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2013 POLICY RECOMMENDATIONS FOR THE OBAMA ADMINISTRATION

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Science and Technology: Ensuring America's Science Future

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> *"At a time when our economy is still recovering from the Great Recession, our top priority has to be jobs and growth. That's the focus of the plan I talked about during the campaign … It's a plan to make sure this country is a global leader in research and technology and clean energy, which will attract new companies and high-wage jobs to America."*[1]
>
> *—President Barack Obama, November 9, 2012*

Science and technology (S&T) underpin almost every area of policy including national security, the economy, health and safety, the environment, education, energy, and agriculture. The close relationship between S&T and the ability of the nation to meet economic, security, and social goals is clear to government leaders in the United States and other developed nations, but it is a major policy factor in China, India, and other countries of the developing world, where large investments in research and development (R&D) are the rule. At the same time, there are indicators that the United States is starting to fall behind in S&T.[2] Moreover, most research in this country is carried out in America's universities, which are facing a number of challenges to their continued excellence.[3] This is a time when the U.S. should assign a particularly high priority to S&T, especially for federal support of research.

President Obama placed S&T high on his agenda early in his first term by recruiting high profile scientists to head the Office of Science and Technology Policy (OSTP), the National Science Foundation (NSF), the National Institute for Standards and Technology (NIST), the Department of Energy (DOE), the National Institutes of Health (NIH), the National Oceanic and Atmospheric Administration (NOAA), the U.S. Geological Survey (USGS), and other important agencies. The president also requested substantial multi-year increases in the R&D budgets for several of these organizations; implemented new initiatives in science, technology, engineering, and mathematics (STEM) education; expanded the number of human embryonic stem cell lines allowed to receive federal funding; and directed that federal agencies implement guidelines to ensure that politics do not influence science decision-making. These and other positive policy actions of the administration have placed S&T on a strong footing going into the second term, thus creating new opportunities to further strengthen American S&T.

It is in that spirit that we offer the following three recommendations for President Obama's second term:

- **Recommendation 1:** Ensure that federal policy is grounded in the best scientific and technical information and advice.
- **Recommendation 2:** Enhance federally funded science and engineering research and science, technology, engineering, and mathematics (STEM) education.
- **Recommendation 3:** Promote legislation that codifies the president's 2009 executive order and NIH guidelines for human embryonic stem cell research.

With these three areas addressed, we believe that the federal government's science and technology policies will lead to economic growth and innovation through scientific discoveries and inventions as well as the education of the next generation of scientists and engineers.

Recommendation 1: Ensure that federal policy is grounded in the best scientific and technical information and advice.

Applications of the knowledge and tools that result from advances in S&T influence virtually every aspect of people's lives—how they live, work, communicate, stay healthy and happy—as well as public policy issues as diverse as energy, national security, and public health. To assure that the best policy decisions are made, it is essential that the best scientific and technical information and advice are available not only to the president and his White House team, but also to all senior policymakers in government. This requires that scientists, engineers, and other technical professionals be willing to commit a portion of their careers to government service. It also requires that the administration continue to recruit outstanding, qualified people to top positions in government and on federal advisory committees.

Recommendation 1.1: Designate the assistant to the president for science and technology ("president's science adviser") as a Cabinet officer who is invited to all Cabinet meetings as a participant.

President Obama's science adviser, John Holdren, reports directly to the president with the title "assistant to the president for science and technology." As has been the tradition, he also serves as director of OSTP, a Senate-confirmed position. Holdren and his OSTP staff are located in the Dwight David Eisenhower Executive Office Building, within the White House complex, thus giving them immediate access to other senior policy advisers and councils as well as to the president and vice president. Holdren participates in senior staff meetings and is invited to attend Cabinet meetings, along with other senior aides. His advice is also sought by Cabinet secretaries and heads of many federal agencies dealing with S&T issues. We believe that this important role should be recognized and encouraged by the president. Designating the science adviser as a Cabinet officer who actively participates in all Cabinet meetings alongside secretaries of departments and other Cabinet officers would ensure that S&T is appropriately considered in major policy discussions.

Recommendation 1.2: Nominate individuals to fill all four Senate-confirmed associate director positions in OSTP as soon as possible and ensure that the OSTP budget is sufficient to support the president's enhanced S&T research and STEM education priorities.
OSTP has authorization for four Senate-confirmed associate director positions. Three of these are currently vacant. We recommend that the president, with the science adviser, fill the remaining three positions in science, technology, and environment and energy as soon as possible to allow the departments to move forward on the president's science and engineering initiatives for the second term.

Furthermore, we recommend the OSTP budget be increased above fiscal year 2011 levels to allow the office to adequately support the president's ambitious science and engineering initiatives and priorities. Last year, Congress penalized OSTP for doing its job—working with other countries to build ties in science and engineering R&D that are beneficial to the United States. Because one of these countries was China, Congress reduced the OSTP appropriation by 32 percent. Restoring the OSTP budget should be a high priority during budget negotiations with Congress.

Recommendation 1.3: Review compliance of agencies with the president's "Memorandum on Scientific Integrity" and, if deficiencies are found, direct agencies to take corrective action.
On March 9, 2009, President Obama issued the Memorandum on Scientific Integrity, which assigned the science adviser the responsibility of ensuring scientific integrity throughout the executive branch.[4] OSTP released recommendations in December 2010, and agencies and departments began to submit their policies shortly thereafter.[5]

We commend the administration for addressing these issues during the president's first term and recommend that the OSTP oversee a comprehensive review of the departments and agencies to verify compliance with the rules, and to work with agencies to correct any deficiencies in their policies. We believe this review is necessary to emphasize the importance of maintaining scientific integrity in federal government activities, including the process of selecting and retaining scientific advisers; allowing government scientists to express their views in their areas of expertise; ensuring that accurate scientific information is available to the public and policymakers and is the basis of regulations and other federal policies; and, in general, keeping partisan politics out of S&T policy matters.

Recommendation 2: Enhance federally funded science and engineering research and science, technology, engineering, and mathematics (STEM) education.

U.S. government policies on S&T matters have important ramifications for universities as well as most industrial sectors and millions of high quality jobs. U.S. science and engineering R&D has spearheaded innovation that has been a major driving force for our economy since World War II. New products, powerful medical treatments, and innovative

technologies that lead to new jobs all come out of discoveries and inventions based on science and engineering R&D—often from universities—funded by federal agencies. But the future of S&T in the United States is in limbo, with many decisions on funding for R&D agencies in question as the president and Congress contend with the federal budget deficit. President Obama will set priorities for the upcoming budgets, advancing some initiatives and programs at the expense of others. We believe that increased investments in S&T, particularly funding for research activities and facilities and equipment, will contribute to the nation's economic recovery as well as ensure its long-term economic sustainability and security.

Recommendation 2.1: Reaffirm the president's commitment to double R&D funding for the three research agencies—NSF, NIST, and DOE's Office of Science—over a decade; and commit to real growth in the NIH budgets.
Federal investment in non-defense R&D (which is mainly research), as a fraction of the gross domestic product (GDP), dropped to 0.4 percent in 2012 from 0.7 percent in 1970.[6] While the U.S. spends approximately $140 billion—or 2 percent of its total annual budget—on R&D, most of these funds are spent on development and testing of large weapons systems for the Department of Defense. Only $56 billion (fiscal year 2013) is invested in research (basic and applied) conducted in universities, medical schools, and national laboratories. The NIH budget is roughly half of the total federal investment in non-defense R&D. But after seeing its budget double from 1998 to 2002, and after participating in the stimulus investments of the American Recovery and Reinvestment Act of 2009, the NIH budget has been flat, or increased in amounts lower than the rate of inflation, each year for the past decade. In constant dollars, the NIH budget has actually decreased since 2005, after adjusting for inflation. The NSF, NIST, and DOE's Office of Science budgets have fared better, seeing modest increases under the Obama administration, but they still have seen little real growth over the past several decades.

We recommend that the president continue his commitment to double the budgets of NSF, NIST, and DOE's Offices of Science over the next decade as well as provide for some real growth in the NIH budget. Clearly, increases in agency budgets, especially during a time of budget austerity, will receive a high level of scrutiny. When it comes to research, peer review (employed by the above agencies) is the best mechanism to ensure these funds are spent wisely. These increases are prudent investments in S&T that are likely to pay big dividends in both the short- and long-run.

Recommendation 2.2: Place a high priority on increasing funding for early-career research and high-risk, high-reward (potentially transformational) research in all agencies supporting R&D.
Scientists applying for NSF and NIH grants are seeing the lowest success rates in decades. This development has the greatest impact on grants for new and young investigators, as well as grants proposing highly innovative projects that have a higher risk of failure, but if successful would be transformational. But regardless of the budget levels, additional funding should be provided to improve support for early-career investigators and high-risk, high-reward, "transformational" projects.[7]

NSF defines transformational research as "research driven by ideas that have the potential to radically change our understanding of an important existing scientific or engineering concept or leading to the creation of a new paradigm or field of science or engineering."[8] Agencies have trouble funding truly daring and high-risk ideas for which the opinions of expert reviewers are often mixed. When funding is limited, projects that are innovative, but unconventional, usually get put aside in favor of low-risk projects with more predictable results. Science often proceeds in incremental steps, though unexpected breakthroughs that can result in bold paradigm shifts, and projects challenging accepted ideas, make the biggest contributions to new innovations.

These issues also impact young scientists who increasingly face long graduate and post-doctoral training periods before having an opportunity to establish independent careers. Many agencies have difficulty cultivating and rewarding new investigators, especially during times in which overall success rates are low. From 1980 to 2008, the average age for a first-time NIH grantee increased from 37 to 42, while faculty positions in medical schools more than doubled (medical schools receive approximately 55 percent of NIH's research funding).[9]

Recommendation 2.3: Implement necessary reforms in visa and export control policies to remove barriers to international research collaboration and foreign students who wish to study in U.S. universities.
International scientific collaboration will be increasingly important in meeting the many challenges of the 21st century, such as understanding and responding to global climate change and finding better therapies and cures for diseases. While most scientists and engineers are eager to engage with their international counterparts, some U.S. policies—including visa and export control issues—inhibit these interactions. The most common barriers to scientific collaborations are the difficulties associated with obtaining a visa to study in the U.S. or even visit the United States. The U.S. State Department should improve its visa application process by hiring more specialists with scientific and technical backgrounds who can knowledgeably review visa applications. In addition, U.S. export controls and International Traffic in Arms Regulations (ITAR) should be reviewed and revised to avoid unintended damage to both research collaborations and the exchange of research findings. This is a particularly serious problem for research related to the space program.

Recommendation 2.4: Create a set of "presidential grand research challenges" and interdisciplinary federal research budget initiatives focused on specific national needs early in the second term.
In his first term, President Obama increased research funding incrementally in several key agencies—notably NSF, NIST, and the DOE's Office of Science—and he is committed to continuing his strong support for science. In addition to each agency's individual accomplishments, the impact of federal investments can multiply if agencies work together. We recommend that the president set a series of interdisciplinary, interagency grand challenges to help focus on issues of high importance including, but not limited to,

climate change, renewable energy, the environment, health technology, and infectious disease prevention. These "presidential grand research challenges" will help highlight current U.S. research programs as well as galvanize new interdisciplinary approaches to big research questions. Consideration should be given not only to coordinating related research activities of various agencies but also to co-funding major projects.

Recommendation 2.5: Give high priority to implementing the recommendations of the President's Council of Advisers on Science and Technology (PCAST) to improve the nation's STEM education and provide necessary funding.
PCAST is a top-level external advisory body for the president on all matters of S&T. It includes leading scientists, engineers, and industry leaders appointed by the president to help guide S&T policy. During President Obama's first term, PCAST produced two insightful reports on STEM education issues. In 2010, PCAST made a series of recommendations on improving K-12 STEM education.[10] These recommendations included improving federal coordination and leadership in STEM education; supporting state-led movements to adopt national baselines; creating STEM-related experiences to excite students; and cultivating, recruiting, and rewarding STEM teachers who prepare and inspire students. The second report proposed ways to attract new STEM college graduates, with the goal of graduating an additional one million students in the next decade with STEM degrees.[11] Recommendations included catalyzing the adoption of empirically validated teaching practices, advocating for the support of discovery-based research courses, launching national experiments to improve math education and scores, encouraging partnerships with different stakeholders in education, and creating a presidential council on STEM education to provide leadership on changes to undergraduate STEM education. With funding, these initiatives can go a long way toward educating the next generation of scientists and engineers in the United States.

Recommendation 2.6: Establish a dialogue with research universities and industrial sectors concerned with the country's status in S&T to explore new mechanisms for cooperation in the nonpartisan analysis of policy options on vital national issues.
Over the past 60 years, the federal government's approach to science and technology, R&D in particular, has been based on principles created immediately after World War II—principles stemming from a model put forward by Vannevar Bush in his "Science, the Endless Frontier" report to President Harry Truman—and in response to the Cold War.[12] But since the end of the Cold War, the national security impetus for steady investments in R&D has faded, and no powerful rationale has emerged to replace it. In today's world, federal S&T research priorities have largely shifted toward finding medical treatments and therapies. Thus, NIH budgets increased in real terms until the past decade to encompass approximately one-half of all S&T research spending. But research funding for other scientific disciplines, including chemistry, physics, engineering, and basic biology, which provide the basic knowledge for the drugs and technologies currently in use in hospitals, lagged behind. This lack of a balance and direction highlights the need for a new paradigm in science policy development.

What the new paradigm should be is unclear, but we should consider allowing federal policymakers who deal with S&T matters to have convenient access to objective, nonpartisan analysis of rational policy options. To explore plausible approaches to accomplishing this goal, we believe that one or more nongovernmental organizations concerned with S&T policy should call together recognized leaders who can bring the perspectives of government, academia, and industry to the table. It will be important to have the views of high-level federal officials currently serving in the administration. We recommend that the president encourage participation in this effort.

Recommendation 3: Promote legislation that codifies the president's 2009 executive order and NIH guidelines for human embryonic stem cell research.

Human embryonic stem cell (hESC) research is an emerging field of biomedical research that started in 1998 with the derivation of the first cell line. Scientists look forward to the possibility that hESCs, along with other types of stem cells found in adults, can advance research in areas as diverse as developmental biology, cancer research, and regenerative medicine.

Early in his administration, President Obama passed an executive order that directed NIH to develop new guidelines for regulating federally funded hESC research.[13] As with the previous administration, and consistent with the "Dickey-Wicker Amendment" appropriation rider, the NIH only funds research that uses hESC lines previously approved by an ethics review committee and created through private funds. As of November 2012, there are 184 hESC lines eligible for federal funding, a nine-fold increased from 21 lines in 2008.[14] Following the adoption of the new NIH guidelines, a lawsuit was brought against the federal government, *Sherley v. Sebelius*, which challenged the new NIH guidelines. A district court judge subsequently granted a preliminary injunction halting all funding of hESC research at NIH. Ultimately, the injunction was dismissed as well as the case, but scientists had already begun to question the sustainability of this type research.

During the past 15 years, each presidential administration—Presidents Bill Clinton, George W. Bush, and now Obama—have created their own stem cell policies using executive orders. While there was consistency during each administration, the executive orders were altered when a new president was elected. This inconsistency is negatively impacting stem cell research, causing scientists to shy away from the field and making them unsure about the area's funding future.

Working with Congress, the president should create new legislation that will make his 2009 executive order permanent. The law should:

- Support research on all types of human stem cells, including embryonic and adult.

- Authorize federal funding of hESC research on lines derived according to NIH ethical guidelines, regardless of the date the cell lines were derived or created.
- Clarify which research is eligible for federal funding (i.e., research utilizing approved hESCs) and which research is not (i.e., the creation of hESC lines).

This law would assure scientists that federal policy would remain the same year-to-year and administration-to-administration.

Conclusion

Science and technology impact most areas of public policy, including domestic and national security, energy and climate change, the environment, health and safety, agriculture, transportation, education, and, of most immediate concern, the economy and jobs for Americans. From federal investments in science and engineering R&D, particularly basic and applied research, we obtain new knowledge and technologies that improve the ability of our nation to meet its economic, security, and social goals. In the United States, scientific discoveries and technological breakthroughs have been shown to drive innovation, which plays a vital role in sustainable economic growth.

The second term of the Obama administration will provide a unique opportunity to keep the nation on track to advance U.S. science and technology research and ensure its applications to societal goals. That will require that the administration's S&T team give particular attention to the integrity of scientific advice to government, research funding, STEM education, the creation of a permanent U.S. stem cell policy, and the development of new tools for science policy.

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