thorium reactors do not meet these criteria.

5. Are you aware of any stockpile of U233 in our national inventory, that can produce Pu-238 in a Thorium reactor, that is currently being considered for destruction.

DOE should be contacted for information regarding the status of the national inventory of special nuclear materials.

HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

"A Review of the President's FY 2015 Budget Request for Science Agencies"

Questions for the Record, The Honorable John P. Holdren,
Director, Office of Science and Technology Policy

Questions submitted by Rep. Frederica Wilson

1. My district in South Florida lies in an area that is likely to be impacted by sea rise associated with climate change. The American people deserve our full attention on this issue. The budget request proposes as part of the President's Opportunity, Growth, and Security Initiative, a $1 billion Climate Resilience Fund. The stated purpose of this Fund is to "expand on existing climate-change preparedness programs to ensure that we are doing everything we can to support the safety and security of our communities and resources." For example, the Fund includes an additional $50 million to NOAA for a competitive grant program that will improve coastal community resilience and resources through EPA for States to improve water quality through activities such as wetlands restoration. Can you please describe the risk our communities and the Nation's aging infrastructure faces as it relates to climate change? Why is it important for us to expand our mitigation and adaptation efforts? How does the Climate Resilience Fund address these needs? How will the President's budget enhance scientific efforts to research, prepare for, and recover from, Hurricanes and other natural disasters?

The climate is changing globally and in the United States as a consequence of the build-up of atmospheric greenhouse gases that is the result of fossil-fuel production and use, as well as land-use change. Consequential impacts of those changes are already being felt in many places.

Climate change is not just a matter of increases in the average temperatures of the atmosphere and the oceans; it also entails extended periods of extreme heat, a greater number of heavier downpours, more severe regional drought and wildfires in parts of the American West, permafrost thawing in Alaska, and sea-level rise threatening coastal communities. In addition, ocean acidification resulting from ocean uptake of some of the excess CO2 in the atmosphere is posing an increasing threat to many ocean food chains.

Much of the Nation's infrastructure has been designed for the climate over the period in which the infrastructure was built, not the changing climate now being experienced and expected going forward. One example is the increasingly frequent flooding of the streets of Miami at high tide by ocean water, which is also infiltrating poorly-protected freshwater supplies.

The best current understanding of the full range of climate-change impacts on the United States is embodied in the Third National Climate Assessment (NCA), which was produced over the past four years by hundreds of expert authors inside and outside government and released by OSTP and NOAA on May 6. The NCA devotes considerable attention to the kinds of actions that government officials, firms, and

individuals can take to ameliorate the damages from the changes in climate that are materializing and will materialize for some time to come in spite of efforts to reduce the emissions that are responsible. And, as part of the President's Climate Action Plan announced in June 2013, the Administration is following up the NCA's findings with a wide-ranging strategy to bolster preparedness, resilience, and adaptation in the face of climate change, as well as increasing efforts to reduce domestic carbon emissions and provide leadership for other countries to do the same.

The President's Budget Request for Fiscal Year 2015 reflects these priorities. Among other thrusts, it includes robust support for State, local, and tribal preparedness efforts, analysis of vulnerabilities of critical infrastructure, creation of incentives to address those vulnerabilities, and development and dissemination of better information and planning tools.

All Federal departments and agencies are engaged in these efforts. For example, the Department of Health and Human Services is supporting public-health officials working on the challenges at the interface of human health and climate. Programs at the Department of Transportation are engaging with communities to minimize the effects of extreme weather and climate change on critical transportation infrastructure. The U.S. Department of Agriculture and the Department of the Interior are providing grants and technical support to promote water conservation and efficiency. EPA and other agencies are continuing to provide technical assistance and funding for sustainable communities, and the Department of the Interior is supporting efforts by tribal communities to enhance their own preparedness.

Recognizing the continuing need for sound science to guide our national efforts, the Budget Request also includes more than $2.5 billion for Federal research through the United States Global Change Research Program, to improve our understanding of and ability to predict and respond to global change. The Budget Request also supports the development of the Climate Resilience Toolkit and Climate Data Initiative, called for in the President's Climate Action Plan, to make Federally-supported science even more accessible to those who need it on the ground.

The Budget also proposes a new $1 billion Climate Resilience Fund within a fully paid for $56 billion Opportunity, Growth, and Security Initiative. The Climate Resilience Fund would expand on existing climate-change preparedness programs and augment adaptation planning by States, tribes, and local communities and help them prepare for events such as wildfire, floods, or other disasters that could be exacerbated by climate change.

2. During the hearing risk communications research was briefly mentioned. According to the National Research Council, risk communication is defined as "an interactive process of exchange of information and opinion among individuals, groups, and institutions. It involves multiple messages about the nature of risk and other messages, not strictly about risk, that express concerns, options, or reactions to risk messages or to legal and institutional arrangements for risk management." I understand that risk communications can be used to manage health and

environmental risks. Can you tell me more about risk communications research and how it benefits the American People?

Decisions are often based, at least in part, on assessment of risks and associated tradeoffs. When providing information to support decisions, it is therefore important to include communication of risks. Thus the Third National Climate Assessment included risk-based framing for the identification and communication of key vulnerabilities faced by the American people.

The Federal government's efforts to communicate risks in the National Climate Assessment and many other documents are based on a growing body of risk-communications research supported by Federal agencies. The National Science Foundation (NSF) supports fundamental research in this field; multiagency initiatives including the National Nanotechnology Initiative (NNI) include risk communications research in their portfolios; and agencies including the National Weather Service (NWS) in the National Oceanic and Atmospheric Administration (NOAA) support and utilize risk-communications research to improve the effectiveness of risk communications relevant to agency missions. One example is research on improving the likelihood that the public will act in response to NWS warnings about severe weather.

3. In your written statement you mention that one of the goals of the President's budget is to "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." I am very concerned about the level of participation and retention among women and minorities in science education and the STEM workforce. A recent study of over 400,000 STEM Ph.D.'s conducted by the American Institutes for Research, "The Nonacademic Careers of STEM Ph.D. Holders" showed that women with STEM doctorates are more likely to work in non-STEM fields than their male colleagues and that of those women who work in nonacademic sectors, less than half work in research and development. Can you tell me more about how this budget prioritizes the participation of women and minorities in STEM education and the STEM workforce?

I share your concern about participation of women and underrepresented minorities in STEM education and their retention in the STEM workforce. The Committee on STEM Education (CoSTEM) also shares your concerns. That is why one of the five priority areas identified in the Federal STEM Education 5-Year Strategic Plan is to Better Serve Groups Historically Underrepresented in STEM Fields.

The 2015 Budget supports agency efforts in this priority area by providing resources to help agencies broaden participation in STEM education to women and minorities traditionally underrepresented in many of these fields. The 2015 Budget proposes strong support for broadening participation at NSF: for example, $32 million for NSF's 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). It also provides resources for NASA Education efforts to reach underserved students: the Budget proposes $30 million for NASA's Minority University Research and Education Program (MUREP),

which strives to ensure that underrepresented and underserved students participate in NASA education and research projects and to assist more students in their pursuit of STEM careers.

4. I understand that consolidation of STEM education programs is a very important element of the Committee on STEM education's 5-year Strategic Plan to guide Federal efforts in STEM education. What are the possible risks of coordination of STEM education programs across the government, what are the possible rewards? In this case do the rewards really outweigh the risks?

In your statement you say that, "Agencies will focus on internal consolidations and eliminations, while funding their most effective programs." During this consolidation effort what is the possibility that programs that do not overlap with other programs will be cut? How can we guarantee that programs that serve groups that will otherwise not be served will not be cut?

The rewards of improved coordination of STEM education programs across the government will be the ability of Federal agencies through STEM education programs to reach more students more effectively. As described in the Federal STEM Education 5-Year Strategic Plan released in May 2013, improving STEM education is a high priority for President Obama. The Strategic Plan and its vision for improving coordination of STEM education programs reflects the President's desire to reorganize STEM education programs for greater coherence, efficiency, ease of evaluation, and greater focus on his highest STEM-education priorities. In any change to the status quo there are risks, but the Strategic Plan's vision is the product of years of deliberation, is supported by two reports from the President's Council of Advisors on Science and Technology (PCAST) on STEM education, is accompanied in the strategic plan by initial implementation roadmaps, and is reinforced by ongoing agency dialogue to ensure that Federal STEM education agencies do not lose their ability to serve students and others who are reached by Federal STEM education programs.

The effort to consolidate STEM education programs focuses on internal consolidations and eliminations and is designed in a way that should minimize the chances that students and teachers who have been served by agency programs will lose access to Federal STEM-education resources. The 2015 Budget continues to provide resources to agencies in a streamlined way to support the implementation of the Strategic Plan, ensuring that agencies have what they need to serve students, teachers, and institutions effectively. The Committee on STEM Education agencies, guided by the Strategic Plan, are coordinating to ensure that STEM-education opportunities continue to be available to groups currently served by Federal STEM education programs, regardless of program structure, and to ensure that students, teachers, schools, and local institutions are made aware of and have access to STEM education opportunities that exist throughout the Federal government, including opportunities through agencies they may not have interacted with before.

5. The President's budget request for DOE places great emphasis on the need to invest in clean energy technologies. Can you explain how the Administration's proposed investments in this area can help revitalize the U.S. manufacturing sector? Will jobs in factories producing clean energy technologies require advanced degrees, or will some of them be accessible to people with two-year or technical degrees?

The proposed investments in clean energy in the 2015 Budget are key to revitalizing the U.S. manufacturing sector and to bringing about a clean energy economy with new businesses, jobs, and opportunities for American workers. One example that makes explicit the link between clean energy technologies and U.S. manufacturing is the Department of Energy's (DOE) Clean Energy Manufacturing Initiative (CEMI), a comprehensive DOE-wide approach to increase U.S. competitiveness in clean-energy manufacturing. CEMI supports innovation in manufacturing technology that will help companies competitively manufacture clean energy technologies in the U.S., while increasing U.S. manufacturing competitiveness across the board by increasing energy productivity. DOE already supports a number of manufacturing-innovation institutes related to clean-energy technologies and proposes to support at least one additional institute in the 2015 Budget. Although many jobs in factories utilizing clean-energy technologies will require advanced degrees, many of them will be accessible to workers with two-year or technical degrees who have strong skills in science and mathematics.

6. The President's Budget Request proposes less than a 1% increase in funding for the Office of Science. This is less than inflation, effectively making it a cut. No additional funding for the Office is identified in the Administration's proposed Opportunity, Security, and Growth Initiative. Given that the National Academies, as well as your own testimony, identify the Office of Science as one of the three agencies that are "especially important to this Nation's continued scientific and economic leadership", how do you explain this proposed budget?

The Department of Energy's (DOE) Office of Science is indeed one of the three agencies that are especially important to this Nation's continued scientific and economic leadership. The DOE Office of Science 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 making nanomaterials—on which our scientists depend for research breakthroughs. The funding constraints agreed to in the Budget Control Act led to a budget request that allowed for just a 0.2 percent average funding growth over FY 2014 enacted levels across discretionary appropriations government-wide. Within these very tight fiscal constraints, the 0.9 percent growth allowed by the $5.1 billion proposal for the Office of Science reflects our prioritization due to the importance of this investment. The 2015 Budget provides the resources the DOE Office of Science needs to continue to play its part in sustaining U.S. scientific and economic leadership.

7. Recent articles in the New York Times have discussed the growing role of billionaires in providing private funding for scientific research. As much as 30 percent of the research funding at the 50 universities who spend the most in science-related research now comes from private donors. While I welcome philanthropic efforts to support scientific research endeavors, not all areas of science will have the same level of private donor appeal. In these challenging budgetary times, how does the President's budget protect vital areas science that might not have as much private donor support?

I share your interest in philanthropic efforts to support research. In these challenging budget times, it is important to engage multiple sources of support for scientific research in the United States. But it is also important to preserve the Federal government's

indispensable role in supporting research, especially in areas that are unlikely to attract adequate philanthropic or corporate support.

The 2015 Budget sustains the Federal government's leadership role in supporting research across all fields of science and engineering, including fields that may not be of interest to the philanthropic community. The 2015 Budget proposes $64.7 billion for research, with additional research investments proposed as part of the Opportunity, Growth, and Security Initiative.

Appendix II

Additional Material for the Record

Progress Report on Coordinating Federal Science, Technology, Engineering, and Mathematics (STEM) Education

March 2014

About the Office of Science and Technology Policy

The Office of Science and Technology Policy (OSTP) advises the President on the effects of science and technology on domestic and international affairs. The office serves as a source of scientific and technological analysis and judgment for the President with respect to major policies, plans, and programs of the Federal Government. OSTP leads an interagency effort to develop and implement sound science and technology policies and budgets. The office works with the private sector to ensure Federal investments in science and technology contribute to economic prosperity, environmental quality, and national security. For more information, visit http://www.ostp.gov.

About this document

As called for in the America COMPETES Reauthorization Act of 2010, the National Science and Technology Council's (NSTC) Committee on STEM Education (CoSTEM) released, in May of 2013, the *Federal Science, Technology, Engineering, and Mathematics (STEM) Education 5-Year Strategic Plan* (Strategic Plan). As required by the Act, this report includes an update on Strategic Plan implementation activities, a report on efforts being taken to increase efficiency and coherence across the Federal STEM education portfolio, and a discussion of methods to disseminate information about Federally-supported STEM education research and resources.

This report also includes tables containing Federal STEM Education funding by agency (FY2013-2015) and program (FY2012-2015). These data build on historical reporting of Federal STEM Education investment that appear in the Strategic Plan and in the *Federal Science, Technology, Engineering, and Mathematics (STEM) Education Portfolio* released by CoSTEM in December 2011.

This report is also in fulfillment of the requirement in Title III of the Joint Explanatory Statement for the Consolidated Appropriations Act of 2014 (Public Law 113-76) for the Office of Science and Technology Policy (OSTP) to report to the House and Senate Appropriations Committees on the dissemination of STEM education findings.

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EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20502

March 24, 2014

Members of Congress,

I am pleased to transmit this update on the Administration's efforts to coordinate Federal investments in science, technology, engineering, and mathematics (STEM) education.

President Obama believes that strong and sustained investment in STEM education is critical for the Nation. In order for the United States to continue to lead the world in science, technology, and innovation and reap the health, security, and economic benefits these disciplines offer, we must improve STEM engagement, learning, and achievement in schools and communities nationwide.

From the beginning of his Administration, the President has focused on several key strategies to improve STEM education:

- Setting ambitious national goals: These goals include moving American kids from middle to top of the pack of international rankings in science and math, preparing 100,000 excellent STEM teachers, producing 1 million more STEM college graduates over a decade, and broadening participation in STEM fields for women and underrepresented minorities.

- Maintaining a strong investment in STEM education even during difficult budgetary times: The President's 2015 Budget invests $2.9 billion in STEM education, an increase of 3.7 percent over the 2014 enacted level.

- Incorporating STEM education into the Administration's overall education reform strategy: For example, the Department of Education's $4 billion *Race to the Top* program included preference to states whose proposals emphasized innovation in STEM education.

- Building a strong "all hands on deck" effort that includes business, non-profits, foundations, and others: The President launched the *Educate to Innovate* campaign including commitments from more than 100 CEOs; more than 150 organizations are stepping up in response to the President's goal of preparing 100,000 excellent STEM teachers and have formed a coalition called *100kin10* with more than $50 million raised; and more than $100 million in philanthropic investments has been committed to support the President's goal of one million more STEM college graduates.

- Deploying the President's personal passion for getting more students excited about science and math: The President has hosted the first-ever White House Science Fairs—three so far—which celebrate student winners of math, science, and robotics competitions. He will host the first-ever Maker Faire

later this year, which will showcase students and adults accessing the tools and skills necessary to design and make just about anything.

The Administration has also prioritized improving the ability of Federal agencies to collaborate to improve STEM education, while reducing the fragmentation of the STEM-education portfolio. In support of that shared goal, Congress passed and President Obama signed the America COMPETES Reauthorization Act of 2010, a key piece of legislation supporting the Federal Government's STEM-education enterprise. As called for in this Act, the Administration formed a Committee on STEM Education (CoSTEM) under the National Science and Technology Council and produced a Federal STEM Education 5-Year Strategic Plan released in May 2013.

This shared agenda by the Administration and Congress has also resulted in a substantial reduction in the fragmentation of the Federal Government's STEM education portfolio, with the number of STEM-education programs reduced by almost 40 percent in the past two years—from 228 STEM-education programs in 2012 to an estimated 138 as reflected in FY14 agency operating plans.

This progress report describes STEM-education investments in the President's 2015 Budget request, their alignment with the Strategic Plan, and continuing efforts to coordinate agency activities under the CoSTEM, while further reducing fragmentation. This progress report also describes current efforts to disseminate Federal STEM-education resources, as well as potential enhancements to those efforts.

I thank you for your leadership on this national priority and look forward to working with you on this shared agenda.

Sincerely,

John P. Holdren

John P. Holdren
Assistant to the President for Science and Technology
Director, Office of Science and Technology Policy

Table of Contents

Department and Agency Abbreviations

Department of Agriculture	USDA
Department of Commerce	DOC
Department of Defense	DOD
Department of Education	ED
Department of Energy	DOE
Department of Health and Human Services	HHS
Department of Homeland Security	DHS
Department of the Interior	DOI
Department of Transportation	DOT
Environmental Protection Agency	EPA
National Aeronautics and Space Administration	NASA
National Institute of Standards and Technology (part of DOC)	NIST
National Institutes of Health (part of HHS)	NIH
National Oceanic and Atmospheric Administration (part of DOC)	NOAA
National Science Foundation	NSF
National Science and Technology Council	NSTC
Nuclear Regulatory Commission	NRC
Office of Science and Technology Policy	OSTP
Smithsonian Institution	SI
United States Geological Survey (part of DOI)	USGS

I. Science, Technology, Engineering, and Mathematics (STEM) Education in the 2015 Budget

"Teachers and principals in schools from Tennessee to Washington, D.C., are making big strides in preparing students with skills for the new economy – problem solving, critical thinking, science, technology, engineering, and math. Some of this change is hard... But it's worth it – and it's working."

President Barack Obama
State of the Union Address
January 2014

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. The 2015 Budget includes critical investments in a number of areas that will benefit aspiring students:

- Recruiting, preparing, and supporting excellent STEM teachers, with $40 million to support the President's goal of preparing 100,000 excellent STEM teachers over the next decade and $20 million to launch a pilot National STEM Master Teacher Corps.

- Supporting more STEM-focused school districts, with an investment of $110 million to create new STEM Innovation Networks to better connect school districts with local, regional, and national resources to transform K-12 STEM teaching and learning and $150 million in continued support for the Math and Science Partnerships Program. The Budget also provides $150 million for a new program to redesign high schools to focus on providing students with challenging, relevant learning experiences that will help them gain the knowledge and skills they will need to succeed in today's economy, including in STEM fields.

- Improving undergraduate STEM education, with the National Science Foundation (NSF) investing $118 million to increase retention of undergraduate students in STEM majors and improve undergraduate teaching and learning in STEM subjects to meet the President's goal of preparing 1 million more STEM graduates over the next decade.

- Investing in breakthrough research on STEM teaching and learning, with approximately $50 million for the Advanced Research Projects Agency for Education (ARPA-ED), through which the Department of Education (ED) would support high-risk, high-return research on next-generation learning innovations and technologies, including for STEM education.

In addition, the 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 in the five key areas identified by the Federal STEM Education 5-Year Strategic

Plan: (1) K-12 instruction; (2) undergraduate education; (3) graduate education; (4) broadening participation in STEM education and careers by women and minorities traditionally underrepresented in these fields; and (5) education activities that typically take place outside of the classroom.

K-12 Education

The President's 2015 Budget includes investments to improve STEM education in K-12 schools and prioritizes efforts to support 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 the STEM Innovation Initiative with inter-related investments that include:

- STEM Innovation Networks: The Budget invests $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 by developing coordinated plans to promote student inspiration, achievement, and preparation in STEM subjects; improve STEM instruction; and build regional networks of support for STEM education. The competitive grant program will support approximately 10 partnerships in its first year, building on promising models such as the partnership between the Ohio STEM Learning Network, the Cleveland Metropolitan School District, GE, and MC2High School. The Budget also provides support for a STEM Virtual Learning Network, a national, online community of STEM educators. The networks will complement the Department of Education's continued $150 million investment in the Math and Science Partnerships program, a formula grant to all States to support K-12 STEM education.

- Preparing 100,000 Excellent STEM Teachers over the Next Decade: In his 2011 State of the Union address, the President called for a new effort to prepare 100,000 STEM teachers over the next decade with strong teaching skills and deep content knowledge. Answering the President's call to action, more than 150 organizations have formed a coalition called *100Kin10*. These organizations have made over 150 measurable commitments to increasing the supply of excellent STEM teachers; hiring, developing, and retaining excellent STEM teachers; and building the *100Kin10* movement. *100Kin10* has launched two funds totaling over $50 million provided by a broad range of foundations and philanthropists under a unique "funding marketplace" through which funders have access to a registry of high-quality projects. To build on these private-sector investments, ED is proposing $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.

- National STEM Master Teacher Corps: The Budget also includes $20 million to launch a pilot of the National STEM Master Teacher Corps, a new effort to enlist some of America's best and brightest science and math teachers that will help improve instruction in their schools and districts, and to serve as a national resource for best practices in math and science teaching.

The President's Budget makes other investments to support ED's STEM Innovation Initiative:

- Redesigning high schools to teach real-world skills: The President has called for a comprehensive effort to rethink the high-school experience, challenging schools to scale up innovative models that personalize teaching and learning so students receive the rigorous and relevant education needed to graduate and transition into postsecondary learning and careers. The Budget provides $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. Additional resources would be provided through the Opportunity, Growth, and Security Initiative.

- Identifying and scaling promising STEM education practices: The Administration proposes over $100 million to support NSF's Discovery Research K-12, which supports research on teaching and learning STEM and by dedicating a portion of the 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 ED, 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 education.

- Helping more military-impacted students get access to rigorous STEM courses: Since 2011, the Department of Defense (DOD) has partnered with the non-profit National Math and Science Initiative to expand access to Advanced Placement courses in 40 military-connected public high schools. With additional investments by private-sector partners, 31 additional schools are now participating in the NMSI's Initiative for Military Families. Through this strategic public-private partnership, since 2011, those 71 schools have observed, on average, a 67 percent increase in the number of passing math, science, and English AP scores - more than nine times the national average, while African-American and Hispanic students saw an 80 percent increase and young women experienced a 62 percent increase in passing math and science AP scores. Building on this success, the Department of Defense will continue to work to bring this AP program to additional schools and communities.

Undergraduate STEM Education

The focus of the Budget's undergraduate STEM education investments is on supporting the President's goal to increase the number of well-prepared graduates with STEM degrees by one million over the next 10 years, including investments to:

- Transform undergraduate teaching and learning with NSF investments: 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.

- Improve STEM education at community colleges: The Administration proposes over $60 million for NSF's Advanced Technological Education (ATE) program, which centers on education of technicians for high-technology fields, with a focus on partnerships between academic institutions and employers.

Graduate Education

The focus of the 2015 Budget's graduate STEM education investments is on preparing highly-skilled scientists and engineers who will support American innovation. Key investments in this goal include:

- Enhancing NSF's efforts to train tomorrow's workforce: The Budget provides $333 million to support thousands of outstanding graduate-student researchers who will be tomorrow's leaders in the innovation economy in a range of careers. The Budget provides $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.

- Continuing support for major graduate training programs, including the 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.

Informal STEM Education

The President believes that we need to give many more boys and girls engaging STEM experiences that show them the potential of these high-wage careers. That's why he hosted the first-ever White House Science Fairs, recorded a video urging students to try an hour of code and connect a million minds, challenged students to be "makers of things", and called on the Nation's 200,000 Federal scientists and engineers to volunteer in their local communities and think of creative ways to engage students in STEM subjects.

In addition, later this year, the Administration will host its first-ever White House Maker Faire, which will include commitments by leading organizations to help more students access the tools and skills necessary to design and make just about anything and pursue careers in design, advanced manufacturing, and related STEM fields.

The 2015 Budget builds on the President's leadership with key investments that include:

- Identifying and scaling best practices to engage youth in STEM: The Administration 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.

- Leadership by the Smithsonian Institution and the broader museums and library community: 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. In addition, the Institute of Museum and Library Services (IMLS) will prioritize support for STEM and "making" programs within existing IMLS funding streams, with special emphasis on at-risk youth.

- Supporting High-Quality Informal STEM Education Programs at NASA: 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 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 meet the Nation's STEM education goals.

Broadening Participation in STEM Education and Careers

The Budget sustains support for key programs to broaden participation in STEM education to women and minorities traditionally underrepresented in many of these fields.

- Strong support for broadening participation at NSF: $32 million for NSF's 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).

- NASA education effort to reach underserved students: $30 million for NASA's Minority University Research and Education Program (MUREP) which strives to ensure that underrepresented and underserved students participate in NASA education and research projects and to assist more students in their pursuit of STEM careers.

Supporting Innovation and Next-Generation Learning Technologies

Building on the President's *Strategy for American Innovation* and the Administration's commitment to tackle the Grand Challenges of the 21st Century, the Budget provides support for:

- ARPA-ED: approximately $50 million for the Advanced Research Projects Agency for Education (ARPA-ED), a "DARPA for Education." ARPA-ED will allow the Department of Education to support high-risk, high-return research on next-generation learning innovations and technologies. It will advance the field of education research, development, and demonstration by sponsoring the synthesis and vetting of public and private R&D efforts; identifying breakthrough development opportunities; shaping the next wave of R&D; investing in the development of new education innovations and technologies, learning systems, and digital learning materials; and identifying and transitioning the best and most relevant R&D from other Federal agencies.

- Virtual Learning Lab: In addition, ED's Institute of Education Sciences (IES) and NSF will collaborate on a "Virtual Learning Laboratory" initiative, investing to support rapid experimentation and use of "Big Data" to discover better ways to help students master important concepts in core academic subjects such as STEM.

These investments in next-generation learning technologies will complement the Administration's ConnectED initiative. The President has called on the Federal Communications Commission to take steps to connect 99 percent of American students to the digital age through next-generation broadband and high-speed wireless in their schools and libraries. The Budget proposes $200 million at ED for the ConnectEDucators program to ensure that students receive the full benefit of connectivity by providing professional development opportunities that help teachers make effective use of these new resources. The Opportunity, Growth, and Security Initiative would dedicate an additional $300 million to this effort, providing a total of 100,000 teachers in 500 school districts across the country with access to professional development.

Making the Most of Our STEM Education Investments

The President's 2015 Budget maintains a strong commitment to STEM education and supports the core principles of the 2014 Budget proposal and the goals of the Five-Year Strategic Plan, while making important changes that reflect valuable input from the STEM education community. For example:

- 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 restored compared to the 2014 Budget proposal. This means, for example, that funding is provided to NASA, NIH, and the National Oceanic and Atmospheric Administration (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.

- 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.

- 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.

II. Progress on the Federal STEM Education 5-Year Strategic Plan

The Federal STEM Education 5-Year Strategic Plan (Strategic Plan), released in May 2013, was the result of substantial work by the Administration to identify strategic priorities for STEM education investment, ways that agencies could collectively contribute to those goals, and to continue to grow the evidence base of what works in STEM education.

Many Federal agencies place a high priority on STEM education and have developed initiatives unique to their agency's mission, vision, and resources. The Strategic Plan builds upon these efforts and identifies five priority investment areas, each with a corresponding national goal toward which Federal agencies and their partners in state and local entities and the private sector, should aspire:

- Improve STEM Teacher Training: Prepare 100,000 excellent new K-12 STEM teachers by 2020, and support the existing STEM teacher workforce;

- Increase and Sustain Youth and Public Engagement in STEM: Support a 50 percent increase in the number of youth in America who have authentic STEM experiences each year, prior to completing high school;

- Enhance STEM Experience of Undergraduate Students: Graduate 1 million additional students with degrees in STEM fields over a decade;

- Better Serve Groups Historically Under-represented in STEM Fields: Increase the number of underrepresented minorities that graduate with STEM degrees in the next 10 years and improve women's participation in areas of STEM where they are significantly underrepresented; and

- Design Graduate Education for Tomorrow's STEM Workforce: Provide graduate-trained STEM professionals with basic research foundational expertise, options to acquire specialized skills in areas of national importance and mission agency's needs, and ancillary skills needed for success in a broad range of careers.

In addition, CoSTEM agencies recognize that improved coordination and collaboration across the Federal STEM education investment portfolio is necessary to make the most effective use of their resources and expertise. Accordingly, the Strategic Plan outlines two priority coordination approaches:

- Build new models for leveraging assets and expertise. Implement a concept of lead and collaborating agencies to leverage capabilities across agencies to ensure the most significant impact of Federal STEM education investments.

- Build and use evidence-based approaches. Conduct STEM education research and evaluation to build evidence about promising practices and program effectiveness, use across agencies, and share with the public to improve the impact of the Federal STEM education investment.

Progress on Strategic Plan Implementation

The Strategic Plan laid out draft implementation roadmaps in each of the priority STEM education investment and coordination areas, and proposed potential short, medium, and long-term objectives and strategies to help Federal agencies achieve the goals described.

With the release of the Strategic Plan, the CoSTEM directed the Taskforce on Federal Coordination in STEM Education (FC-STEM) to undertake planning for Strategic Plan implementation. As of January 2014, FC-STEM continues this implementation role and has been re-chartered as the Subcommittee on Federal Coordination in STEM Education under the CoSTEM.

In addition, since the release of the plan, FC-STEM has launched five working groups, each tasked with executing one of the five strategic objectives to improve P-12 STEM instruction, increase and sustain youth and public engagement in STEM, enhance the STEM experience of undergraduate students, better serve groups historically underrepresented in STEM fields, and design graduate education for tomorrow's STEM workforce.

These interagency groups have convened over the last year to begin Strategic Plan implementation. Across priority areas, these working groups are planning new pilot projects that leverage agency assets and expertise to improve the reach of STEM content in formal school and afterschool settings; increasing coordination across agencies to identify meaningful opportunities and experiences for P-12 teachers, undergraduate, and graduate students; identifying localities with common grantees to best leverage Federal investment; and developing common data collection strategies for improved evaluation.

Some early highlights of their work include:

- The **P-12 STEM instruction group** is addressing the near-term goal of identifying ways that multiple agencies can support STEM teachers in high-need districts and in expanding authentic STEM opportunities for P-12 teachers. Agencies are also working on common definitions which will allow increased syncing and evaluation of programs and on sharing existing examples of outreach and assessment.

- Agencies in the **informal STEM education group** are sharing information on existing investments and evaluations of different activities that give students the opportunity to discover, create, and invent, with the goal of supporting scale-up for the most promising strategies.

- Agencies in the **graduate education group** are exploring ways to make it easier for students and administrators to learn about fellowship and traineeship opportunities offered across the Federal government. In addition, they are exploring where additional training or workforce alignment is needed in graduate programs and how the Federal resources in STEM graduate education can support these program and curricular improvements.

To further support these interagency efforts and institutionalize the STEM Education Strategic Plan into agency performance metrics, the STEM Education Strategic Plan has also been recently codified as a Cross Agency Priority Goal, toward the achievement of which multiple Federal agencies come together around a central priority.

Going forward, CoSTEM and FC-STEM will continue to make progress on Strategic Plan implementation, with particular focus on short- and medium-term implementation goals. The working groups will also incorporate input from the STEM education community and make the adjustments needed to ensure progress on the shared goal of giving more Americans access to critical STEM skills.

III. Reducing Fragmentation and Duplication of STEM Education Programs

Leadership by this Administration and Congress has already resulted in substantial reduction in the fragmentation of the STEM education portfolio, with the number of STEM education programs reduced by almost 40 percent in the past two years. This reduction from approximately 228 STEM education programs in 2012 to an estimated 138 as reflected by FY14 agency operating plans, has improved the ability of agencies to evaluate programs, locate strategic partners, and deploy resources against priorities. The President's 2015 Budget builds on this record by further reducing fragmentation to 111 requested programs.

Internal Consolidations

The primary mechanism for reducing fragmentation has been internal agency-level consolidations. Notable examples include:

- Major reorganization of NASA's education investments, by consolidating education efforts currently spread throughout the agency to within the Office of Education's STEM education and Accountability Projects (SEAP) program. Through a competitive process, the Office of Education will identify and support the most effective STEM education activities across NASA. Additionally, the President's FY15 Budget provides $15 million for NASA's Science Mission Directorate to fund, also through a competitive process, the best application of NASA's science assets to meet the Nation's STEM goals.

- Consolidation of NSF education investments, helping NSF to focus on improving the research base and delivery of undergraduate STEM education. NSF is also bringing greater coherence to its undergraduate education investments by creating an agency-wide framework to guide those investments.

Cross-Agency Partnerships

Under CoSTEM and the STEM Education Strategic Plan, agencies have also begun a number of efforts to reduce duplication through increased coordination and collaboration. These efforts include:

- NASA's growing partnership with the Department of Education's 21st Century Community Learning Center program: In 2013, NASA began a pilot with ED's $1.2 billion 21st Century Community Learning Center (21stCCLC) program, which is estimated to serve over 1.6 million students. NASA customized online STEM challenges and associated curriculum materials aligned to 21stCCLC objectives, working with three 21stCCLC states: Colorado, Michigan, and Virginia. NASA and ED are now using the results from the pilot to draft a framework for other Federal collaborations to customize agency STEM education content for the 21stCCLC community.

- Common research guidelines, and other resources to support agency STEM education investments: ED and NSF have developed common guidelines for education research. The guidelines include suggestions for describing high-quality work within six education research study types: (1) foundational research; (2) early stage and exploratory research; (3) design and development projects; (4) efficacy studies; (5) effectiveness studies; and (6) scale-up studies. The evidence guidelines are intended to be used by prospective grantees, Federal agency staff members, and merit reviewers. NSF has begun work with several other agencies to develop opportunities for broader professional development, such as internships at Federal labs or in industry, for students in its graduate fellowship program and exploring a common graduate fellowship portal to reach more students.

Agencies are also collaborating as part of larger multi-sector coalitions, such as *100Kin10*, a partnership of over 150 organizations working together to meet the President's goal of training 100,000 excellent STEM teachers over the next decade. *100kin10* now includes ED, the Department of Energy, NASA, NSF, and NOAA as members.

The President's 2015 Budget builds on these efforts with investments that improve the ability of agencies to leverage each other's grant-making expertise, regional infrastructure, and ability to collect data – all with the goal of reaching more students and more teachers more effectively. These include:

- **Department of Education**'s 2015 Budget requests $110 million for supporting STEM Innovation Networks, regional partnerships among school districts, Federal science agencies, universities, museums, and other partners to transform teaching and learning.

- **NIH**'s 2015 Budget requests approximately $15 million for the Science Education Partnerships Awards program, which will for the first time be coordinated with the Department of Education to support more grants going to school districts most in need of assistance.

- **Smithsonian Institution**'s 2015 Budget requests $10 million to work with Federal agencies and other science partners to harness their unique expertise and resources to create relevant materials and on-line resources, and to harness Smithsonian's effective delivery mechanisms to reach more students. Their efforts will include build on an existing cross-agency pilot with NOAA, NASA, NIH, EPA, DOD, and the National Park Service on promoting stewardship of water, a project which has fostered strong partnerships among agencies.

- **NOAA**'s 2015 Budget requests $2 million for the NOAA Office of Education to provide expertise, materials, and technical assistance from NOAA's science offices to improve K-12 STEM education programs.

- **Department of Defense**'s 2015 Budget continues support for inter-agency programs such as its Awards to Stimulate and Support Undergraduate Research Experiences (ASSURE) Program, which supports undergraduate research in DoD-relevant disciplines by sub-selecting from a larger NSF program solicitation.

- **National Science Foundation**'s 2015 Budget provides funding for NSF to collect data to better understand the state of the STEM workforce and the outcome of Federal programs aimed at addressing workforce needs and broadening participation.

IV. Improving Dissemination of Federal STEM Education Resources

This section responds to Congressional interest in a "single-stop" repository for the dissemination of Federal STEM education resources by describing current dissemination efforts and potential next steps that agencies can take to better integrate these activities.

Current Dissemination Efforts

The National Science Foundation (NSF) and the Department of Education (ED) have existing mechanisms for making content from federally funded education research available to the public.

One of the most well-known of these is the What Works Clearinghouse (WWC) led by ED's Institute for Education Sciences (IES). The goal of WWC is to provide resources to enable informed decision-making in education at multiple levels across a wide range of topics, including science and math. WWC provides practice guides with recommendations for educators, reports that summarize findings from multiple studies of a particular program, reviews assessing a single research study of a program, and quick reviews of recent research. The content reviewed and presented in WWC is a subset of the available Federal research in education, including only those studies that meet pre-defined rigorous standards that have been reviewed by the WWC team.

IES also maintains the Education Resources Information Center (ERIC), an online, searchable catalog of education research papers and information. ERIC contains bibliographic records including citations, abstracts, and other data dating back to 1966; beginning in FY12, peer-reviewed research papers resulting from new IES grants have been required to be submitted to the collection. The ERIC digital library is a more comprehensive listing of research papers and information than the WWC, but no systematic review of the rigor of a particular study or evidence base is done.

Many educational research programs funded by the NSF Directorate for Education and Human Resources (EHR) have maintained "resource networks" to provide capacity building and technical assistance to the researchers and offer some information about the program to the public. Some of these include: the Math and Science Partnership Network, the Center for Advancing Research and Communication in STEM, and the Center for the Advancement of Informal Science Education. Each resource network is maintained by the individual program, so the levels of content useful to educators and the public vary.

Other federally funded collections of learning resources include the Learning Registry and the National Science Digital Library. The Learning Registry is an online network of educational resources voluntarily submitted by both Federal and non-Federal sources that offers educators a single searchable library of educational materials in lieu of multiple disparate databases and websites. A joint effort of ED and the DOD, with both Federal and non-Federal partners, coding for the Learning Registry was recently completed and ED is working to increase participation by content providers who voluntarily include their materials in the service. The Learning Registry focuses on providing content and applications designed for classrooms more than on results from scholarly research. The National Science Digital Library (NSDL) is an NSF-funded online library

providing education resources specifically in the STEM disciplines. Like the Learning Registry, NSDL is not a repository holding the information that educators or researchers may wish to find, but rather provides the capability to search the suite of resources that external providers have made accessible to the library.

The private sector also maintains some similar content-driven websites. The Best Evidence Encyclopedia, run by the Johns Hopkins University Center for Data-Driven Reform in Education, provides summaries of scientific reviews of research findings and measures of effectiveness for education programs. Like WWC, its intent is to provide a wide range of information to enable informed decision-making in education at many levels. The Coalition for Evidence based Policy's "Top Tier Evidence Initiative" evaluates select social programs (including some education programs) that meet the evidence standard of a "well-designed randomized control trial [showing] sizable, sustained effects on important...outcomes" and provides decision-makers with the ability to distinguish evidence-driven programs from others.

Potential Enhancements

To create the one-stop resource as envisioned in Congress' informational request, the most straightforward path is to build upon the infrastructure already developed by NSF and ED, with the goal of making their existing activities more useful to a broader set of communities, including researchers and practitioners.

There are a wide range of stakeholders with interests in education research, each with different needs and seeking solutions to different questions. For example, research results as published in scholarly journals are often most useful to fellow researchers, not necessarily to school districts or educators seeking evidence-based curricula or programs. Translating from data-supported research results published by scientists to evidence-based programs that can be considered by school districts and to applications and curricula that can be implemented by teachers in the classroom requires additional work that is performed only in part by many of the existing services.

With additional support, a joint effort led by NSF EHR and ED IES could build on existing expertise to expand its infrastructure to meet the needs of multiple communities – for example, providing scholarly research results to the research community as is currently done through WWC and ERIC and also presenting or developing evidence-based practice guides intended for practitioners, some of which can currently be found through the WWC, the Learning Registry, and NSDL.

Leveraging the investments already made by IES in WWC and ERIC and by NSF in the resource networks and searchable catalogs like the Learning Registry and NSDL will enable the Federal government to avoid the duplicative effort of starting from scratch and capitalize on some of the utility and public-facing recognition that have already been demonstrated by these resources.

Table 1. Federal STEM Education Funding by Agency

Table 1. Federal STEM Education Funding by Agency
(budget authority in millions)

	2013 Actual	2014 Enacted	**2015 Budget**
Agriculture	74	91	**78**
Commerce	33	35	**22**
Defense	137	129	**102**
Education	462	485	**658**
Energy	68	43	**41**
Health and Human Services	599	602	**601**
Homeland Security	11	6	**5**
Interior	3	2	**2**
Transportation	87	86	**100**
Environmental Protection Agency	17	17	**2**
NASA	141	127	**116**
National Science Foundation	1,176	1,179	**1,182**
Nuclear Regulatory Commission	15	16	**1**
Smithsonian Institution	0	0	**10**
Total Federal STEM Education	2,823	2,817	**2,920**

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TABLE 2: STEM EDUCATION FUNDING IN MILLIONS BY AGENCY AND PROGRAM, FY 2012-2015

AGENCY	SUB-AGENCY	PROGRAM	2012 Enacted	2013 Actual	2014 Enacted	2015 Budget
Agriculture	NIFA	1890 Facilities Grant Program	19.7	18.2	19.7	19.7
Agriculture	NIFA	1890 Institutions Capacity Building Grants Program:	6.4	6.0	6.4	6.4
Agriculture	NIFA	1890 Institutions Capacity Building Grants Program: Teaching	6.4	6.0	6.4	6.4
Agriculture	NIFA	4-H Science, 4-H Youth Development Program	24.0	22.8	25.2	23.5
Agriculture	APHIS	AgDiscovery	0.5	0.5	0.5	0.5
Agriculture	NIFA	Agriculture in the Classroom	0.6	0.5	0.6	-
Agriculture	NIFA	AITC Secondary Postsecondary Agriculture Education Challenge Grants (SPECA)	0.9	0.8	0.9	-
Agriculture	NIFA	Alaska Native-Serving and Native Hawaiian-Serving Institutions Education Competitive Grants Program	3.2	3.0	3.2	3.2
Agriculture	NIFA	Distance Education Grants for Institutions of Higher Education in Insular Areas (DEG)	0.8	-	-	-
Agriculture	NIFA	Food and Agricultural Sciences National Needs Graduate and Postgraduate Fellowship Grant Program	3.2	-	-	-
Agriculture	NIFA	Higher Education Challenge Grants (HEC)	4.8	-	-	-
Agriculture	NIFA	Higher Education Multicultural Scholars Program (MSP)	1.0	-	-	-
Agriculture	NIFA	Hispanic-Serving Institutions Education Grants Program	9.2	8.5	9.2	9.2
Agriculture	NIFA	Insular Programs	-	1.5	1.8	1.8
Agriculture	NIFA	Multicultural Scholars, Graduate Fellowship and Institution Challenge Grants	-	-	9.0	-
Agriculture	NIFA	NIFA Fellowship Grants Program	6.1	6.3	7.3	7.5
Agriculture	NIFA	Resident Instruction Grants Program for Institutions of Higher Education in Insular Areas	0.9	-	-	-
Agriculture	NIFA	Women and Minorities in Science, Technology, Engineering and Mathematics Fields Program (WAMS)	0.4	0.4	0.4	-
Commerce	NOAA	Competitive Education Grants (including Environmental Literacy Grants)	5.1	3.4	3.6	-
Commerce	NOAA	Coral Reef Conservation Program	0.5	0.5	-	-
Commerce	NOAA	Dr. Nancy Foster Scholarship Program	0.5	0.5	0.5	-
Commerce	NOAA	Educational Partnership Program with Minority Serving Institutions	12.5	13.0	14.4	12.4
Commerce	NOAA	Ernest F. Hollings Undergraduate Scholarship Program	4.9	5.1	5.3	5.5
Commerce	NOAA	National Estuarine Research Reserve System	0.6	-	-	-
Commerce	NOAA	National Sea Grant College Program	0.8	0.8	1.0	-

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Commerce	NIST	NIST Summer Institute for MIddle School Teachers	0.3	0.3	0.3	-
Commerce	NOAA	NOAA Bay Watershed Education and Training (B-WET)	5.5	6.7	7.2	-
Commerce	NOAA	NOAA Fisheries Education Program	3.5	-	-	-
Commerce	NOAA	NOAA Office of Ocean Exploration and Research (Education	0.9	-	-	-
Commerce	NOAA	NOAA Teacher at Sea Program	0.6	0.6	0.6	-
Commerce		Office of Education-STEM Coordination	-	-	-	2.0
Commerce	NOAA	Satellite and Information Service	3.2	0.4	-	-
Commerce	NIST	STEM Pipeline for the Next Generation Scientists and Engineers.	0.4	1.0	1.0	1.0
Commerce	NIST	Summer Undergraduate Research Fellowship (SURF)	0.8	0.9	0.8	0.8
Defense		Army Educational Outreach Program (AEOP)	8.2	8.4	9.4	9.3
Defense		Awards to Stimulate and Support Undergraduate Research Experiences (ASSURE)	4.5	4.5	4.5	4.5
Defense		DoD STARBASE Program	25.0	25.0	25.0	-
Defense		Iridescent Learning	2.5	1.6	-	-
Defense		National Defense Education Program (NDEP) K-12	16.6	12.0	-	-
Defense		National Defense Education Program (NDEP) Science, Mathematics And Research for Transformation (SMART)	43.3	40.3	46.3	45.5
Defense		National Defense Science and Engineering Graduate (NDSEG) Fellowship Program	39.7	33.5	36.0	36.0
Defense		National Science Center (NSC)	1.9	1.5	-	-
Defense		Navy - Science and Engineering Apprenticeship Program (SEAP)	0.8	1.0	1.0	1.0
Defense		Navy Historically Black Colleges and Universities/Minority Institutions Research and Education Partnership	1.4	0.5	0.6	0.9
Defense		SeaPerch	1.5	1.1	1.1	-
Defense	NSA	Stokes Educational Scholarship Program	2.0	1.8	1.9	1.6
Defense		The Naval Research Enterprise Intern Program (NREIP)	1.3	1.3	1.3	1.3
Defense		Uniformed Services University of the Health Sciences	0.5	0.5	-	-
Defense		University Laboratory Initiative (ULI)	2.2	2.1	-	-
Defense		University NanoSatellite Program	1.2	1.6	1.6	1.6
Education	OPE	Developing Hispanic Serving Institutions STEM and articulation programs	100.0	94.9	92.8	92.8
Education	OPE	Graduate Assistance in Areas of National Need (GAANN)	30.9	29.3	29.3	29.3

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AGENCY	SUB-AGENCY	PROGRAM	2012 Enacted	2013 Actual	2014 Enacted	2015 Budget
Education	IES	High School Longitudinal Study of 2009	6.7	5.7	4.7	4.8
Education	OII	Investing in Innovation	28.5	21.0	25.0	25.0
Education	OESE	Mathematics and Science Partnerships/Effective Teaching and Learning for a Complete Education	149.7	141.9	149.7	149.7
Education	OPE	Minority Science and Engineering Improvement Program	9.5	9.0	9.0	9.0
Education	IES	Research in Special Education	3.3	1.2	3.9	4.5
Education	IES	Research, Development, and Dissemination	31.2	35.7	35.0	35.0
Education	OESE	STEM Innovation Networks	-	-	-	170.0
Education	OPE	Strengthening Predominantly Black Institutions	5.7	5.7	5.7	5.7
Education	OESE	Teacher Incentive Fund	40.3	-	-	-
Education	OPE	Teacher Loan Forgiveness	67.3	77.6	87.0	89.0
Education	OPE	Upward Bound Math and Science Program	43.8	40.5	43.1	43.1
Energy	Office of Energy Efficiency	Advanced Vehicle Competitions	2.0	1.9	2.0	2.5
Energy	Office of Science	American Chemical Society Summer School in Nuclear and Radiochemistry	0.1	1.0	0.4	-
Energy	Office of Science	Community College Internship (formerly Community College Institute of Science and Technology)	0.6	0.7	0.7	1.0
Energy	Office of Science	Computational Sciences Graduate Fellowship 1/	6.0	11.4	-	-
Energy	Office of Science	Global Change Education Program	0.6	-	-	-
Energy	Office of Energy Efficiency and Renewable Energy, Vehicle Technologies	Graduate Automotive Technology Education	1.0	0.9	-	-
Energy	Office of Science	Graduate Student Research Program (formerly Office of Science Graduate Fellowship) 2/ 3/	5.0	3.0	8.7	-
Energy	Office of Environmental Management	HBCU Mathematics, Science & Technology, Engineering and Research Workforce Development Program	8.3	8.0	8.0	8.0
Energy	Office of Energy Efficiency and Renewable Energy, Water Power	Hydro Research Fellowships	0.8	1.4	-	-
Energy	Office of Energy Efficiency and Renewable Energy, Advanced Manufacturing	Industrial Assessment Centers	4.3	5.3	5.3	6.0

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AGENCY	SUB-AGENCY	PROGRAM	2012 Enacted	2013 Actual	2014 Enacted	2015 Budget
Energy	Office of Economic Impact and Diversity	Minority Educational Institution Student Partnership Program	1.2	-	-	-
Energy	Office of Energy Efficiency and Renewable Energy, Solar Energy Technologies	Minority University Research Associates Program (MURA)	0.5	-	-	-
Energy	Office of Science	National Science Bowl	2.7	2.8	2.8	2.9
Energy	Office of Science	National Undergraduate Fellowship Program in Plasma Physics and Fusion Energy Sciences	0.4	0.3	-	-
Energy	Office of Science	Plasma/Fusion Science Educator Programs	0.8	0.4	-	-
Energy	Office of Science	QuarkNet	0.6	0.6	0.6	-
Energy	Office of Science	Science Undergraduate Laboratory Internships	6.5	7.3	7.8	8.3
Energy	Office of Energy Efficiency and Renewable Energy, Building Technologies	Solar Decathlon	4.2	3.8	2.2	3.0
Energy	Office of Fossil Energy	Special Recuitment Programs/Mickey Leland Fellowship	0.7	0.7	0.7	0.7
Energy	Office of Science	Visiting Faculty Program (formerly Faculty and Student Teams)	1.2	1.3	1.3	1.7
Energy	Office of Energy Efficiency and Renewable Energy, Wind Energy	Wind for Schools	0.6	0.6	-	-
Energy	Office of Science	U.S. Particle Accelerator Training	0.6	0.6	0.6	0.6
Energy	Office of Science	Graduate Student Research Program	-	-	2.0	2.5
Energy	Office of Science	GEARED (Grid Engineering for Accelerated Renewable Energy Deployment) 4/	-	15.1	-	-
Energy	Office of Energy Efficiency and Renewable Energy, Solar Energy	DISTANCE-Solar (Diversity in Science and Technology Advances National Clean Energy in Solar) 4/	-	1.1	-	-
Energy	Office of Environmental Management	Subsurface Remediation and Project Management Traineeship	-	-	-	2.0

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Energy	Office of Energy Efficiency and Renewable Energy, Advanced Manufacturing	Wide Bandgap Power Electronics Traineeship	-	-	-	2.0
EPA	ORD	Cooperative Training Partnership in Environmental Sciences Research	0.5	0.5	0.7	0.1
EPA	Office of Environmental Education	Environmental Education Grants	3.5	-	-	-
EPA	ORD	Greater Research Opportunities (GRO) Fellowships for Undergraduate Environmental Study	2.1	1.8	1.8	-
EPA	Office of Environmental Education	National Environmental Education and Training Partnership	2.0	2.0	2.2	-
EPA	ORD	P3-People, Prosperity & the Planet-Award: A National Student Design Competition for Sustainability	3.1	2.5	2.1	1.7
EPA	NCER	Science to Achieve Results Graduate Fellowship Program	14.0	9.3	9.3	-
EPA	ORD	University of Cincinnati/EPA Research Training Grant	0.6	0.6	0.6	0.6
HHS	NIH, NIGMS	Bridges to the Baccalaureate Program	6.3	6.0	6.2	6.2
HHS	NIH, NCI	Cancer Education Grants Program	6.4	6.4	6.6	6.6
HHS	NIH, Intramural Training	Clinical Research Training Program	0.2	-	-	-
HHS	NIH, Office of Science	Curriculum Supplement Series 5/	0.3	0.2	-	-
HHS	NIH, NINDS	Diversity Research Education Grants in Neuroscience	2.7	1.0	1.0	-
HHS	NIH, Intramural Training	Graduate Program Partnerships	-	11.3	11.7	11.7
HHS	HRSA	Health Careers Opportunity Program	15.0	14.0	-	-
HHS	NIH, NIGMS	Initiative for Maximizing Student Development	2.7	-	-	-
HHS	NIH, NLM	Institutional Grants for Research Training in Biomedical Informatics	0.2	-	-	-
HHS	NIH, NIGMS	MARC U-STAR NRSA Program	18.2	19.8	20.4	20.4
HHS	NIH, NICHD	Mathematics and Science Cognition and Learning (MSCL)	3.7	9.8	10.1	10.1
HHS	NIH	Medical Research Scholars Program (MRSP)	-	0.1	0.1	0.1
HHS	NIH, NCI	National Cancer Institute Cancer Education and Career Development Program	0.9	17.0	17.5	17.5
HHS	NIH, Office of Science	Office of Science Education K-12 Program 5/	2.2	0.2	-	-
HHS	NIH, Intramural Training	Post-baccalaureate Intramural Research Training Award	-	19.2	19.8	19.8
HHS	HRSA	Public Health Traineeship	1.6	-	-	-

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HHS	NIH, NIGMS	RISE (Research Initiative for Scientific Enhancement)	6.3	-	-	-
HHS	NIH	Ruth L. Kirschstein National Research Service Award Institutional Research Training Grants (T32, T35)	487.1	458.5	473.2	473.2
HHS	NIH	Ruth L. Kirschstein NRSA for Individual Predoctoral Fellows, including Underrepresented Racial/Ethnic Groups,Students from Disadvantaged Backgrounds, and Predoctoral Students with Disabilities	4.0	3.7	3.8	3.8
HHS	NIH, NIAID	Science Education Awards	1.1	1.0	-	-
HHS	NIH, NIDA	Science Education Drug Abuse Partnership Award	3.6	0.7	-	-
HHS	NIH, OD	Science Education Partnership Award 5/	15.4	13.8	14.6	14.6
HHS	NIH, NICHD	Short Courses in Population Reseach (Education Programs for Population Research R25)	0.1	0.6	0.6	0.6
HHS	NIH, NIGMS	Short Courses on Mathematical, Statistical, and Computational Tools for Studying Biological Systems	0.5	1.8	1.9	1.9
HHS	NIH, NIEHS	Short Term Educational Experiences for Research (STEER) in the Environmental health Sciences for Undergraduates and High School Students	0.4	0.5	0.5	-
HHS	NIH, NHLBI	Short-Term Research Education Program to Increase Diversity in Health-Related Research	2.9	4.3	4.4	4.4
HHS	NIH, Intramural Training	Student Intramural Research Training Award Program	0.2	5.1	5.3	5.3
HHS	NIH, NHLBI	Summer Institute for Training in Biostatistics	0.1	1.5	1.5	1.5
HHS	NIH, Intramural Training	Undergraduate Scholarship Program for Individuals from Disadvantaged Backgrounds	0.1	2.7	2.8	2.8
Homeland Security	S&T Office of University Programs	Homeland Security STEM Career Development Grant Program	2.7	0.6	-	-
Homeland Security	DNDO	National Nuclear Forensics Expertise Development Program	5.5	6.6	6.0	5.0
Homeland Security	S&T Office of University	Scientific Leadership Awards Program	2.9	3.8	-	-
Interior	Bureau of Land Management	Conservation and Land Management Internship Program	1.6	2.2	1.5	1.5
Interior	USGS	EDMAP	0.6	0.4	0.4	0.4
Interior	National Park Service	George Melendez Wright Climate Change Youth Initiative	0.4	-	-	-
Interior	National Park Service	Geoscientists-in-the-Parks Program	0.3	0.1	0.1	0.1
NASA	ARMD	Aeronautics Academy	0.5	0.5	0.3	-
NASA	ARMD	Aeronautics Content - Smart Skies/Product Content Upgrade	0.8	0.1	-	-

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NASA	ARMD	Aeronautics Scholarship	1.8	1.3	1.7	-
NASA	Education Office	AESP - Aerospace Education Services Project	3.1	-	-	-
NASA	Science Mission Directorate (SMD)	Aqua	0.3	0.3	0.3	-
NASA	Science Mission Directorate (SMD)	Astrophysics Forum	1.0	1.0	-	-
NASA	Science Mission Directorate (SMD)	Aura	0.3	0.3	0.3	-
NASA	Science Mission Directorate (SMD)	Cassini	0.9	0.9	-	-
NASA	Center JSC	CEP - Career Exploration Project	1.1	0.4	-	-
NASA	Science Mission	Chandra	0.5	0.5	0.8	-
NASA	Center JPL	Curriculum Improvement Partnership Award for the Integration of Research into the Undergraduate Curriculum (CIPAIR)	1.6	-	-	-
NASA	Science Mission Directorate (SMD)	DAWN	0.3	0.3	-	-
NASA	ARMD	Design Competitions	0.1	0.1	-	-
NASA	Science Mission Directorate (SMD)	Earth Science E/PO Forum	0.9	0.9	-	-
NASA	Center MSFC	eEducation Small Projects/Central Operation of Resources for Educators (CORE)	0.7	0.4	-	-
NASA	Center JSC	EFP - Education Flight Projects	2.2	-	-	-
NASA	Science Mission Directorate (SMD)	EPOESS	6.6	6.5	-	-
NASA	ESMD	ESMD Space Grant Project	0.6	-	-	-
NASA	Education Office	GCCE - Global Climate Change Education	3.2	-	-	-
NASA	Science Mission Directorate (SMD)	GLOBE Program	4.5	4.5	6.0	6.0
NASA	Science Mission Directorate (SMD)	GRAIL	0.4	0.2	-	-
NASA	Education Office	GSRP - Graduate Student Researchers Program	2.8	-	-	-
NASA	Science Mission Directorate (SMD)	Heliophysics E/PO Forum	0.7	0.8	-	-
NASA	SOMD	HEOMD-Goldstone Apple Valley Radio Telescope (GAVRT) Project	0.5	-	0.1	0.1

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NASA	ESMD	HEOMD-NASA's Beginning Engineering, Science and Technology (BEST) Students (NBS)	0.4	0.4	0.4	-
NASA	ESMD	HEOMD-University Student Launch Initiative	0.3	0.5	0.5	0.5
NASA	Science Mission Directorate (SMD)	HST	1.6	1.6	2.0	-
NASA	Education Office	Informal STEM Education	10.0	9.3	-	-
NASA	ARMD	Innovation in Aeronautics Instruction Competition	0.1	-	-	-
NASA	Education Office	Innovation in Higher Education STEM Education	0.5	-	-	-
NASA	Education Office	INSPIRE - Interdisciplinary National Science Program Incorporating Research and Education Experience	0.7	-	-	-
NASA	Education Office	JPFP - Jenkins Pre-Doctoral Fellowship Program	2.6	-	-	-
NASA	Science Mission Directorate (SMD)	Juno	0.6	0.4	-	-
NASA	Center LaRC	LARSS - NASA Langley Aerospace Research Summer Scholars Program	0.6	0.8	-	-
NASA	Science Mission Directorate (SMD)	LDCM	0.6	0.4	-	-
NASA	Education Office	LEARN - Learning Environment and Research Network	3.0	-	-	-
NASA	Center GRC	LERCIP - Lewis Educational Research Collaborative Internship Project (College)	0.1	0.1	0.1	-
NASA	Education Office	LTP - Learning Technologies Project	0.5	-	-	-
NASA	Science Mission Directorate (SMD)	Mars E/PO Formal Ed	1.1	1.1	0.3	-
NASA	Science Mission Directorate (SMD)	Mars E/PO Informal Ed	1.0	1.0	-	-
NASA	Science Mission Directorate (SMD)	MESSENGER	0.3	0.2	-	-
NASA	Education Office	MSP - MUREP Small Projects	1.0	-	-	-
NASA	Education Office	MUREP	-	27.9	30.0	30.0
NASA	Center GRC	MUST - Motivating Undergraduates in Science and Technology	2.3	-	-	-
NASA	Center JSC	NAS - NASA Aerospace Scholars	0.3	0.3	-	-
NASA	Science Mission Directorate (SMD)	NASA Science Mission Directorate STEM Projects 6/	-	-	-	15.0
NASA	Education Office	NES - NASA Explorer Schools	3.8	-	-	-
NASA	Center MSFC	NETS - NASA Education Technologies Services	1.0	1.3	-	-

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NASA	ESMD	NSBRI Higher Education Activities - National Space Biomedical Research Institute	0.8	-	-	-
NASA	Education Office	NSTI-MI - NASA Science and Technology Institute for Minority Institutions	0.6	-	-	-
NASA	Science Mission Directorate (SMD)	Planetary Science E/PO Forum	0.9	0.9	-	-
NASA	SOMD	Reduced Gravity Student Flight Opportunity Project	0.3	0.4	0.4	-
NASA	Education Office	Research Cluster	1.4	-	-	-
NASA	ESMD	SEED - Systems Engineering Educational Discovery	0.3	0.2	-	-
NASA	Center GRC	SEMAA - Science Engineering Mathematics and Aerospace Academy/FIRST Buckeye	1.0	0.1	-	-
NASA	Science Mission Directorate (SMD)	SOFIA (Stratospheric Observatory for Infrared Astronomy) Education and Public Outreach	0.6	0.7	0.5	-
NASA	Education Office	SOI - Summer of Innovation/NASA IV&V Engineering Apprenticeship Program	5.9	-	-	-
NASA	Education Office	Space Grant - National Space Grant College and Fellowship Program	40.0	37.2	40.0	24.0
NASA	OCT-ST	Space Technology Research Fellowships	12.0	12.0	15.0	15.0
NASA	CMO/ARC	Spaceward Bound	0.4	-	-	-
NASA	Education Office	STEM Education & Accountability Project 7/	-	25.1	28.6	25.9
NASA	Education Office	TCUP - NASA Tribal College and University Project	1.2	-	-	-
NASA	Education Office	URC - University Research Centers	16.0	-	-	-
NASA	Education Office	USRP - Undergraduate Student Research Project	0.3	-	-	-
NRC	Office of the Chief Human Capital Officer	Integrated University Program	15.0	14.2	15.0	-
NRC	Small Business and Civil Rights Office	Minority Serving Institutions Program (MSIP)	0.7	0.8	0.7	0.9
NSF	Directorate for Education and Human Resources	Advanced Informal STEM Learning (AISL), formerly Informal Science Education (ISE)	61.4	48.0	55.0	55.0
NSF	Directorate for Education and Human Resources	Advanced Technological Education (ATE)	64.0	63.5	64.0	64.0
NSF	Directorate for Education and Human Resources	Alliances for Graduate Education and the Professoriate (AGEP)	7.8	7.2	7.8	7.8
NSF	Directorate for Geosciences (GEO)	Centers for Ocean Sciences Education Excellence	4.2	1.0	-	-

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NSF	Directorate for Education and Human Resources	Climate Change Education (CCE)	10.0	3.4	-	-
NSF	Directorate for Computer & Information Science & Engineering (CISE)	Computing Education for the 21st Century (CE21)	15.0	12.2	-	-
NSF	Directorate for Education and Human Resources	Cybercorps: Scholarship for Service (SFS)	45.0	41.3	45.0	25.0
NSF	Office of Cyberinfrastructure (OCI)	Cyberinfrastructure Training, Education, Advancement, and Mentoring for Our 21st Century Workforce (CI-TEAM)	4.0	-	-	-
NSF	Directorate for Education and Human Resources	Discovery Research K-12 (DR-K12)	99.2	96.7	92.5	102.5
NSF	Office of International & Integrative Activities	East Asia & Pacific Summer Institutes for U.S. Graduate Students (EAPSI)	2.4	1.4	2.4	2.4
NSF	Directorate for Engineering (ENG)	Engineering Education (EE)	11.1	11.0	-	-
NSF	Directorate for Math and Physical Sciences (MPS)	Enhancing the Mathematical Sciences Workforce in the 21st Century (EMSW21)	11.8	10.9	10.0	5.7
NSF	Directorate for Education and Human Resources	Excellence Awards in Science and Engineering (EASE)	5.2	4.7	5.8	5.8
NSF	Directorate for Geosciences (GEO)	Geoscience Education	1.5	0.0	-	-
NSF	Directorate for Geosciences (GEO)	Geoscience Teacher Training (GEO-Teach)	2.0	-	-	-
NSF	Directorate for Geosciences (GEO)	Global Learning and Observations to Benefit the Environment (GLOBE)	1.1	0.8	-	-
NSF	Directorate for Education and Human Resources (EHR) & Office of International and Integrative Activities	Graduate Research Fellowship Program (GRFP)	198.1	243.0	300.0	333.4
NSF	Directorate for Education and Human Resources	Graduate Teaching Fellows in K-12 Education (GK-12)	27.0	25.4	-	-
NSF	Directorate for Education and Human Resources	Historically Black Colleges and Universities Undergraduate Program (HBCU-UP)	31.9	30.3	31.9	31.9
NSF	Directorate for Education and Human Resources	Improving Undergraduate Education	-	-	89.0	118.5

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NSF	Directorate for Education and Human Resources	Innovative Technology Experiences for Students and Teachers (ITEST)	25.0	31.5	25.0	25.0
NSF	Directorate for Education and Human Resources	Integrative Graduate Education and Research Traineeship (IGERT) Program	59.8	64.0	31.4	20.4
NSF	Office of International & Integrative Activities	International Research Experiences for Students (IRES)	3.2	3.1	2.3	2.3
NSF	Directorate for Education and Human Resources	Louis Stokes Alliances for Minority Participation (LSAMP)	45.6	42.0	45.6	45.6
NSF	Directorate for Education and Human Resources	Math and Science Partnership (MSP)	57.1	52.5	-	-
NSF	Directorate for Engineering (ENG)	Nanotechnology Undergraduate Education in Engineering	1.5	1.7	-	-
NSF	NSF	NSF Research Traineeships (NRT)	-	-	23.7	37.8
NSF	Directorate for Education and Human Resources	NSF Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM)	75.0	84.0	75.0	75.0
NSF	Directorate for Geosciences (GEO)	Opportunities for Enhancing Diversity in the Geosciences	3.6	-	-	-
NSF	Directorate for Engineering (ENG) and Directorate for	Research Experiences for Teachers (RET) in Engineering and Computer Science	5.5	8.6	5.5	5.5
NSF	Directorate for Education and Human Resources	Research Experiences for Undergraduates (REU)	66.0	74.1	75.2	75.1
NSF	Directorate for Education and Human Resources	Research in Disabilities Education (RDE)	6.5	-	-	-
NSF	Directorate for Education and Human Resources (EHR)	Research on Education and Learning (REAL), formerly Research and Evaluation on Education in Science and Engineering (REESE)	37.7	54.6	48.7	-
NSF	Directorate for Education and Human Resources	Research on Gender in Science and Engineering (GSE)	10.5	-	-	-
NSF	Directorate for Education and Human Resources	Robert Noyce Scholarship (Noyce) Program	54.9	51.1	60.9	60.9
NSF	Directorate for Education and Human Resources (EHR)	Science, Technology, Engineering, and Mathematics Talent Expansion Program (STEP)	25.3	17.0	-	-

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NSF	Directorate for Education and Human Resources (EHR) and Directorate for Computer & Information	STEM-C Partnerships	-	-	69.1	69.1
NSF	Directorate for Education and Human Resources	Transforming Undergrad Education in STEM (TUES)	39.5	56.4	-	-
NSF	Directorate for Biological Sciences (BIO)	Transforming Undergraduate Biology Education (TUBE)	13.0	3.9	-	-
NSF	Directorate for Education and Human Resources	Tribal Colleges and Universities Program (TCUP)	13.3	12.4	13.5	13.5
NSF	Directorate for Education and Human Resources	Widening Implementation and Demonstration of Evidence-based Reforms (WIDER)	8.0	18.5	-	-
Smithsonian		STEM Informal Education and Instruction	-	-	-	10.0
Transportation	Federal Aviation Administration (FAA)	Air Transportation Centers of Excellence	15.0	13.1	13.0	13.0
Transportation	Office of the Assistant Secretary for Research and Technology	Dwight David Eisenhower Transportation Fellowship Program	1.9	-	-	-
Transportation	Office of the Assistant Secretary for Research and Technology	Garrett A. Morgan Technology and Transportation Education Program	1.1	0.4	0.4	0.4
Transportation	Office of the Assistant Secretary for Research and Technology	National Summer Transportation Institute Program (STI)	2.6	2.8	2.8	2.8
Transportation	Office of the Assistant Secretary for Research and Technology	Summer Transportation Institute Program for Diverse Groups (STIPDG)	1.3	1.3	1.3	1.3
Transportation	Office of the Assistant Secretary for Research and Technology	University Transportation Centers Program	80.0	69.3	68.8	82.0
Total, All Federal STEM Education Programs			**2,888.8**	**2,823.4**	**2,817.5**	**2,919.8**

1/ Awards made in FY 2013 were funded for the full period at the time of award. Prior to FY 2013, continuation costs of awards were funded on a year-to-year basis. In FY 2014, the program will make no new awards, reflected by the zero funding level.

2/ The Office of Science Graduate Fellowship was restructured in FY2013 and succeeded by the Office of Science Graduate Student Research Program.

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3/ This one-time increase in FY 2014 will be used to fund awards in the area of computational science. FY 2014 awards will be funded for the full period at the time of award. Prior to FY 2014, continuation costs of awards were funded on a year-to-year basis.

4/ Both of these DOE programs are forward-funded. Funding was provided in FY13 to support activities in FY13, FY14, and FY15. Thus, the zeroes reported in FY14 and FY15 do not reflect terminations, but rather that the program is supported in those fiscal years with FY 13 funding.

5/ The NIH Office of Science Education K-12 Program and the Curriculum Supplement Series were merged with the Science Education Partnership Awards (SEPA) in FY 2014.

6/ The Budget provides $15 million to consolidate and streamline programs within the Science Mission Directorate. Previously funded Science Mission Directorate activities, including consolidated programs, may be eligible to compete for this funding.

7/ The Budget provides $26 million to consolidate and streamline programs within the STEM Education and Accountability Projects (SEAP). Projects and activities previously funded by ARMD, HEOMD, or NASA Centers may also be eligible to compete for this funding.