

Statement of Dr. John P. Holdren
Director, Office of Science and Technology Policy
Executive Office of the President of the United States
to the
Subcommittee on Science and Space
Committee on Commerce, Science and Transportation
United States Senate
on
Investing in Federal R&D
March 17, 2011

Chairman Nelson, Ranking Member Boozman, and Members of the Committee, it is my distinct privilege to be here with you today to discuss investments in Federal research and development (R&D) in the President's fiscal year (FY) 2012 Budget.

Administration Initiatives in Education, Innovation, and Infrastructure

President Obama, in his most recent State of the Union address, called on all of us to help create the American jobs and industries of the future by doing what this Nation does best – investing in the creativity and imagination of the American people. The President identified this time in history as our generation's Sputnik moment. And just as investments in science and engineering research and development (R&D) turned the original Sputnik moment into a Golden Age of American technological and economic dominance, so new investments in science, technology, and innovation (STI) will be the foundation for continued American leadership in the future. Targeted investments in the most promising frontiers of science, made in the context of responsible reductions in less productive endeavors, will fuel this trajectory and allow us, in the President's words, to "out-innovate, out-educate, and out-build the rest of the world."

President Obama understands that our ability to meet the grand challenges before us is intimately dependent on robust research and development; superior science, technology, engineering, and mathematics (STEM) education; and 21st century transportation, telecommunications, and energy infrastructure. His 2012 Budget provides strategic investments in these domains while also streamlining aspects of the Federal government and responding responsibly to the deficit. At a difficult time in America's history, the President's 2012 Budget proposes to invest intelligently in innovation, education, and infrastructure today to generate the industries, jobs, and environmental and national security benefits of tomorrow. Obviously, 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 two years of the Administration. And in this 112th Congress, we hope to extend this partnership with both the Senate and the House across the entire science and technology portfolio. Such a collaboration to stimulate scientific discovery and new technologies will take America into this new century well-equipped for the challenges and opportunities that lie ahead.

In the remainder of this testimony, I elaborate on the reasons the President and I are most hopeful you'll provide that support.

The Federal R&D Budget

In his State of the Union address, the President said: “The first step in winning the future is encouraging American innovation,” and he promised to deliver a budget that would ensure the Nation’s ability to achieve that goal. Last month, the President released that budget. It proposes a record \$66.8 billion investment in civilian research and development, an increase of \$4.1 billion or 6.5 percent over the 2010 funding level, reflecting the Administration’s firm belief that investment in civilian research is a key ingredient for cultivating the innovation that is so important to growing the American economy of the future.

(Because of the uncertainty around the outcome of 2011 appropriations, all the comparisons in my testimony are between the 2012 Budget and the enacted 2010 appropriations. My testimony discusses changes in current dollars, not adjusted for inflation. The latest economic projections show inflation of 2.7 percent between 2010 and 2012 for the economy as a whole, using the GDP deflator.)

These important R&D investments will bolster the fundamental understandings of matter, energy, and life that are at the root of much innovation, and they will foster significantly new and potentially transformative technologies in areas such as biotechnology, information technology, and clean energy.

The Obama Administration’s investments in innovation, education, and infrastructure fit within an overall non-security discretionary budget that would be frozen at 2010 levels for the second year in a row and would stay frozen to 2015. The Budget reflects strategic decisions to focus resources on those areas where the payoff for the American people is likely to be highest, while imposing hard-nosed fiscal discipline on areas lacking that kind of promise. For example, the 2012 Budget proposes \$79.4 billion for development within the Federal R&D portfolio—a decline compared to the 2010 funding level primarily because of reductions in development funding in the Department of Defense. Across government, important programs will have to make do with less, as noted in several of the program descriptions below. The total (defense and nondefense) R&D budget would be \$147.9 billion, \$772 million or 0.5 percent above the 2010 enacted level. That modest increase is difficult to accept, of course, given the many needs that could potentially be addressed by an expanded Federal R&D portfolio. But the Administration is committed to making tough choices and it has made many such in this Budget.

Budgets of Science Agencies

Three agencies have been identified as especially important to this Nation’s continued economic leadership by the President’s Plan for Science and Innovation, the America COMPETES Act, the Administration’s Innovation Strategy, and the America COMPETES Reauthorization Act, passed by the Congress in December through the leadership of this Committee and signed by the President in January. Those three jewel-in-the-crown agencies are the National Science Foundation, a primary source of funding for basic academic research; the Department of Energy’s (DOE’s) Office of Science, which leads fundamental research relevant to energy and also builds and operates the major research infrastructure—advanced light sources, accelerators, supercomputers, and facilities for making nano-materials—on which our scientists depend for energy research breakthroughs; and the National Institute of Standards and Technology laboratories, which support a wide range of pursuits from accelerating standards

development for health information technology and "smart grid" technologies to conducting measurement science research to enable net-zero energy buildings and advanced manufacturing processes.

In recognition of the immense 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 put these agencies on a doubling trajectory. The FY2012 budget maintains that trajectory, as newly authorized in the America COMPETES Reauthorization Act (Public Law 111-358), with a 12.2 percent increase between 2010 and 2012 for their combined budgets, totaling \$13.9 billion. I want to emphasize that the proposed increases for these three agencies are part of a fiscally responsible budget focused on deficit reduction that holds overall non-security discretionary spending flat at 2010 levels for the second year in a row, meaning these increases are fully offset by cuts in other programs.

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 (the Department of Defense and DOE's defense 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 believed that optimal use of federal funds relies on two conditions: ensuring that its research is aimed – and continuously re-aimed – at the frontiers of understanding; and certifying that every dollar goes to competitive, merit-reviewed, and time-limited awards with clear criteria for success. When these two conditions are met, the nation gets the most intellectual and economic leverage from its research investments. In recognition of the time-proven truth that today's NSF grants are tomorrow's billion dollar, job-creating companies, the 2012 Budget request for NSF is \$7.8 billion, an increase of 13.0 percent above the 2010 funding level. This keeps NSF on track to double its budget as promised in the President's Plan for Science and Innovation.

NSF puts the greatest share of its resources in the nation's colleges and universities. Universities are the largest performers of basic research in the United States, conducting over fifty percent of all basic research. 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 2012 Budget sustains the doubling of new NSF Graduate Research Fellowships to support 2,000 new awards. The 2012 Budget also includes \$64 million for the Advanced Technological Education (ATE) program to promote partnerships between higher-education institutions and employers to educate technicians for the high-technology fields that drive our nation's economy; ATE is the centerpiece of an overall \$100 million NSF investment in community colleges, an important part of the higher education system.

NSF also proposes to increase research funding to promote discoveries that can spark innovations for tomorrow's clean energy sources with a cross-disciplinary approach to

sustainability science. The Science, Engineering, and Education for Sustainability (SEES) portfolio will increase to \$998 million in the 2012 Budget for integrated activities involving energy and environment. NSF is also committed to enhancing U.S. economic competitiveness with Science and Engineering Beyond Moore's Law (SEBML), a multidisciplinary research program that aims to extend the technological and conceptual limits on computer processing, with an investment of \$96 million in the 2012 Budget. NSF is also investing \$76 million in a multi-directorate initiative on research at the interface of the Biological, Mathematical, and Physical Sciences (BioMaPS) that aims for an accelerated understanding of biological systems and the opening of new frontiers in biotechnology. The Administration proposes \$15 million in the 2012 Budget for NSF's contribution to a new interagency initiative called Enhancing Access to the Radio Spectrum, or EARS, to support research into new and innovative ways to use the radio spectrum more efficiently so that more applications and services used by individuals and businesses can occupy the limited amount of available spectrum.

National Aeronautics and Space Administration (NASA)

This past October, the President signed the 2010 NASA Authorization Act (the "Act", Public Law 111-267), which stands as a statement of bipartisan agreement by Congress and the Administration regarding NASA and its many programs. NASA's programs not only support the grand and inspiring adventures of space exploration, scientific discovery, and aeronautical advancement, but also provide an indispensable platform for observing the Earth to ensure that we have the information we need to cope with weather-related and other environmental threats to human well-being. NASA programs also fuel new technology development and innovation and help launch new products, services, businesses, and jobs with enormous growth potential. The Act will further our joint goal of placing NASA's programs on a more stable footing and enhancing the long-term sustainability of these exciting endeavors as we chart a new path forward in space.

The FY2012 NASA budget reaffirms the Administration's commitment to a bold and ambitious future for NASA. Every initiative called for in the Act is funded, including: a robust program of space science and Earth science, including a commitment to invest in new satellites and programs of Earth observation; a strong aeronautics research program; the Space Launch System (SLS) heavy-lift launch vehicle and Multi-Purpose Crew Vehicle (MPCV) needed to support human spaceflight and exploration missions beyond Earth's orbit; a vigorous technology development program; extension of International Space Station (ISS) activities through at least 2020, coupled with a plan to use this orbiting outpost more effectively; and the development of private-sector capabilities to transport cargo and crew into low Earth orbit, thus shortening the duration of our reliance solely on Russian launch vehicles for access to the ISS.

Within the context of a difficult budget environment and the President's decision to freeze non-security discretionary spending at 2010 levels for five years, NASA's budget remains at \$18.7 billion in the 2012 Budget. This budget level demands difficult choices, and those choices were made while keeping in mind the priorities of the Act as well as the collective desire of the Congress and the Administration to have a balanced program of science, research, technology development, safe spaceflight operations, and exploration. One such difficult choice was limiting the budget for the James Webb Space Telescope, keeping the project funded at \$375 million in 2012, to assure NASA the opportunity to begin work on new scientific opportunities identified in the National Academies' most recent decadal survey in astronomy and astrophysics. Similarly, the 2012 Budget reduces the planned increases in Earth-science research outlined in

the 2011 Budget. The Budget demonstrates the President's continued commitment to our shared priorities even when difficult decisions are required, providing \$1.8 billion in FY2012 funding for the Space Launch System and \$1.02 billion for the Multi-Purpose Crew Vehicle, thereby laying the critical foundation for these exploration programs. As NASA reported in January of this year, it is still in the process of shaping these efforts and will discuss them in more detail in a report to Congress this spring. Similarly, the Budget provides a solid foundation for the commercial crew and cargo transportation programs that are necessary to provide safe and cost-effective access to low Earth orbit, including sufficient support for the operations of the ISS.

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

The hugely 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, helping ensure that America remains the world leader in measurement innovation and systems interoperability. Reflecting NIST's vital role in supporting the economy and infrastructure, the 2012 Budget of \$764 million for the Institute's intramural laboratories amounts to a 15.1 percent increase over the 2010 enacted level. That increase will support high-performance laboratory research and facilities for a diverse portfolio of investigations in areas germane to advanced manufacturing, health information technology, cybersecurity, interoperable smart grid, and clean energy. For NIST's extramural programs, the 2012 Budget requests \$143 million for the Hollings Manufacturing Extension Partnership (MEP), an \$18 million increase over the 2010 enacted level. The 2012 Budget also requests \$75 million for the Technology Innovation Program (TIP), a \$5 million increase over 2010, and \$12 million for the Advanced Manufacturing Technology Consortia program, a new public-private partnership that will develop road maps for research that will broadly benefit the Nation's industrial base. All of these NIST programs are important components of *A Framework for American Manufacturing*, a comprehensive strategy for supporting American manufacturers announced in December 2009, and the Administration's revised Innovation Strategy released in February.

Department of Commerce National Oceanic and Atmospheric Administration (NOAA)

NOAA plays a vital role supporting research on the Earth's oceans, atmosphere, and marine habitats. The NOAA budget of \$5.5 billion is an increase of \$749 million over the 2010 enacted level. This will allow NOAA to strengthen the scientific basis for consequential environmental decision-making, improve critical weather and climate services that protect life and property, invest more heavily in restoring our oceans and coasts, take advantage of high-performance computing to manage weather and climate data, and ensure continuity in crucial Earth-observation satellite coverage. The 2012 Budget proposes a restructuring of NOAA, including the creation of a Climate Service line office in NOAA that will focus on the delivery of climate services while sustaining research on oceans, atmosphere, and climate.

NOAA satellite systems are critical for our Nation's ability to forecast severe weather, such as blizzards or hurricanes, and as such can save lives and property. Ensuring that we retain these capabilities remains a top priority in the 2012 Budget. The former National Polar-orbiting Operational Environmental Satellite System (NPOESS) program had a troubled history, as illustrated by numerous Congressional hearings and GAO reports. Because of this, in early 2010 the Administration announced a significant restructuring of the program, and this plan was

endorsed by Congress as part of the 2010 NASA Authorization Act (Section 727). This restructuring was accompanied by significant increases in NOAA's 2011 Budget request in order to expedite the launch schedule of these essential weather satellites and reduce the risks of a gap in forecasting data. However, because the current continuing resolution allows for only a fraction of the funding necessary in FY2011 to continue work on the instruments and spacecraft for the first of NOAA's satellites (the first Joint Polar Satellite System mission, or JPSS-1), work on the first JPSS satellite has been slowed down considerably. Under current funding scenarios, the JPSS-1 mission could be delayed by up to two years, thus forcing the weather forecasting community to rely solely on satellites that will be operating well past their planned mission life. The 2012 Budget request provides \$1.1 billion to continue the development of the Joint Polar Satellite System, a significant increase over the 2010 enacted level which reflects the need for NOAA to fully fund the acquisition of satellites for the afternoon orbit within its own budget. NOAA recognizes the magnitude of the requested investment for environmental operational satellites. However, given the impact of weather on society and the nation's economy, the ability to warn and protect our citizens from harm is well worth the cost.

Department of Energy (DOE)

The Administration is directing Federal innovation incentives to one of the most important, job-creating, innovation-inspiring challenges of our time: making clean energy affordable and abundant. The DOE R&D portfolio is a key part of this effort, which is why DOE R&D increases to \$13.0 billion in the 2012 Budget. This represents targeted growth of 19.9 percent and does not include DOE's non-R&D cleanup, weapons, and energy-deployment programs. The 2012 Budget also proposes significant resources for demonstration and deployment incentives as part of a comprehensive framework for moving the United States toward a clean-energy future. The Administration's clean-energy R&D priorities focus on developing cutting-edge technologies with real-world applications to advance a clean-energy economy, increase energy efficiency in industry and manufacturing, reduce energy use in buildings, and reach the goal of having 1 million electric vehicles on the road by 2015. To help pay for these priorities, we are proposing to cut inefficient subsidies that we currently provide, unnecessarily, for fossil fuels.

The 2012 Budget proposes \$550 million in appropriations for the Advanced Research Projects Agency-Energy, or ARPA-E, and another \$100 million in mandatory funding under the Wireless Innovation Fund. The Budget will advance ARPA-E's portfolio of transformational energy research with real-world applications across areas ranging from grid technology and power electronics to batteries and energy storage. First funded as part of the American Recovery and Reinvestment Act (ARRA), ARPA-E is a signature component of the America COMPETES Act, which was recently reauthorized.

The 2012 Budget also doubles the number of Energy Innovation Hubs to solve key challenges that require cross-cutting inputs from diverse disciplines. The three new Hubs will focus on Batteries and Energy Storage, Smart Grid Technology and Systems, and Critical Materials. In early February, the President visited the existing Energy Efficient Building System Design Hub, which will accelerate the development of innovative designs for cost-effective lighting, sunlight-responsive windows, and smart, thermodynamic heating and cooling systems, which together will help make America home to the most energy-efficient buildings in the world. The other two existing Hubs focus on Fuels from Sunlight and Modeling and Simulation for Nuclear Reactors.

The Department of Energy's Office of Science pursues fundamental discoveries and supports major scientific research facilities that provide the foundation for long-term progress in economically significant domains such as nanotechnology, advanced materials, high-end computing, energy supply and end-use efficiency, and climate change. The 2012 Budget of \$5.4 billion, more than 10 percent above the 2010 enacted level, increases funding for facilities and cutting-edge research geared toward addressing fundamental challenges in many areas including clean energy and climate change, as well as multi-scale carbon cycle research to underpin measurement, reporting, and verification of greenhouse gas emissions.

Investments in DOE's clean-energy applied R&D programs target gains over the next several decades for reducing dependence on oil and accelerating the transition to a low-carbon economy. The President's 2012 Budget increases investments in Energy Efficiency and Renewable Energy by more than 40 percent over the 2010 appropriation to a total of \$3.2 billion. EERE supports important work in industrial productivity, R&D on advanced batteries for electric and hybrid vehicles, and building technology R&D to cut energy consumption. It also supports new deployment activities in these areas, including a \$200 million competitive grant program to encourage electric vehicle (EV) readiness and a \$100 million competitive "Race to Green" program to encourage state and local governments to streamline codes, regulations, and performance standards and make efficient building the norm. Strong support continues for carbon capture and storage options that can significantly reduce the cost of transitioning to a low-carbon economy. The Budget also increases investments by more than 40 percent over 2010 funding levels in R&D to modernize the electric grid, critical to enabling clean energy sources, by providing \$238 million for Electricity Delivery and Energy Reliability.

To help pay for these programs and align policies toward new clean energy technologies, the Budget proposes to repeal over \$4 billion per year in inefficient fossil fuel subsidies. The Administration will continue to work in a bipartisan fashion to put in place market-based incentives to promote U.S. leadership in the clean-energy marketplace. Consistent with Administration policy to phase out inefficient fossil fuel subsidies, the Budget eliminates funding for R&D focused on increasing hydrocarbon production.

Environmental Protection Agency (EPA)

The R&D portfolio of the Environmental Protection Agency (EPA) is \$584 million in the 2012 Budget, a decline of \$13 million or 2.2 percent compared to the 2010 funding level. With this investment, EPA will focus on enhancing and strengthening the planning and delivery of science by restructuring its research and science programs to be more integrated and cross-disciplinary. This request supports high-priority research of national importance in such areas as endocrine disrupting chemicals, green chemistry, e-waste and e-design, green infrastructure, computational toxicology, air monitoring, drinking water, and STEM fellowships. In addition, by way of strategic redirections, EPA will significantly increase—by \$25 million—its outreach to the broader scientific community through its Science to Achieve Results (STAR) program. This investment will bring innovative and sustainable solutions to 21st century environmental science challenges by engaging the academic research community.

United States Geological Survey (USGS)

The total 2012 budget of the United States Geological Survey (USGS), Interior's lead science agency, is \$1.1 billion or a \$6 million increase from the 2010 enacted level. The Budget includes a total of \$126 million in program increases, offsetting a total of \$120 million in program reductions and savings, reflecting shifting priorities towards climate variability research and ecosystem restoration. There are significant decreases in minerals and water resources research as well as targeted increases, including \$11 million to complete the network of climate science centers that will develop research-based decision support tools for use by Federal land managers. The 2012 Budget also proposes an addition of \$60 million over the 2010 level for Landsat operations and the development of a new operational Landsat satellite program, which will continue to collect remote sensing data that are invaluable for many purposes, including climate and land-use change research.

Department of Homeland Security (DHS)

Department of Homeland Security (DHS) R&D totals \$1.1 billion in the 2012 Budget, up \$167 million or 18.8 percent from the 2010 enacted level. Within the DHS Science and Technology Directorate, the 2012 Budget proposes \$150 million to begin construction of the National Bio and Agro-defense Facility (NBAF), which will serve as a new, state-of-the-art biosafety level 3&4 facility for the development of vaccines and anti-virals and enhanced diagnostic capabilities for protecting the United States against emerging agricultural diseases. The Budget also proposes \$64 million for research to support the Comprehensive National Cybersecurity Initiative (CNCI), an increase of \$22 million from the 2010 enacted level.

Department of Transportation (DOT)

The 2012 Budget provides \$1.2 billion for Department of Transportation (DOT) R&D, an increase compared to the 2010 funding level. One significant part of DOT's R&D activities is the Federal Aviation Administration's (FAA) Research, Engineering, and Development program. The Budget includes funding for several R&D activities in FAA's Next Generation Air Transportation System, known as NextGen. The Joint Planning and Development Office coordinates this important effort with NASA and other participating agencies. The Federal Highway Administration (FHWA) also manages a comprehensive, nationally-coordinated highway research and technology program, engaging and cooperating with other highway research stakeholders. FHWA performs research activities associated with safety, infrastructure preservation and improvements, and environmental mitigation and streamlining.

White House Office of Science and Technology Policy (OSTP)

The 2012 Budget requests \$6.65 million for White House Office of Science and Technology Policy (OSTP) operations, 5 percent below the 2010 enacted funding level, in recognition of the need for shared sacrifice to freeze non-security discretionary spending. OSTP works with OMB to ensure that the President's S&T priorities are appropriately reflected in the budgets of all the executive branch departments and agencies with S&T and STEM-education missions. OSTP also provides science and technology advice and analysis in support of the activities of the other offices in the Executive Office of the President and supports me in my role as the Assistant to the President for Science and Technology, with the responsibility to provide the President with such information about science and technology issues as he may request in

connection with the policy matters before him. In addition, OSTP coordinates interagency research initiatives through administration of the National Science and Technology Council (NSTC), serves as the lead White House office in a range of bilateral and multilateral S&T activities internationally, and provides administrative and technical support for the very active 21-member President's Council of Advisers on Science and Technology (PCAST). This work is accomplished with approximately 34 full-time equivalent staff supported by the OSTP appropriation, which includes the OSTP Director, four Associate Directors (for Science, Technology, Environment, and National Security and International Affairs), additional technical experts, and a small administrative function. In addition, there are approximately 40 scientific and technical experts detailed to OSTP from all across the executive branch along with approximately a dozen other experts brought in under the Intergovernmental Personnel Act or various fellowship arrangements. This mix of personnel allows OSTP to tap a wide range of expertise and leverage all available resources to ensure that the science and technology work of the Federal government is appropriately resourced, coordinated and leveraged.

Interagency Initiatives

A number of priority interagency S&T initiatives are highlighted in the President's 2012 Budget. These initiatives 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) program plans and coordinates agency research efforts in cyber security, high-end computing systems, advanced networking, software development, high-confidence systems, information management, and other information technologies. The 2012 Budget provides \$3.9 billion for NITRD, an increase of \$74 million over the 2010 funding level.

Networking and computing capabilities are more critical than ever for a range of national priorities, including national and homeland security, reforming the health care system, understanding and responding to environmental stresses, increasing energy efficiencies and developing renewable energy sources, strengthening the security of our critical infrastructures including cyberspace, and revitalizing our educational system for the jobs of tomorrow. The 2012 Budget includes a focus on research to improve our ability to derive scientific insights and economic value from enormous quantities of data that heretofore would have been too large to take full advantage of, and continues to emphasize foundations for assured computing and secure hardware, software and network design, and engineering to address the goal of making Internet communications more secure and reliable.

National Nanotechnology Initiative

The 2012 Budget provides \$2.1 billion for the multi-agency National Nanotechnology Initiative (NNI), an increase of \$201 million over the 2010 funding level. Research and development in the NNI focuses on the development of materials, devices, and systems that exploit the fundamentally distinct properties of matter at the nanoscale. NNI-supported R&D is enabling breakthroughs in disease detection and treatment, manufacturing at or near the nanoscale, environmental monitoring and protection, energy conversion and storage, and the design of novel electronic devices. In 2012, NNI agencies will be moving forward, using close

and targeted program-level interagency collaboration, on three signature initiatives in areas ready for advances: Nanoelectronics for 2020 and Beyond; Sustainable Manufacturing—Creating the Industries of the Future; and Nanotechnology for Solar Energy Collection and Conversion.

In addition, agencies continue to maintain a focus on developing nanotechnology responsibly with attention to potential human and environmental health impacts, as well as ethical, legal, and other societal issues. I will also add that I recently submitted to the Committee a revised strategic plan for the NNI reflecting the changing opportunities for frontier research at the nanoscale.

U.S. Global Change Research Program

The Budget includes an expanded commitment to global change research, with the understanding that insights derived today will pay off with interest in the years and decades ahead as our Nation works to limit and adapt to shifting environmental conditions. Investments in climate science over the past several decades have contributed enormously to our 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 2012 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 we adapt to those changes that are inevitable. Specifically, the 2012 Budget provides \$2.6 billion for the multi-agency U.S. Global Change Research Program (USGCRP)—an increase of 20.3 percent or \$446 million over the 2010 enacted level—to continue its important work of improving our ability to understand, predict, project, mitigate, and adapt to climate change.

As you are no doubt aware, 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 funding plans to ensure the program is aligned with the Administration's priorities and reflects agency planning. In 2011, the USGCRP is undertaking a comprehensive process that will result in an updated strategic plan, which will be submitted to Congress later this year.

Funding in the 2012 Budget will support an integrated and continuing National Climate Assessment of climate change science, impacts, vulnerabilities, and response strategies as mandated by Congress. The Budget also prioritizes an interagency research effort for measuring, reporting, and verifying greenhouse-gas emissions.

Innovation, Entrepreneurship, and Job Creation

The President believes we must harness the power and potential of science, technology, and innovation to transform the Nation's economy and to improve the lives of all Americans. In addition to the investments in research and development (R&D) I have described, the President's 2012 Budget targets strategic investments to spur innovation in the public and private sectors and to maximize the impact of the Federal R&D investment for innovation. Last month, the President released a revised Strategy for American Innovation, building on an earlier version

released in September 2009. This strategy describes how investments in R&D work together with other Federal investments and policies to support American innovation. Let me share with you a few highlights that are reflected in the Budget.

The Budget proposes a permanent extension of the research and experimentation (R&E) tax credit to spur private investment in R&D by providing certainty that the credit will be available for the duration of the R&D investment. In December, the President and Congress worked together to extend expiring tax breaks for Americans; as part of that agreement, the current R&E tax credit was extended through the end of this year. The 2012 Budget proposes to expand and simplify the credit as part of making it permanent.

In addition, earlier this year the Administration announced Startup America, a campaign to inspire and accelerate high-growth entrepreneurship throughout the Nation. This coordinated public/private effort brings together an alliance of the country's most innovative entrepreneurs, corporations, universities, foundations, and other leaders, working in concert with a wide range of Federal agencies to increase the prevalence and success of American entrepreneurs. A broad set of Federal agencies will launch a coordinated series of policies that ensure high-growth startups have unimpeded access to capital, expanded access to quality mentorship, an improved regulatory environment, and a rapid path to commercialization of federally-funded research.

The 2012 Budget sustains the Administration's effort to promote regional innovation clusters as significant sources of entrepreneurship, innovation, and quality jobs. These efforts are taking place in several agencies working together, including the Small Business Administration (SBA), DOE, and especially the Economic Development Administration (EDA) within the Department of Commerce. EDA will be pursuing several programs in research parks, regional innovation clusters, and entrepreneurial innovation activities, as authorized recently in the America COMPETES Reauthorization Act. And as mentioned earlier, the 2012 Budget continues to increase funding for the Hollings Manufacturing Extension Partnership (MEP) in NIST to disseminate the latest advanced manufacturing techniques and innovative processes to small- and medium-sized manufacturers around the Nation. Taken together, these investments will help ensure that Federal investments in innovation, education, and infrastructure translate into commercial activity, real products, and jobs.

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

In his State of the Union address, the President said: "If we want innovation to produce jobs in America and not overseas, then we also have to win the race to educate our kids." To help win that race, the 2012 Budget emphasizes science, technology, engineering, and mathematics (STEM) education, building on two strong years of progress. Through his past budget requests and actions—including his recent hosting of the first White House science fair, his launch of the "Educate to Innovate" and "Change the Equation" initiatives, and his challenging the Nation's 200,000 Federal scientists and engineers to get more involved in STEM education—the President has shown that he is deeply committed to improving STEM education. These efforts have engaged not only the Federal government but also the private, philanthropic, and academic sectors. The Educate to Innovate campaign has resulted in over \$700 million in financial and in-kind private-sector support for STEM education programs. And the Change the Equation program has brought together over 100 corporations in a historic effort to scale up effective models for improving STEM education. The Administration has also integrated STEM education into broader education programs. For example, the Race to the Top competition provided a

competitive advantage to states that committed to a comprehensive strategy to improve STEM education.

Building on these efforts, the 2012 Budget proposes an investment of \$100 million as a down payment on a 10-year effort to help prepare 100,000 new highly effective STEM teachers. This coordinated effort between NSF and the Department of Education will help prepare teachers with both strong teaching skills and deep content knowledge. The Administration proposes \$80 million for the Department of Education in the 2012 Budget to expand promising and effective models of teacher STEM preparation within the new Teacher and Leader Pathways program—for example, ones that provide undergraduates with early and intensive field experience in the classroom along with extensive STEM subject coverage. At the same time, NSF proposes to launch a \$20 million teacher-education research program called Teacher Learning for the Future. In cooperation with the Department of Education, this NSF program will fund research that will increase our understanding of what makes a great STEM teacher and how to best prepare, support, and retain highly effective STEM teachers in the most cost effective manner. The coordination of these two programs will ensure that there is continual innovation and improvement in teacher preparation that is grounded firmly in evidence.

This is part of a broader Administration commitment to look carefully at the effectiveness of all STEM programs and find ways to improve them. To further this goal, I have established a Committee on STEM Education under the National Science and Technology Council. The STEM Education Committee is co-chaired by OSTP's Associate Director for Science, Carl Wieman, a Nobel Prize-winning physicist renowned for his work on improving STEM education, and involves participation from the many Federal agencies involved in STEM education activities.

The work of this Committee is closely aligned with the vision for STEM education outlined by Congress in the America COMPETES Reauthorization Act and focuses on improving the coordination and effectiveness of all Federal STEM education programs. In this spirit, the Department of Education and NSF are leading an effort, with active OSTP participation, to increase the impact of the Federal STEM investments I've outlined above by (1) developing an aligned strategy that emphasizes key agency capacities; (2) clarifying evidence standards used to assess program impact; and (3) identifying the most promising STEM efforts for further validation, testing, and suitability for scaling up.

All told, the 2012 Budget requests \$3.4 billion for STEM education programs across the Federal government. This is \$200 million lower than the 2010 funding level and reflects some difficult choices. However, we feel this budget is better focused on programs that will make an impact.

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

21st Century Infrastructure

I've talked about innovation and education, and now I would like to talk briefly about the third step in winning the future: rebuilding America. In his State of the Union address, the President established a vision of rebuilding America for the 21st century. This vision is reflected in the 2012 Budget in investments that will not only rebuild the roads and bridges of the 20th

century but will also help build the new infrastructure needed for America to remain competitive in this century.

Within science and technology, the 2012 Budget proposes a Wireless Innovation and Infrastructure Initiative to help businesses extend the next generation of wireless coverage to 98 percent of the U.S. population. This Initiative will enable businesses to grow faster, students to learn more, and public safety officials to access state-of-the-art, secure, nationwide, and interoperable mobile communications. It will also foster the conditions for the next generation of wireless technology, nearly doubling the amount of wireless spectrum for mobile broadband and providing critical support for R&D in wireless innovation. The Initiative builds upon the Presidential Memorandum on spectrum released last year, which proposes to reallocate a total of 500 megahertz of Federal agency and commercial spectrum bands over the next ten years to increase the Nation's access to wireless broadband.

As part of the Initiative, the 2012 Budget proposes the creation of a \$3 billion Wireless Innovation (WIN) Fund to be funded out of receipts generated through electromagnetic-spectrum auctions. This Fund will advance our economic growth and competitiveness goals, supporting key technological developments that will enable and take advantage of the private sector's rollout of next-generation wireless services and pave the way for new technologies. The WIN Fund will support basic research, experimentation and testbeds, and applied development in a number of areas including public safety, education, energy, health, transportation, and economic development.

The 2012 Budget also proposes investments in novel, game-changing physical infrastructure systems including a national high-speed rail system, an improved civil aviation system taking advantage of the NextGen air-traffic-control innovations, and new standards for smart-grid technologies.

Conclusion

The investments in research and development, innovation, STEM education, and 21st century infrastructure proposed in the President's FY2012 Budget reflect his clear understanding of the critical importance of science and technology, STEM education, and 21st century infrastructure to the challenges the Nation faces. Recognizing the importance of responsibly reducing projected budget deficits and holding the line on government spending, the President has made difficult choices in order to maintain and in some cases increase critical investments that will pay off by generating the American jobs and industries of the future. Indeed, the science and technology investments in the 2012 Budget are essential to keep this country on a path to revitalized economic growth, real energy security, intelligent environmental stewardship, better health outcomes for more Americans at lower costs, strengthened national and homeland security, and continuing leadership in science and in space.

As this Committee has long understood over the decades, the best environment for innovation in all technologies is a broad and balanced research program for all the sciences. Such a broad base of scientific research will provide the foundation for a cornucopia of multidisciplinary discoveries with unimagined benefits for our society. The truth is that this country's overall prosperity in the last half-century is due in no small measure to America's "innovation system" – a three-way partnership among academia, industry, and government.

One of President Obama's guiding principles is that America's present and future strength, prosperity, and global preeminence depend directly on fundamental research. Knowledge drives innovation, innovation drives productivity, and productivity drives America's economic growth. And so it logically follows that economic growth is a prerequisite for opportunity, and scientific research is a prerequisite for growth.

That is why President Obama believes that leadership across the frontiers of scientific knowledge is not merely a cultural tradition of our nation – today it is an economic and national security imperative. This Administration will ensure that America remains at the epicenter of the ongoing revolution in scientific research and technological innovation that generates new knowledge, creates new jobs, and builds new industries.

By sustaining our investments in fundamental research, we can ensure that America remains at the forefront of scientific capability, thereby enhancing our ability to shape and improve our Nation's future and that of the world around us.

I look forward to working with this Committee to make the vision of the President's FY2012 Budget proposal a reality. I will be pleased to answer any questions the Members may have.