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#14: *Summary of Major Organizations' Reports and Recommendations on National Science, Technology and Innovation Policies and Investments, 2006-2008*

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This summary reviews studies and policy documents on national science, technology and innovation policy and budget issues presented by major organizations in 2006-2008. The recommendations, including fiscal requirements (if available), are organized by a taxonomy of policy issues. This organization provides the basis by which the policy statements can be compared to identify areas of agreement and disagreement among these organizations.

The summary was compiled by Deborah D. Stine, who currently serves as Specialist in Science and Technology Policy at the Congressional Research Service (CRS), Library of Congress. Prior to joining CRS, Dr. Stine served as study director for the National Academies' 2005 study, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future.* That study's recommendations also are included in this report.

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Summary of Major Organization's Reports and Recommendations on National Science, Technology and Innovation Policies and Investments 2006-2008

Deborah D. Stine

January 20, 2009

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Summary of Major Organization's Reports and Recommendations on

National Science, Technology and Innovation Policies and Investments

2006-2008

Deborah D. Stine[1]

Overview

This summary, on behalf of the Center for the Study of the Presidency and Congress (CSPC), reviews recent studies and policy documents on national science, technology and innovation (STI) policy and budget issues issued by major organizations. The recommendations, including fiscal requirements (if available), from these studies and policy documents are organized by a taxonomy of policy issues. This organization provides the basis by which the policy statements can be compared to identify areas of agreement and disagreement among these organizations.

Sources of Information

The summary examines reports and other policy-related documents of major organizations developed by committees, or on behalf of the organization in the following eight categories:

- Federal advisory committees
- Congressionally-chartered honorific organizations
- Policy institutes
- Professional organizations and disciplinary societies
- University and college associations
- Advocacy, special interest, or action groups
- Industry and trade associations
- Labor

Appendix A provides a list of the over 60 organizations whose documents were reviewed, and if appropriate, recommendations summarized. In addition, documents submitted by organizations to the Change.gov, President Obama's transition website, were also reviewed to see if there were relevant recommendations. Due to the large number of submissions on the "Seat at the Table" portion of the website, the focus of this review was on those identified as relevant to technology policy.

Taxonomy

[1] The views expressed herein are those of the author and are not presented as those of the Congressional Research Service or the Library of Congress.

The summary organizes the recommendations of reports and other documents from these organizations into the following eight categories:

- Innovation
- Workforce
- Energy
- Environment
- Health
- Space
- Security
- Indicators.

Subcategories are used to further delineate the recommendations within each category.

Limitations on Analysis

Due to the large number of organizations and documents involved and the limited time available, only a selected set was reviewed. There are thousands of organizations and documents that could have been included in this summary. Those identified are likely to be considered by those in their category as major organizations, and because they are the based on a consensus of individuals, the reviews of many as opposed to an individual.

Although the website of each organizations in Appendix A was examined for relevant documents, there may or may not have been a suitable consensus document from that organization. For example, the review does not include opinions of individual scholars or opinion leaders. In a few cases, it was unclear if a document represented an organization or an individual or set of individuals within that organization. In those situations, the document was included. Similarly, submissions to the Change.gov website may have not been appropriate for this review as they were submitted by individual corporations or individuals, rather than providing the consensus of an organization.

In addition, this review only includes documents issued between the three-year period of January 2006 and December 2008, with the exception of the National Academies *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* report which was released in October 2005. Many website documents are undated, so it is difficult to determine the time of their initial release. Those documents were included in this review even though their timing was uncertain. In addition, a few major reports were released in early January 2009. Those documents are also included in this review, but the original organizational analysis that began in December 2008 was not re-conducted.

In examining the documents, recommendations were only included if they included some reference to science, technology, or innovation. For example, an organization may make a recommendation about climate change. The recommendation was only included if it discussed proposed recommendations as to what science, technology, or innovation actions should be taken in relationship to climate change. It was not included if its primary focus was the general policy response should or should not be made in response to concerns about possible climate change.

Summary of Recommendations

Tables 1-8 provide the consensus recommendations organized by taxonomy and using the methodology described earlier. Each is organized by subcategories within the overall taxonomy. The approximately 460 recommendations have been broken into subcategories to aid comparability by issue. Each has a footnote that provides the name of the organization and the document. After the initial reference, this information is summarized. (**Appendix B** provides a list of the acronyms used in this review.) A number of documents are from a coalition of organizations. In those cases either the name of the organizations or the coalition is listed. Only a few organizations provided cost estimates. When available, those cost estimates are included either in the text of the recommendation, or following it in parenthesis.

Overall, there was broad agreement by a number of organizations on several general recommendations such as the funding of research, the need to enhance science, technology, engineering, and mathematics (STEM) education, and making the research and experimentation (R&E) tax credit permanent. These organizations sometimes did differ, however, as to best way to reach the goal specified in these more general recommendations. One area of disagreement was immigration policy, where some organizations indicated their belief that this policy was important to change, others believed the policy should remain as currently stated.

In addition, some organizations were not specific as to the actions they believe should be taken to reach their recommendation, while others provided far more detail. As a result, the degree to which there might be agreement on the more specific actions, even though there was agreement on a broader set of recommendations is unknown. For example, some organizations agreed on the more general recommendation that funding graduate students was important, but perhaps disagreed as to whether or not the best action to fund graduate students is through research grants, portable fellowships or traineeships, or scholarships.

Few organizations prioritized their recommendations, or made recommendations in each of the categories or subcategories. Further, some organizations provided recommendations both on their own behalf and through multiple coalitions, so the recommendations may not be unique. As a result of these limitations, this summary of organization recommendations may best be used as source of ideas for possible actions, rather than as a way to judge the degree to which there is overall consensus on the recommendations themselves.

Table 1: Innovation

Subcategory	Recommendations
Funding of Research	• Increase federal investment in long-term research by 10% each year for 7 years.[2] ($8,000 million per year at peak) • Fully fund the America COMPETES Act.[3] • Double the federal investment in basic and applied research in the physical and life sciences, and within this investment, increase the allocation of R&D investment for multi-disciplinary research to support multi-disciplinary innovation.[4] • Fulfill the promise of the COMPETES Act and double NSF's funding across all the sciences it supports, including the social, behavioral, and economic sciences.[5] • Enhance the funding level for, and the transformational nature of, basic research.[6] • Recognize and maintain federal government support of basic research while exploring new partnership models, and assessing the evolving innovation ecosystem.[7] • Balance defense/civilian share of federal R&D portfolio.[8] • Increase federal funding for physical sciences and

[2] National Academy of Sciences, National Academy of Engineering, Institute of Medicine, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* (National Academies Press, 2007). The report was released in pre-publication for m in October 2005, but the printed report was not released until January 2007. Hereafter called "Gathering Storm."
[3] U.S. Chamber of Commerce (CC), *A Transition Plan for Securing America's Energy Future*, 2008. Hereafter called "CC Energy."
[4] Council on Competitiveness, *Compete: New Challenges, New Answers*, November 2008. Hereafter known as "CoC Compete."
[5] Consortium of Social Science Associations, *The Social, Behavioral, and Economic Sciences, in the New Administration*, Memorandum to President-Elect Barack Obama. Hereafter known as "COSSA."
[6] National Science Board, *Research and Development: Essential Foundation for U.S. Competitiveness in A Global Economy*, 2008. Hereafter called "NSB Competitiveness."
[7] President's Council of Advisors on Science and Technology, University-Private Sector Research Partnerships in the Innovation Ecosystem, November 2008. Hereafter called "PCAST Partnerships."
[8] ASTRA, *Riding the Rising Tide: A 21st Century Strategy for U.S. Competitiveness and Prosperity*, December 2007. Hereafter called "ASTRA Rising Tide."
[9] ASTRA Rising Tide.

Subcategory	Recommendations
	engineering R&D.[9] • Increase and optimize federal investments in basic physical sciences research and science infrastructure.[10] • Provide, at a minimum, the president's budget request of $6.8 billion in NSF funding for FY2009, and strive to return to the funding blueprint in the America COMPETES Act. This funding should primarily support a greater number of highly rated core research proposals.[11] • Support NIST core programs at the $634 million funding level outlined in the President's budget request for FY2009, and strive to return to the funding blueprint in the America COMPETES Act, including funding of the Technology Innovation Program and its development of consensus-based measurement standards, where a lack of funding has hampered NIST's ability to promote U.S. standards and international trade.[12] • Increase federal funding for basic research, specifically for physical science, engineering, math, and computer science

[10] American Chemical Society, *Statement on U.S. Innovation Strategy for the 21st Century*. Hereafter called "ACS Strategy."
[11] American Chemical Society, *Statement on the National Science Foundation: FY2009*. Hereafter called "ACS NSF."
[12] American Chemical Society, *Statement on the National Institute of Standards and Technology: FY2009*. Hereafter called "ACS NIST."
[13] American Electronics Association, *We are Still Losing the Competitive Advantage: Now is the Time to Act*, March 2007. Hereafter called AeA.
[14] American Innovation Proclamation.
[15] National Governors Association, *National Research, Development, and Technology Policy*, EDC-04, July 24, 2007. Hereafter called "NGA Research."
[16] NGA Research.
[17] Science Coalition, *Basic Research and Innovation Essential Elements for Economic Recovery*.
[18] Association of American Universities, *Policy Recommendations for President-Elect Obama*, December 2008. Hereafter called "AAU."
[19] AAU.
[20] Institute of Electrical and Electronics Engineers-United States of America, *Position Statement: Maintaining U.S. Leadership in Innovation and Competitiveness*, June 20, 2008. Hereafter called "IEEE."
[21] Information Technology Industry Council, *2008 High Tech Priorities*. Hereafter called ITIC
[22] American Chemical Society and the American Institute of Chemical Engineering, *Science and Technology to Meet Our Energy Needs*. Hereafter called "ACS/AICHE."
[23] ACS/AICHE.

Subcategory	Recommendations
	research with the NSF, NIST, DOE, and DOD.[13] • Renew America's commitment to discovery by doubling the basic research budgets at the NSF, NIST, DOE Office of Science, and DOD.[14] • Continue federal investments in R&D programs within such government agencies as federal laboratories, NSF, DOE, NIST, NOAA, DARPA, NASA, and NIH.[15] • Fund the Small Business Innovation Program, Manufacturing Extension Partnership, and the Advanced Technology Program. [16] • Make basic research and innovation integral components of any economic recovery effort, and make substantial investments in basic research.[17] • Provide a sustained and balanced growth for basic scientific research including doubling basic research budgets in the physical and life sciences, mathematics, and engineering over the next decade; continuing DOD efforts to fund defense basic research; recognizing the critical role of NASA in advancing the nation's innovation agenda, and funding the Technology Improvement Program at NIST.[18] • Expand behavioral and social science researcher to support efforts to meet key national challenges.[19] • Maintain stable, consistent, long-term federal funding of R&D.[20] • Encourage researchers to produce the next break-through technology or innovative solution by increasing funding for basic research at universities, government institutions, and public-private partnerships.[21] • Make a balanced program of federal investment in research a top priority, including significant investment in peer-reviewed, individual investigator basic research and related investments on a national and international level; and a portion focused on applied research, technology development, and enabling technologies such as non-

Subcategory	Recommendations
	energy source-specific electricity storage and transportation.[22] • Establish an integrated systems approach to the government's energy R&D portfolio to choose the best available science and technology, and minimize investments driven by factors other than technical potential.[23]
Research Initiatives	• Allocate at least 8% of federal research funds to catalyze high-risk, high-payoff research.[24] ($0) • Take actions to encourage greater intellectual interchange between industry and academia, including encouraging industry researchers to participate as authors and reviewers for articles in open, peer-reviewed publications.[25] • Rebalance the federal networking and information technology (NIT) R&D funding portfolio by increasing support for important NIT problems that require larger-scale, longer-term, multi-disciplinary R&D, and emphasizing innovative, higher-risk explorations with a potentially higher-payoff.[26] • Maintain current infrastructure of multidisciplinary centers, user facilities, instrumentation, equipment, and technical expertise essential for US competitiveness in nanotechnology, improve intra-agency coordination, and continue to support international coordination activities.[27] • Focus R&D on leading edge of science and technology.[28] • Increase focus on interdisciplinary and multi-disciplinary

[24] Gathering Storm.
[25] PCAST Partnerships.
[26] President's Council of Advisors on Science and Technology, Leadership Under Challenge: Information Technology R&D in a Competitive World, August 2007. Hereafter called "PCAST IT."
[27] President's Council of Advisors on Science and Technology, *The National Nanotechnology Initiative: Second Assessment and Recommendations of the National Nanotechnology Advisory Panel*, April 2008. Hereafter called "PCAST Nanotechnology."
[28] ASTRA Rising Tide.
[29] ASTRA Rising Tide.

Subcategory	Recommendations
	research, new forms of collaboration, and nurturing capacity in new geographic regions.[29] • Consider targeted programs, grant mechanisms, and policies --- and adapt existing grant programs --- at federal agencies to foster transformative research; establish metrics with which to evaluate their success.[30] • Strengthen the application and review processes at federal agencies so that high-risk research proposals face less challenges in a stressed peer-review system otherwise not equipped to appreciate them.[31] • Invest in program officers at federal agencies, by providing an adequate administrative budget (not at the expense of the research budget), so they are encouraged and expected to engage with the professional communities that they fund.[32] • Establish new research programs at federal agencies only if they have enough critical mass to avoid fruitless grant-writing efforts that may occur if a program funds only a very small percentage of applications.[33] • Collect and analyze demographic data on applicants and principal investigators government-wide and in a uniform format to establish how well federal agencies support research, instead of the current nonstandardized tracking

[30] American Academy of Arts and Sciences, *ARISE - Advancing Research in Science and Engineering: Investing in Early-Career Scientists and High-Risk, High-Reward Research*, 2008. Hereafter called "AMACAD ARISE."
[31] AMACAD ARISE.
[32] AMACAD ARISE.
[33] AMACAD ARISE.
[34] AMACAD ARISE.
[35] ACS Strategy.
[36] AAU.
[37] Council of Graduate Schools, *Graduate Education: The Backbone of American Competitiveness and Innovation.* Hereafter called "CGS."
[38] IEEE.
[39] IEEE.
[40] IEEE.
[41] IEEE.
[42] ACS/AICHE.

Subcategory	Recommendations
	system used by funding agencies.[34] • Encourage research and technology development that brings the most effective tools to bear on our economic, national, and homeland security needs today and in the future.[35] • Reaffirm and strengthen the principles that underpin the university government partnership, including supporting critical research and educating the next generation of scientists, engineers, and scholars, and select research projects on the basis of merit.[36] • Dedicate a percentage of federal research agency budgets to programs that focus on new frontiers in research. [37] • Foster nationwide NSF-type centers of excellence to exploit regional assets through private and public sector investments, to bridge and accelerate the transition of R&D to the marketplace.[38] • Continue Small Business Innovation Research and Small Business Technology Transfer programs.[39] • Reform federal and state regulations to promote historic U.S. risk-embracing innovative technical culture. [40] • Provide incentives to support and encourage venture capital firms to fund U.S. start-up companies and discourage off-shoring. [41] • Emphasize investments in cutting-edge research, which is often overlooked as high-risk, thus depriving us of potentially significant areas of exploration.[42]
Researchers and Faculty	• Provide 200 early-career researcher grants of $500,000 each annually payable over 5 years.[43] ($100 million per year)

[43] Gathering Storm.
[44] AAU.

Subcategory	Recommendations
	• Provide $1.8 billion to enable research universities to hire more young scientists and engineers for tenure-track faculty positions.[44] (NIH Pathway to Independence Award - $910 million; NSF Career Award - $905 million) • Formalize and enhance opportunities and incentives for researchers to have flexibility in moving between academia, industry, and government. [45] • Instruct the heads of scientific and regulatory agencies to issue memos to their staffs indicating their commitment to open government and stating that scientific integrity is a crucial component to achieving their missions.[46] • Create or strengthen existing large, multiyear awards for early-career faculty.[47] • Pay special attention to early-career faculty during merit reviews of regular grant programs, and adopt career-stage-appropriate expectations for grant funding.[48] • Develop policies responsive to the needs of primary caregivers, such as grant extensions or other appropriate support mechanisms. [49] • Support young scientists by creating new sources of competitive research funding at federal research funding agencies for exceptional young scientists and engineers. [50]
Facilities and Instrumentation	• Institute a national coordination office for research instrumentation and facilities to manage $500 million in incremental funds per year over 5 years.[51] • Provide additional funding of $750 million for academic

[45] PCAST Partnerships.
[46] Union of Concerned Scientists, *Federal Science and the Public Good: Securing the Integrity of Science in Policymaking: Presidential Transition Update*, December 2008. Hereafter called "UCS Integrity."
[47] AMACAD ARISE.
[48] AMACAD ARISE.
[49] AMACAD ARISE.
[50] AAU.
[51] Gathering Storm.

Subcategory	Recommendations
	research facilities modernization and instrumentation programs.[52] (NSF Major Research Instrumentation Program - $100M; NSF Academic Research Facilities Modernization Program - $250 million; NIST University Facilities Program - $100 million; NIH National Center for Research Resources Extramural Research Facilities Improvement Program - $300 million) • Provide $2 billion to colleges and universities that invest in needed research infrastructure in 2009.[53]
International	• Continue to engage national and international nanotechnology standards activities such as R&D, commerce, and regulation, and where appropriate, develop reference materials, test methods, and other standards that provide broad support for industry production of safe nanotechnology-based products.[54] • Strengthen embassy attaché offices to monitor foreign developments in R&D, and to facilitate interaction with the U.S. R&D community. [55] • Seek greater U.S. funding stability for the international ITER project to ensure that the United States remains able to influence the developing ITER research program, to capitalize on research at ITER to help achieve U.S. fusion energy goals, to participate in important scientific results on burning plasmas from ITER, and to be an effective participant in and beneficiary of future international scientific collaborations.[56] • Encourage global efforts to simplify and enforce intellectual property while making sure that a proper balance is maintained between thoroughly examined

[52] AAU.
[53] Information Technology & Innovation Foundation, *Timely, Targeted, Temporary and Transformative: Crafting an Innovation-Based Economic Stimulus Package*, by Robert D. Atkinson, October 2008. Hereafter called "ITIF Stimulus."
[54] PCAST Nanotechnology.
[55] IEEE.
[56] National Academy of Sciences, *A Review of the DOE Plan for the U.S. Fusion Community Participation in the ITER Program*.

Subcategory	Recommendations
	formal intellectual property rights and free access to knowledge and information.[57] • Develop and implement government policies in G-8 countries to remove barriers to innovation, in addition to the provision of a fertile infrastructure to foster it.[58] • Establish bold initiatives by global financial institutions to facilitate and protect innovation in the developing world.[59] • Urge and assist the developing world to have local infrastructure, laws, and regulations to catalyze and protect local innovation, thus providing a stimulating environment for the transfer of technology.[60] • Ensure U.S. companies can compete in international markets by eliminating trade barriers to IT, telecom and media products bilaterally, regionally and through the World Trade Organization negotiations; promote passage of bilateral and regional trade agreements; support renewal of Trade Promotion Authority; reduce regulatory barriers to trade; and ensure technical standards promote rather than distort trade.[61] • Press our international competitors to uphold the Information Technology Agreement.[62] • Remain globally competitive in elementary particle physics by playing a leading role in the worldwide effort to aggressively study Terascale physics by fully exploiting the opportunities afforded by the construction of the Large Hadron Collider (LHC) at the European Center for Nuclear Research (CERN); planning and initiating a comprehensive program to become the world-leading

[57] *Joint Science Academies' Statement on Growth and Responsibility: the Promotion and Protection of Innovation,* May 2007. Hereafter called "Joint Academies."
[58] Joint Academies.
[59] Joint Academies.
[60] Joint Academies.
[61] ITIC.
[62] ITIC.
[63] National Research Council, *Revealing the Hidden Nature of Space and Time: Charting the Course for Elementary Particle Physics,* 2006.

Subcategory	Recommendations
	center for research and development on the science and technology of a linear collider, and do what is necessary to mount a compelling bid to build the proposed International Linear Collider (ILC) on U.S. soil; and expanding the program in particle astrophysics and pursuing an internationally coordinated, staged program in neutrino physics.[63]
Technology transfer to marketplace	• Create a Clean Energy Bank of the United States (CEBUS), a quasi-governmental, self-financing entity, with sufficient initial capitalization to invest in and accelerate the market penetration of advanced clean energy technologies, and authority to issue loans, loan guarantees, lines of credit, insurance, and other financial products to help support demonstration projects.[64] • Continue to fund world-class nanotechnology research to promote technology transfer, and the resulting top-notch nanoscale scientists, engineers, and entrepreneurs.[65] • Structure National Nanotechnology Initiative (NNI) funded centers to spur partnering with industry, which enhances technology transfer. [66] • Maintain a commitment to speed the efficient and effective transfer of technology innovations developed with federal assistance or by the federal government, while retaining appropriate protections for national security and patent integrity.[67] • Create within the Department of Commerce an office to oversee and ensure consistent implementation of federal technology transfer laws, report annually on federal laboratory and university technology transfer performance, and lead an interagency committee on technology transfer.[68]

[64] CC Energy.
[65] PCAST Nanotechnology.
[66] PCAST Nanotechnology.
[67] NGA Research
[68] AAU.

Subcategory	Recommendations
Prizes and Awards	• Institute a Presidential Innovation Award to stimulate scientific and engineering advances in the national interest.[69] ($50 million per year) • Establish national prize competitions and focused research efforts through public-private partnerships to address grand technology challenges in areas such as energy and the environment, food and water shortages, health and pandemics and security threats.[70] • Expand the use of prizes to address certain challenging research questions.[71] • Take an experimental approach at NSF to implement its congressional directive to award innovation inducement prizes during the program's formative period including offering several small-scale prizes ($200,000 to $2 million each) in diverse areas that differ regarding prize scope and scale, contest duration, and engagement of outside groups; and commerce planning for much larger awards ($3 million to $30 million) to encourage more complex innovations, well beyond the state of the art and addressing significant economic, social, or other challenges to the United States.[72]
Fiscal Policy	• Make the research & experimentation (R&E) tax credit permanent, increase it from 20 to 40% of the qualifying increase, and extend it to companies who have already spent large amounts on R&D so not subject to de facto penalties for previous investments.[73] ($5,100 million per year) • Examine tax incentive options for US-based innovation, such as corporate tax rates, incentives for purchase of high-technology research and manufacturing equipment,

[69]Gathering Storm.
[70] CoC Compete.
[71] PCAST Partnerships.
[72] National Research Council, *Innovation Inducement Prizes at the National Science Foundation,* 2007.
[73]Gathering Storm.
[74]Gathering Storm.
[75] AIAA.
[76] CC Energy.

Subcategory	Recommendations
	treatment of capital gains, and incentives for long-term investments in innovation.[74] ($0) • Make the R&D tax credit permanent to provide the research environment needed to attract the best and brightest into technology and engineering (T&E) fields. [75] • Establish a long-term R&D tax credit so that companies can plan their R&D activities with greater certainty. [76] • Develop a tax structure that encourages investments in America's economic engines such as capping the corporate tax rate at 25% for all businesses regardless of size, reforming and making the R&D tax credit permanent, reducing the tax liability on repatriated foreign earnings for 12 months, and maintaining competitive capital gains tax rates for all assets.[77] • Update and enhance the R&D tax credit to make it a more stable and effective incentive for industry to perform and support R&D.[78] • Modify, or clarify through additional guidance, tax-exempt policies that may have an unintended negative

[77] CoC Compete.
[78] PCAST Partnerships.
[79] PCAST Partnerships.
[80] PCAST Partnerships.
[81] AeA.
[82] ASTRA Rising Tide.
[83] American Innovation Proclamation.
[84] ITIF Stimulus.
[85] National Association of Manufacturers, *A 21st-century Tax Policy to Promote Job Creation and Economic Growth.*
[86] AAU.
[87] AAU.
[88] CGS.
[89] IEEE.
[90] Biotechnology Industry Organization, *The Ongoing Financial Markets Crisis and Lack of Access to Capital Threatens America's Biotechnology Industry and the Development of Innovative New Therapies for Patients*. Hereafter called "Bio."
[91] Bio.
[92] Bio.
[93] Bio.
[94] ITIC.

Subcategory	Recommendations
	impact on industry-supported research on university campuses. [79] • Develop a task force to assess tax policies impacting innovation. [80] • Strengthen the R&D tax credit and make it permanent.[81] • Provide incentives to capture benefits of public R&D within US. [82] • Make permanent a strengthened R&D tax credit to encourage continued private-sector innovation investment.[83] • Allow information technology investments to be completely expensed in 2009.[84] • Make permanent a strengthened R&D tax credit, reduce the federal corporate tax rate by at least 10 percentage points to 25% or lower, repeal the corporate alternative minimum tax, promote fair rules for U.S. taxation of active foreign income, improve rules for utilizing foreign tax credits, provide a preferential tax rate for foreign earnings invested in the United States, provide permanent tax rate relief, enhance capital cost recovery rules by increase the expensing allowance to $200,000 and the dollar limit to $800,000 and making enhanced small business expenses a permanent part of the tax code, repeal the federal estate and gift tax, and promote investments by making permanent the current lower, preferential tax rates for capital gains and dividends, and lowering the tax rate on corporate capital gains.[85] • Make the R&D tax credit permanent, with removal of the current penalty for supporting R&D outside of the company, including at universities. [86] • Maintain a cost-sharing policy at NSF as adopted by the National Science Board.[87] • Institute an R&D tax credit to encourage private investment in innovative research.[88]

Subcategory	Recommendations
	• Enact a permanent R&D business tax credit, for industrial research and industrial support of university R&D performed in the United States.[89] • Allow emerging companies to temporarily elect to receive a refund of their accumulated net operating losses (NOLs) at a discounted rate, to be spent on qualified research expenses, in exchange for permanently foregoing the opportunity to use NOLs at their full value in the future.[90] • Consider a one-time monetization of existing tax credits for tax year 2008.[91] • Extend and expand the opportunity for loss companies to utilize R&D tax credits in lieu of bonus depreciation to offset either the cost of capital investments or qualified research expenses. [92] • Consider short term stimuli for new investments, such as zero or reduced capital gains for funds invested in cutting-edge, high-playing industries. [93] • Promote continued expansion and permanency of the R&D tax credit; and advocate tax policies that will stimulate the technology sector, including a reexamination of national and international tax structure. [94]
Intellectual Property	• Enhance intellectual property (IP) protection by providing US Patent and Trademark Office (PTO) with sufficient resources, switch US patent system to "first-inventor to file system," institute administrative review after a patent is granted, shield research use of patent inventions from infringement liabilities, and change IP laws that act as barriers to innovation in specific industries.[95] ($323 million) • Create an Intellectual Property Enforcement Coordinator (IPEC) in the Executive Office of the President as

[95]Gathering Storm.
[96]U.S. Chamber of Commerce, *Empowering the Intellectual Property Enforcement Coordinator to Protect Innovation at Home or Abroad.*

Subcategory	Recommendations
	provided for in "The Prioritization of Resources and Organization Act of 2008" (PRO-IP Act).[96] • Modernize the PTO by improving patent quality, providing adequate resources, reforming the patent examiner production system, improving the timeliness of administrative actions, strengthening the PTO's relationship with the user community, enhancing organizational management, appointing a well-qualified undersecretary and director, permitting applicants to defer patent examination, and enhancing the efficiency of the examination process by reforming examiner and applicant incentives.[97] • Establish PTO as a government corporation.[98] • Develop guidance and educational tools on intellectual property and technology transfer practices for university and private sector partners. [99] • Foster improvements in the U.S. and international systems for patent protection and for voluntary consensus standards. [100] • Fully fund the PTO to help reduce the lag times between patent filing and approval. [101] • Promote stronger enforcement of intellectual property protection worldwide. [102] • Adopt more open and transparent procedures for the Patent and Trademark Public Advisory Committees including selecting members to ensure broad and diverse

[97] U.S. Chamber of Commerce, *Recommendations for Consideration by the Incoming Administration Regarding The U.S. Patent and Trademark Office,* 2008. Hereafter known as "CC PTO."
[98] CC PTO.
[99] PCAST Partnerships.
[100] ACS Strategy.
[101] AeA.
[102] AeA.
[103] American Intellectual Property Law Association, *"Fraud" on the Trademark Office*.
[104] Innovation Alliance, *Recommendations for the New Administration*, November 26. 2008. Hereafter called "IA."
[105] IA.

Subcategory	Recommendations
	representation, provide better meeting and agenda notices, and prompt publication of minutes of activities and rationales for recommendations.[103] • Promote patent quality without undermining patent rights by devoting greater examination resources to complex applications, increasing access to prior art, facilitating communication between examiners and applicants, and tying compensation incentives to quality examination.[104] • Oppose proposals that would mandate apportionment of damages and prior art subtraction; establish an open-ended post-grant opposition system; or require patent applicants to file a prior art search report and patentability analysis.[105]
Broadband	• Ensure ubiquitous broadband internet access.[106] ($0) • Promote broadband diffusion by providing industry with incentives, and ensure access to affordable broadband for every American within 5 years. [107] • Promote expansion of broadband services to all areas of the country, and work with state and territories to ensure federal broadband policies do not unintentionally interfere with state and territory broadband development initiatives.[108] • Establish a National Broadband Strategy Commission that would set goals on broadband network development, subscribership, price, and speed, appoint a White House-based Chief Technology Officer to work in conjunction with the commission, and direct the Commission to propose broadband initiatives and applications such as modernizing economy, reducing energy consumption, and carbon dioxide gas emissions, and delivering better

[106] Gathering Storm.
[107] AeA.
[108] National Governors Association, *State Priorities in Communication*, EDC-08, July 14, 2008.
[109] Benton Foundation, *An Action Plan for America: Using Technology and Innovation to Address Our Nation's Critical Challenges*, by Jonathan Rintels October 30, 2008. Hereafter called "Benton."
[110] Benton.

Subcategory	Recommendations
	healthcare, education, public safety, and national security.[109] • Promote policies to stimulate both demand for, and supply of, robust and affordable broadband including taking actions to ensure that affordable, robust broadband is available to all Americans; directing the National Telecommunications and Information Administration to create a national online broadband mapping system; opening underused spectrum, and co-funding state and municipal broadband initiatives; supporting deployment of broadband to underserved communities and populations; and stimulating private sector investment in robust broadband.[110] • Developed a detailed blueprint for a 21st Century Information Superhighway that includes cost estimates for fiber deployments and descriptions of benefits including economic analysis of the plan's potential to create jobs and stimulate economic recovery and growth.[111] • Minimize regulation on advanced broadband technologies and innovative new Internet services, promote incentives for broadband deployment, and allocate additional spectrum for broadband and other new services.[112] • Encourage public-private partnerships to accelerate broadband deployment and adoption across the United States; provide the private sector with incentives, such as tax credits, to encourage infrastructure investment; and use actions (without restrictions that may deter potential bidders) to allocate wireless spectrum for mobile broadband.[113]

[111] New America Foundation, *Building the 21st Century's Information Superhighway: A Concrete Broadband Build-Out Plan for Advanced Telecommunication Infrastructur*e.
[112] ITIC.
[113] U.S. Chamber of Commerce, *The Road to U.S. Economic Growth*.

Subcategory	Recommendations
Miscellaneous	• Work with other countries with significant partnership professional to institute scientific standards and processes.[114] • Assess mechanisms to enhance Federal-State coordination to improve innovation and university-private sector partnerships. [115] • Assess options to streamline oversight structures and conflict of interest requirements while ensuring the accuracy and integrity of research and preserving the public's trust.[116] • Evaluate the impact and scalability of open collaborations or open innovation models, where individuals and regions can collaborate on a research project in real-time.[117] • Build on existing frameworks of successful university, government, and private sector initiatives to enhance research partnerships.[118] • Issue an executive order outlining the regulatory process that reverses the three major tenets of executive order 13422 and restricting the role of OMB in reviewing the scientific work of executive branch agencies.[119] • Review U.S. laws, regulations, and policies to determine impact on innovation; address inhibitors.[120] • Assure the most open interaction possible among scientists, engineers, and students from across the globe.[121]

[114] National Science Board, *International Science and Engineering Partnerships: A Priority for U.S. Foreign Policy and Our Nation's Innovation Enterprise*, NSB-08-4, February 14, 2008. Hereafter called NSB International.
[115] PCAST Partnerships.
[116] PCAST Partnerships.
[117] PCAST Partnerships.
[118] PCAST Partnerships.
[119] UCS Integrity.
[120] ASTRA Rising Tide.
[121] ACS Strategy.

Subcategory	Recommendations
	• Promote a strong scientific publishing enterprise that enables the open, economical exchange of scientific ideas and appropriate review, management, and archiving of information. [122] • Promote incentives and reduced economic and regulatory barriers to the development of new technologies. [123] • Promote institutions and guidelines to assure that governments, including legislatures, make appropriate and open use of scientific and technological information in making policy decisions. [124] • Engage proactively in the global trade system by advancing free and fair trade policies and agreements, concluding the DOHA round of global trade talks, and renewing the President's trade promotion authority. [125] • Establish an industry clusters program that stimulates the collaborative interactions of firms and supporting organizations to produce more commercial innovation and higher-wage employment by creating an information center to track cluster activity and support effective cluster efforts; and establishing a grants program to support regional and state cluster initiative programs nationwide.[126]

[122] ACS Strategy.
[123] ACS Strategy.
[124] ACS Strategy.
[125] AeA.
[126] Brookings Institution, Blueprint for American Prosperity, *Clusters and Competitiveness: A New Federal Role for Stimulating Regional Economies*, by Karen G. Mills, Elisabeth B. Reynolds, and Andrew Reamer, April 2008.
[127] Brookings Institution-Information Technology & Innovation Foundation, Boosting Productivity, Innovation, and Growth through a National Innovation Foundation, by Robert Atkinson and Howard Wial, April 2008.
[128] ITIF Stimulus.
[129] ITIF Stimulus.
[130] NGA Research.
[131] NGA Research.
[132] NGA Research.
[133] NGA Research.
[134] AAU.
[135] AAU.
[136] AAU.

Subcategory	Recommendations
	• Establish a National Innovation Foundation (NIF) to promote innovation by catalyzing industry-university research partnerships through national sector research grants, expanding regional innovation-promotion through state-level grants, encouraging technology adoption by assisting small and mid-sized firms, supporting regional industry clusters with grants for cluster development, emphasizing performance and accountability, and championing innovation by promoting innovation policy within the federal government.[127] • Provide a one-time $8 billion infusion into the highway trust fund to spur ready-to-go surface transportation infrastructure investments to boost economic growth by raising productivity among businesses and mobility among consumers. [128] • Provide forgivable loans to states to shore up budget shortfalls, provided that states expand "rainy day" funds in later years.[129] • Promote the integration of technology research and development into regional economic development strategies.[130] • Promote greater coordination and communication among federal agencies and departments in ways to encourage R&D innovation as a strategy for national economic growth. [131] • Continue the Bayh-Dole Act.[132] • Advance civil uses and complete construction and implementation of the Global Positioning System and the Nationwide Differential Global Positioning System (NDGPS). [133] • Retain a single presidential advisor for science and technology with strong Associate Director for Technology and Innovation, and name an Associate Director for Energy and the Environment at the President's Office of Science and Technology Policy (OSTP).[134] • Eliminate the 26% cap on university administrative costs

Subcategory	Recommendations
	of federally-funded research, and do not place arbitrary caps on indirect facilities and administrative cost reimbursement.[135] • Launch a major new innovation acceleration initiative by providing approximately $1 billion in new funding directly to states and universities to promote increased commercialization of promising university discoveries, university-industry collaborations, and new campus-based entrepreneurial education programs. [136]

Table 2. Workforce

Subcategory	Recommendation
General	• Establish, fund, and implement a strong innovation and economic competitiveness agenda that prioritizes the development of a robust, homegrown science and engineering (S&E) workforce.[137] • Create transparency in the use of America COMPETES Act funding, so all government agencies can achieve a more coordinated aerospace workforce development effort and be held accountable for the use of funds. [138] • Make full funding of the education provisions of the America COMPETES Act a high priority.[139] • Develop a national skills agenda to meet the demand for middle skills,[140] build service economy skills, and develop scientists and engineers who are more integrative and entrepreneurial, business-savvy service scientists and engineers, and more computational scientists and engineers.[141] • Examine adequacy of skills for innovation economy; educate for non-rule based, judgment-oriented problems.[142] • Improve statistical and career information for STEM workers; companies should articulate skill needs to educators and students. [143] • Strengthen effective STEM education programs at all levels – K-12, undergraduate, graduate, and continuing

[137] Aerospace Industry Association (AIA), *Launching the 21st Century American Aerospace Workforce*, December 2008.
[138] American Institute for Aeronautics and Astronautics, *Key Issues 2008*. Hereafter called "AIAA."
[139] CoC Compete.
[140] As defined by the Council on Competitiveness, middle-skilled jobs are those that do not always require a college degree, but which require training, technical sophistication, and initiative.
[141] Council on Competitiveness, *Thrive: The Skills Imperative*, 2008.
[142] ASTRA Rising Tide.
[143] ASTRA Rising Tide.
[144] ACS Strategy.
[145] ACS NSF.

Subcategory	Recommendation
	education. [144] • Reestablish NSF's preeminent role as the lead agency for improving STEM education, and the funding blueprint for NSF's Education and Human Resources Directorate in the America COMPETES Act.[145] • Improve K-12 math and science instruction to prepare the U.S. workforce for a 21st century knowledge economy including sustaining, strengthening, and reauthorizing the No Child Left Behind Act.[146] • Launch a major STEM education initiative including implementing and supporting the K-16 STEM education programs authorized in the America COMPETES Act. [147] • Double NSF's budget over the next 10 years for its Education and Human Resources directorate, and increase funding for its Mathematics and Science Partnerships program. [148] • Include the social, behavioral, and economic sciences in all programs related to STEM education.[149] • Strengthen ED Math and Science Partnerships by amending the existing program to make possible additional technical support and assistance to state education agency; directing the ED and NSF Math and Science Partnership programs to cooperate; include technology and engineering teachers alongside math and science teachers as allowed participants in all incentive

[146] AeA.
[147] AAU.
[148] National Council of Teachers of Mathematics, *2008 NCTM Legislative Platform*. Hereafter called "NCTM."
[149] COSSA.
[150] STEM Education Coalition, Letter to the Honorable George Miller and Honorable Howard McKeon, March 21, 2007. Hereafter called "STEM Coalition."
[151] National Action Council for Minorities in Engineering, *Confronting the "New" American Dilemma: Underrepresented Minorities in Engineering: A Data-Based Look at Diversity*. Hereafter called "NACME."
[152] American Electronics Association, *AeA Education Principles*.
[153] National Governors Association, *Policy Position: Education Reform*. Hereafter called "NGA Education."
[154] IEEE.
[155] ITIC.

Subcategory	Recommendation
	programs to recruit, train, mentor, retain, and further education K-12 teachers; and authorizing at least $450 million per year as specified funding.[150] • Develop a national STEM workforce development policy that stretches from preschool to PhD level including establishing programs to increase underrepresented minority participation in STEM education and careers; adopting polices to totally transform the education system to emphasize active, hands-on, project-based learning rather than rote learning and memorization; and recognizing that recruiting underrepresented minorities into STEM careers is a key strategy for stemming the offshoring of jobs, keeping them on American soil, and providing a workforce for the defense industry.[151] • Adopt higher standards at our schools, use high-quality assessments aligned to these standards, and hold schools accountable for results so that all students have an opportunity to succeed.[152] • Inspire young people to pursue STEM education and careers by implementing real reform policies that emphasize strong educational and research development systems at every level; by implementing rigorous STEM state developed curricula in our schools; and by featuring strong accountability for both students and teachers.[153] • Ensure that the United States invests in the essential domestic human resources and capabilities necessary t lead in research, development, and manufacturing technologies crucial to the U.S. economy and national security.[154] • Increase the number of students pursuing STEM degrees by strengthening student achievement and provide additional incentives to teachers and other professional for obtaining advanced training.[155]

Subcategory	Recommendation
Fiscal Policy	• Provide targeted corporate tax credits or other incentives for aerospace workforce training expenses. [156] • Establish an IRD&D program for aerospace workforce development. For every $1 spent on a government technology contract, aerospace company receives a small percent of funding for workforce development. [157] • Create the human capital investment tax credit to promote continuous education. [158] • Allocate $735 million to fund computers and broadband for educational opportunity. [159]
K-12 Teachers	• Recruit 10,000 teachers with science, engineering, and mathematics degrees through 4-year scholarships.[160] ($1040 million/year at peak) • Strengthen skills of 250,000 current K-12 teachers' skills at summer institutes (50,000 teachers), in master's programs at research universities (50,000 teachers), and in Advanced Placement (AP)/International Baccalaureate (IB) training programs (70,000 AP/IB; 80,000 pre-AP/pre-IB teachers).[161] (summer – $120 million; master's -- $330 million; AP/IB - $400 million/year at peak) • Enhance recruitment, professional development, and incentives for new and incumbent STEM teachers such as strengthening proven teacher preparation programs, and implementing comprehensive packages to recruit STEM teachers that include incentives such as scholarships, signing bonuses and differential play, and establishing a national standard for STEM teachers. [162] • Incentivize and reduce barriers to employment of retiring

[156] AIAA.
[157] AIAA.
[158] AeA.
[159] ITIF Stimulus.
[160] Gathering Storm.
[161] Gathering Storm.
[162] AIA.

Subcategory	Recommendation
	aerospace workers as educators or teaching assistants, such as revising the federal tax code and other federal laws to mitigate the financial impact for STEM retirees who decide to become teachers, and provide tax incentives to businesses for allowing employees to enroll in alternative teacher credentialing program. [163] • Deploy technologies, management, organization, and performance-enhancing innovations to transform U.S. education, including providing states with funding to design voluntary, incentive-based compensation systems to reward teachers and relevant support staff for improving the overall quality of instruction and creating a stronger educational environment.[164] • Develop strategies for compensating STEM teachers at market rates, provide resources for preparing future STEM teachers, increase STEM teacher mobility by creating national STEM teacher certification standards, and prepare STEM teachers to teach STEM content effectively. [165] • Recruit and retain highly skilled STEM teachers, improve the content knowledge skills of the K-12 STEM teacher workforce, and improve the resources available in STEM classrooms. [166]

[163] AIA.
[164] CoC Compete.
[165] NSB Education.
[166] ACS Strategy.
[167] American Innovation Proclamation.
[168] AAU.
[169] Business Higher Education Forum, *An American Imperative: Transforming the Recruitment, Retention and Renewal of Our Nation's Mathematics and Science Teaching Workforce, 2007*. Hereafter called "BHEF."
[170] BHEF.
[171] BHEF.
[172] NCTM.
[173] STEM Coalition.
[174] STEM Coalition.
[175] Society of Women Engineers, *General Position Statement on Science, Technology, Engineering, and Mathematics (STEM) Education and the Need for a U.S. Technologically-Literate Workforce*, February 2006. Hereafter called "SWE Literacy."
[176] National Research Council, *Taking Science to School: Learning and Teaching Science in Grades K-8*, 2006. Hereafter called NRC Learning.

Subcategory	Recommendation
	• Improve student achievement in math and science through increased funding of proven programs and incentives for science and math teacher recruitment and professional development.[167] • Improve K-12 STEM education by expanding support for summer STEM and foreign language teaching institutes at universities for K-12 teachers such as the NSF Teacher Institutes for the 21st century program, creating a mentoring and tutoring program that offers college students a stipend for tutoring K-12 students in STEM and foreign language coursework, and encouraging states to create innovative programs, modeled on the UTEACH and CALTEACH, to develop a larger and more diverse cadre of STEM teachers.[168] • Strengthen STEM teacher recruitment policies by implementing a comprehensive package of recruitment strategies, starting in P-12 and extending through graduate school, that include incentives such as scholarships, signing bonuses, and differential pay; strengthening the content and pedagogy of teacher preparation programs; and expanding strategies to attract talented individuals in STEM-related professions to teacher, and ensuring they are adequately trained for the classroom.[169] • Improve the retention of both new and experienced teachers and address the causes of teacher dissatisfaction by developing and implementing research –based induction programs for all new STEM teachers, and implementing comprehensive policies and programs to address issues such as inadequate compensation, lack of administrative support, and professional isolation.[170] • Ensure that all STEM teachers participate in renewal activities that support their effectiveness in the classrooms, including providing ongoing, research-based professional development programs focused on both content and pedagogy; revamping teacher license renewal programs to incorporate teacher effectiveness measures; and establishing comprehensive statewide data collection systems that track student progress, teacher effectiveness, and STEM teacher employment trends.[171] • Invest in teachers at every stage of their development to

Subcategory	Recommendation
	ensure the recruitment and retention of qualified teachers including developing and expanding exemplary preservice teacher education programs; maximizing and leverage federal investments in research and teacher professional development; supporting the preparation, mentoring, and ongoing professional development of alternatively certified teachers; supporting early-career teachers through mentoring programs, incentives, and specialized long-term professional development; investing in programs to develop mathematics specialists and math coaches in elementary, middle, and high schools; improving and increasing professional development for all teachers; supporting tax-credit policies for in-service teachers in urban, rural and high-need schools and offering loan forgiveness for beginning teachers; and funding the Math Now mathematics education initiative, authorized at $95 million (FY2009) and designed to prepare elementary and middle school students.[172] • Establish K-8 Master Teacher programs (commonly known as math or science specialists) at the K-8 level in a large number of school districts. [173] • Dedicate funding for teacher professional development under Title IIA of the No Child Left Behind act. [174] • Enlarge America's talent pool by greatly improving K-12 STEM education through the recruitment, training, and retention of STEM teachers through scholarships, student loan forgiveness, bonuses, and tax incentives; increasing STEM coursework in pre-service/university teacher training; allowing for differential pay scales; improving in-service professional development; facilitating alternative certification and transition-to-teaching programs; and instituting mentoring programs for STEM personnel in schools.[175] • Require teacher development programs funded by the federal government incorporate models of instruction that combine the four strands of science proficiency (know, use, and interpret scientific explanations of the natural world; generate and evaluate scientific evidence and explanations; understand the nature and development of scientific knowledge; active participation in scientific collaboration and discussion), focus on core ideas in science, and enhance teachers' science content

Subcategory	Recommendation
	knowledge, knowledge of how students learn science, and knowledge of how to teach science.[176]
K-12 Students	• Prepare 1.5 million students for STEM higher education through AP and IB STEM courses with a goal that 700,000 pass tests; provide student incentives for success with 50% examination fee rebates and $100 mini-scholarships.[177] ($181 million per year at peak) • Establish statewide specialty high schools.[178] • Provide middle and high school students with summer internships and learning opportunities.[179] • Encourage most of our best and brightest students, especially women and those from underrepresented and disadvantaged groups, to study in STEM fields. [180] • Ensure equitable mathematics learning of the highest quality for all students.[181] • Strengthen emphasis on STEM fields in after-school programs. [182] • Promote STEM specialty high schools. [183] • Expand the STEM pipeline, especially targeting women and minorities, by increasing the number of students who pursue STEM coursework by providing incentives and mentoring for students, fostering outreach and providing STEM career guidance materials to K-12 guidance counselors, teachers, and parents; supporting STEM magnet schools in school districts with large minority enrollments; and fostering public-private partnerships to ensure those schools serving large minority enrollments

[177] Gathering Storm.
[178] Gathering Storm.
[179] Gathering Storm.
[180] ACS Strategy.
[181] NCTM.
[182] STEM Coalition.
[183] STEM Coalition.

Subcategory	Recommendation
	have the materials and equipment needed to support the delivery of high-quality STEM education.[184] • Integrate academic and technical skills training to ensure that all students complete their education with the knowledge and skills needed for both the workforce and college.[185]
Curriculum	• Develop voluntary K-12 curriculum materials modeled on a world-class standard.[186] ($20 million per year) • Facilitate a strategy to define national STEM content guidelines that would outline the essential knowledge and skills needed at each grade level.[187] • Support greater focus and coherence in curriculum, assessment, and accountability grounded in research.[188] • Dedicate funding for elementary and middle school mathematics similar to the Reading First program, which provides resources to help schools improve instruction and develop strategies to increase student achievement in mathematics and preparedness for more rigorous high school mathematics coursework. [189] • Incorporate the business community into state and local education planning to align standards to future economic opportunity and employer needs. [190] • Support programs that allow for increased job training and workforce development. [191]

[184] SWE Literacy.
[185] National Association of Manufacturers, *Manufacturing a High-Performance Workforce: NAM Comprehensive Legislative Proposal.* Hereafter called "NAM Workforce."
[186] Gathering Storm.
[187] National Science Board, *A National Action Plan for Addressing the Critical Needs of the U.S. Science, Technology, Engineering, and Mathematics Education System*, NSB-07-114, October 30, 2007. Hereafter called "NSB Education."
[188] NCTM.
[189] STEM Coalition.
[190] NAM Workforce.
[191] NAM Workforce.

Subcategory	Recommendation
	• Strengthen the link between employers and the federal job training system by incorporating better business outreach and services. [192] • Broaden the Trade Adjustment Assistance program to include service workers to help the U.S. workforce thrive in the global economy.[193] • Reform job retraining programs to more effectively focus resources on programs that truly enhance the current skills of U.S. workers. [194] • Develop curricula and standards by presenting science as a process of building theories and models using evidence, checking them for internal consistency and coherence, and testing them empirically, while introducing and discussing scientific methodology in the context of pursuing specific questions and issues rather than as templates or invariant recipes.[195]
Technology and Engineering Education	• Revise the No Child Left Behind Act to improve student achievement in STEM and optimize preparation of students for pursuing technical careers, such as requiring all states to administer the same math and science tests, and consulting with existing programs such as Project Lead the Way to consider establishing a national curriculum pre-engineering standard. [196] • Make federal agencies accountable for promoting STEM education, particularly technology and engineering (T&E).[197] • Provide incentives for creating more in-service and pre-service hands on training in T&E for K-6 educators. [198]

[192] NAM Workforce.
[193] ITIC.
[194] ITIC.
[195] NRC Learning.
[196] AIA.
[197] AIAA.
[198] AIAA.

Subcategory	Recommendation
	• Promote the design and dissemination of a high school Advanced Placement design course and examination. [199] • Continue and expand NSF's existing programs that support engineering education including the Research Experience for Undergraduates (REU), Integrative Graduate Education, Research, and Training (IGERT) program, Increasing the Advancement of Women in Academic Science and Engineering Careers (ADVANCE), Graduate Research Fellowship (GRF), GK-12 Fellows program, and Research Experience for Teachers (RET) programs.[200] • Continue to support engineering education research and experimentation and expand dissemination of results.[201] • Support education that broadens the experience of engineering students such as cross-disciplinary education and seminars, international programs, global educational opportunities, and experimental engineering education programs that produce different kinds of engineers.[202] • Conduct a study to determine how many, and what kinds, of engineers the United States must produce to be economically competitive.[203] • Continue investing in critical technology programs that support teacher and student mastery of 21st century skills including Title V, assistive technology, Educational Technology State Grants, and E-Rate.[204] • Educate the next generation of Americans to ensure a pool of the best and brightest scientists, technologists,

[199] AIAA.
[200] National Science Board, Moving *Forward to Improve Engineering, Education*, NSB-07-122, November 19, 2007. Hereafter called "NSB Engineering."
[201] NSB Engineering.
[202] NSB Engineering.
[203] NSB Engineering.
[204] NGA Education.
[205] IEEE.
[206] National Academy of Engineering/National Research Council, *Tech Tally: Approaches to Assessing Technological Literacy*, 2006.

Subcategory	Recommendation
	engineers, and mathematicians. [205] • Develop tests and surveys to measure Americans' knowledge and use of technology and their ability to make informed decisions on issues involving technology to improve how technology is taught and help policymakers better respond to public concerns about technology.[206]
Higher Education	• Provide 25,000 new 4-year competitive undergraduate scholarships to US Citizens earning bachelor degrees in the physical sciences, life sciences, engineering, and mathematics.[207] ($1,500 million per year at peak) • Fund 5,000 portable fellowships with $30,000 each year as a stipend directly to US citizens pursuing graduate study in areas of national needs, and up to $20,000 annually for their tuition and fees.[208] ($675 million per year at peak) • Enhance support for two-year and four-year institutions that provide students with hands-on experience directly transferable to the workplace. [209] • Create service scholarships to pay college tuition for students who plan to work in aerospace-related government agencies after graduation. [210] • Provide incentives and mentoring for undergraduate and graduate students, including women and minorities, to increase the number and proportion of U.S. citizens who earn STEM degrees and pursue STEM careers.[211] • Increase the federal investment in U.S. R&D, as a means to support the training of graduate students. [212] • Fight back against attempts to make colleges completely

[207] Gathering Storm.
[208] Gathering Storm.
[209] AIA.
[210] AIAA.
[211] SWE Literacy.
[212] SWE Literacy.

Subcategory	Recommendation
	"color-blind" in admissions, financial aid, and other areas.[213] • Provide support for students at both the master's and doctoral levels in STEM fields, including the social sciences, as well as disciplines that foster global understanding of languages and culture including increasing federal funds for graduate education programs by at least 10% at each agency, and designing graduate support and research programs to aware creativity and risk-taking as a key component of a U.S. strategy on innovation.[214] • Create incentives for students, particularly underrepresented groups, to pursue graduate education in STEM fields, social sciences, and humanities, through portable and competitive fellowships and traineeships, loan forgiveness, and other measures.[215] • Create a program, funded by H-1B visa program revenues, to encourage U.S. domestic students to pursue graduate education in key areas of national need that are at the cutting edge of new markets. [216] • Expand models pioneered by NSF and NIH such as the NSF Integrative Graduate Education and Research Traineeship program and the NIH interdisciplinary grant programs to address the impact of graduate education and research on advancing knowledge in cutting-edge fields in support of U.S. competitiveness. [217] • Increase the number of U.S. students in STEM who graduate with a four-year degree.[218]

[213] NACME.
[214] CGS
[215] CGS.
[216] CGS.
[217] CGS.
[218] NAM Workforce.
[219] Tapping America's Potential, *Gaining Momentum, Losing Ground: Tapping America's Potential (TAP) Progress Report 2008.*
[220] National Research Council, *Science Professionals: Master's Education for a Competitive World,* 2008.

Subcategory	Recommendation
	• Increase the annual number of U.S. STEM bachelor's level graduates to 400,000 by 2015 (double the number that graduated in 2005).[219] • Expand the Professional Science Master's program authorized in the America COMPETES Act so that it is the responsibility of NSF and all other major federal science agencies, and that agency programs include competitively awarded institutional grants, and a need-based National Innovation Scholarship program for U.S. citizens.[220]
Postdoctoral	• Expand data collection on postdocs to be more accurate, inclusive, and detailed, especially with regard to under-represented groups; and re-examine science and technology labor shortage projects.[221] • Make initial stipends to postdoctoral scholars supported by the National Research Service Award (NRSA) program $45,000, and to provide automatic cost-of-living increases ear year thereafter to keep pace with inflation.[222]
Continuing Education	• Provide a federal tax credit to encourage employers to make continuing education available to practicing scientists and engineers.[223] ($500 million per year) • Initiate a CompetePass Program with workforce entrants and jobholders receiving a the pass from Department of Labor one-stop training centers that they would redeem at certified employer-, academic-, or labor-sponsored training programs that meet industry-drive skills requirements in high growth job sectors.[224] • Enable lifelong inquiry-based science education for everyone in both formal and informal settings to improve the scientific understanding of all our citizens.[225]

[221] National Postdoctoral Association, *NPA Agenda for Change*. Hereafter called "NPA Change."
[222] National Postdoctoral Association, *Position Paper on NRSA Postdoctoral Stipends.*
[223] Gathering Storm.
[224] CoC Compete.
[225] ACS Strategy.

Subcategory	Recommendation
	• Enhance training opportunities, retirement security, and quality of life for science and engineering professionals.[226] • Provide federal tax credits to encourage employers to make continuing education available (either internally or through colleges and universities) to practicing scientists and engineers. [227] • Provide tax credits to employers so that practicing scientists and engineers can participate in career-long learning and retrain for new markets. [228] • Promote lifelong learning by providing education and training to Americans and assistance to dislocated workers regardless of the cause of their job loss, including providing portability of benefits, and flexible access to benefits depending on need.[229] • Consolidate funding for current government workforce training and adjustment programs and use that funding more effectively and efficiently, plus additional investment, as needed, to create access to a redesigned system for lifelong learning and transition assistance.[230] • Create a bipartisan National Commission on Workforce Competitiveness to consider issues such as a portable tax-advantaged fund for lifelong learning and employment transition planning; "one-stop shops" for workers to access current and easily understood information about labor market trends, education, skill requirements, job opportunities, self-assessments, and available government assistance and training; innovative financing mechanisms; coordination of benefits; and state partnerships; and

[226] ACS Strategy.
[227] SWE Literacy.
[228] CGS.
[229] Business Roundtable, *Prospering Together: America's Citizens, Communities, and Companies*, February 2008. Hereafter called "BRT Prospering."
[230] BRT Prospering.
[231] BRT Prospering.
[232] Washington Alliance of Technology Workers/Communication Workers of America. Hereafter called "Wash Tech."

Subcategory	Recommendation
	lifelong learning initiatives that build on community colleges. [231] • Extend Trade Act Adjustment Assistance to service sector employees.[232]
Visas-Students and Scholars	• Improve visa processing for international students and scholars.[233] ($0) • Provide a one-year automatic visa extension to international students who receive doctorates or the equivalent in STEM or other fields of national need, and provide automatic work permits and expedited residency status if offered job by US-based employer, and pass a security screening test.[234] ($0) • Reform visa and immigration policies to enable the United States to attract and retain science, technology, engineering, and mathematics students from around the world to study for advanced degrees and remain in the United States to work.[235] • Continue to improve the visa process so that the pathway for international students, scholars, and STEM practitioners is made more efficient, allowing them to contribute to America's leadership and global effectiveness. [236] • Create clear pathways to permanent residency for top international students and scholars by reforming immigration policies, such as a new visa category for doctoral students and scholars. [237] • Use information from studies assessing the quality and accountability of graduate education. [238]

[233] Gathering Storm.
[234] Gathering Storm.
[235] CC Energy.
[236] CGS.
[237] CGS.
[238] CGS.

Subcategory	Recommendation
	• Establish a reliable, accurate, and efficient employment eligibility verification system that also provides for enforcements of the laws.[239] • Allow easier entry and re-entry of foreign postdocs into the United States, and greater mobility between institutions within the United States.[240] • Facilitate the ease of obtaining a new visa in the same category as the previous visa for international postdoctoral researchers if they travel to their home country.[241] • Establish a new non-immigrant classification specifically for non-immigrant international postdoctoral research scholars.[242] • Eliminate the "intent to return" requirement currently attached to J-1 immigrant visas.[243] • Reform highly education employee and student visa programs to enable American businesses to attract and retain the most talented scientists and engineers worldwide.[244] • Continue to monitor the visa clearance process and address issues immediately that arise, review and streamline the Technology Alert List to include areas of

[239] NAM Workforce.
[240] NPA Change.
[241] NPA International.
[242] NPA International.
[243] National Postdoctoral Association, *International Postdoctoral Researchers and Their Importance to the Advancement of U.S. Science, Technology, and National Security*. Hereafter called "NPA International."
[244] ITIC.
[245] NRC Security.
[246] NRC Security.
[247] PCAST IT.
[248] ASTRA Rising Tide.
[249] AeA.
[250] American Innovation Proclamation.
[251] National Research Council, *Beyond "Fortress America" National Security Controls on Science and Technology in a Globalized World*, 2009. Hereafter called "NRC Fortress."
[252] NRC Fortress.
[253] NRC Fortress.

Subcategory	Recommendation
	study that clearly have explicit implications for national security, consider creating a new nonimmigrant visa subcategory for doctoral-level graduate students and postdoctoral scholars coming to the United States, and make student visas commensurate with the term of study.[245] • Develop a policy at DOS, along with other federal agencies such as Departments of Commerce and Labor, to determine whether students and scientists here on temporary visas should be allowed to extend their stay if they are working in a scientific or technical field deemed to be in demand in the United States.[246] • Streamline the visa process for non-US students admitted to accredited graduate degree programs in networking and information technology (NIT), and make it routine for foreign nationals who have obtained advanced degrees in NIT subjects at accredited US universities to obtain work permits and US citizenship by easing their visa and Green Card processes.[247] • Strengthen efforts to attract and retain top foreign students and STEM professionals. [248] • Lower barriers for high-skilled individuals to receive temporary work visas, and given green cards to all U.S. educated master and doctoral students. [249] • Welcome highly educated foreign professionals particularly those holding advanced STEM degrees, especially from U.S. universities, by reforming U.S. visa policies. [250] • Streamline the visa process for credentialed short-term visitors in science and technology fields through a Presidential executive order that requires that a non-immigrant visa applicant who is a graduate student, researcher, or professional in any field of science and technology, and whose application is supported by a qualified university, scientific body, or corporation should receive a determination on his or her visa within 30 days.[251]

Subcategory	Recommendation
	• Extend the duration of stay for science and engineering graduates with advanced degrees through a Presidential executive order that provides a one-year automatic visa extension to international students to remain in the United States to seek employment or acceptance into further advanced study on receipt of advanced degrees in science, technology, engineering, mathematics, or other fields of national need at qualified U.S. institutions, and if these students are offered jobs by U.S.-based employers and pass security screening measures, provide them with automatic work permits and expedited residence status. [252] • Institute skills-based preferential process with respect to visa applications through a Presidential executive order that gives priority to visa applications of scientists and engineers, graduate-level education, and science and engineering skills. [253]
Immigration and H-1B Visas	• Adopt a talent-oriented immigration policy.[254] • Institute a new skills-based preferential immigration option.[255] ($0) • Reform legal, employment-based immigration to better reflect market demands and provide the flexibility needed to respond to specialized skill needs, beginning by significantly increasing the number of available H-1B visas.[256] • Raise significantly or reformulate to fluctuate with market demands current limits for H-1B visas and employment-based "green cards," and address processing delays.[257] • Reform the nation's immigration system while maintaining national security priorities.[258]

[254] US Chamber of Commerce, *International Engagement: The U.S. Chamber's Agenda to Help Americans Compete and Win in the Worldwide Economy*. Hereafter called "CC Win."
[255] Gathering Storm.
[256] NAM Workforce.
[257] CC Win.
[258] CoC Compete.

Subcategory	Recommendation
	• Raise the cap on H-1B visas for international postdoctoral researchers who have U.S. and/or other foreign advanced degrees. [259] • Enhance enforcement of Department of Labor laws regarding prevailing wages as required by the H-1B non-immigrant classification. [260] • Raise the H-1B from 65,000 to 115,000; implement a market-based approach, where 20% additional visas are added for the following year if the cap is reached, to ensure predictability; and create an uncapped exemption for professionals who have earned a master's or higher degree from a U.S. university or who a STEM master's degree or higher and have worked for 3 years in a related field in the United States.[261] • Raise the cap from 140,000 to 290,000 visas a year; allow unused green card visas to fall forward annually, while recapturing unused visas from previous fiscal years; and exempt from the cap professionals who have earned a master's or higher degree a master's or higher degree from a U.S. university or who a STEM master's degree or higher and have worked for 3 years in a related field in the United States. [262] • Expedite the visa approval process for companies that have a proven H1-B compliance record; address problems arising from country-specific limits on business immigration; dedicate filing fees to enhance education in needed fields and to improve case processing and program management; and strengthen enforcement to eliminate fraud without placing new burdens on legitimate users of

[259] NPA International.
[260] NPA International.
[261] American Electronics Association, *HR/Workforce & Immigration Overview: Maintaining a High-Skilled U.S. Technology Workforce.* Hereafter called "AeA Workforce."
[262] AeA Workforce.
[263] AeA Workforce.
[264] International Federation of Professional & Technical Engineers (AFL-CIO & CLC), *IFPTE Optimistically Looks Toward the 111th Congressional Session*, IFPTE Outlook, October-December 2008. Hereafter called "IFPTE."
[265] Wash Tech.
[266] IEEE.

Subcategory	Recommendation
	the H-1B program. [263] • Overhaul the H-1B and L-1 visa systems, and block any increases in the number of H-1B visas.[264] • Reform the H-1B and L-1 visa system.[265] • Ensure a strong high-tech workforce through educational and employment-based immigration reforms. [266]
International	• Require that corporations inform workers when jobs are exported outside of the United. States. [267] • Conduct a GAO study of offshore outsourcing and its impact on the high-technology economy. [268] • Develop and implement an integrated strategy at ED for foreign language and international education involving both K-12 and higher education ton enhance national security, help U.S. businesses compete in an increasingly global economy, and broadly education and inform the nation's citizens.[269] • Ensure that, whenever possible, policies and practices are in place to encourage the free movement of foreign students and scholars to scholarly/scientific conferences and to meetings in the United States and elsewhere. [270] • Facilitate "brain circulation" by supporting study abroad opportunities for American students, streamlining the visa process for foreign S&E professionals and students, easing the ability of U.S. students to undertake foreign study and collaborative research by providing professional and scientific opportunities upon their return to the United States, identifying and increasing use of certain specialized research facilities, supporting global fora to

[267] Wash Tech.
[268] Wash Tech.
[269] National Research Council, *International Education and Foreign Languages: Keys to Securing America's Future*, 2007.
[270] National Research Council, *Science and Security in a Post 9/11 World: A Report Based on Regional Discussions Between the Science and Security Communities*, 2007. Hereafter called "NRC Security."

Subcategory	Recommendation
	identify research priorities, and develop common funding and governance schemes.[271] • Appoint a new Assistant Secretary for International Education at ED to oversee and administer all of ED's international education programs, including the HEA Title VI and Fulbright-Hays programs in the international education programs service, as well as the K-12 programs.[272] • Increase the number of students studying abroad to meet the growing demand for globally competent college graduates.[273] • Strengthen U.S. higher education and enhance international understanding by encouraging international students and scholars to come to U.S. colleges and universities, and providing them with a clear path, where appropriate to employment and permanent residency.[274] • Strengthen the academic and cultural exchange programs at the State Department. [275]
Organization	• Create a cabinet-level executive branch interagency STEM education council to identify, align, and coordinate government efforts. [276] • Each state should create its own executive branch STEM council. [277] • Charter a new, independent non-Federal National Council for STEM education to coordinate and facilitate STEM programs and initiatives, and inform policymakers and the

[271] NSB International.
[272] AAU.
[273] AAU.
[274] AAU.
[275] AAU.
[276] AIA.
[277] AIA.
[278] NSB Education.
[279] NSB Education.
[280] NSB Education.

Subcategory	Recommendation
	public on the state of STEM education in the United States.[278] • Create a standing Committee on STEM education within the National Science and Technology Council (NSTC), managed by the President's Office of Science and Technology (OSTP), to coordinate all Federal STEM education programs.[279] • Create a new Assistant Secretary of Education position charged with coordinating the Departments of Education's STEM efforts and interacting with stakeholders.[280] • Develop a national roadmap to improve pre-kindergarten to college (P-16/P-20) STEM Education through the National Science Foundation. [281] • Improve the linkage between high school and higher education and/or the workforce, create or strengthen P-16/P-20 councils in each state, and encourage alignment of STEM content throughout the P-12 education system.[282] • Increase coordination of STEM activities across federal agencies. [283] • Provide grants to establish or strengthen exiting P-16 STEM Councils whose focus is on alignment of K-12, higher education, and workforce systems to provide a venue for addressing pipeline issues and implementing systematic reforms.[284]
Women and Underrepresented Groups	• Step up enforcement of Title IX with respect to STEM disciplines, including fulfilling their monitoring and enforcement obligations under the law and making this information available to the public; and fund programs that will help educate students and their parents, and

[281] NSB Education.
[282] NSB Education.
[283] AAU.
[284] STEM Coalition.

Subcategory	Recommendation
	STEM faculty, of their rights under the law.[285] • Identify strategies and funding mechanism that will encourage more women and underrepresented groups in STEM fields to advance to leadership positions.[286] • Enact recommendations from National Academies *Beyond Bias and Barriers* report that would require agencies that fund scientific research to conduct anti-gender bias workshops, enforce existing federal anti-discrimination laws (including Title IX), publish demographic and funding data for grant applications, extend grant support for researchers on caregiving leave, and that colleges form an NCAA-like inter-institutional monitoring organization that shares data, evaluates progress, and works to eliminate gender bias in faculty recruitment, retention, and promotion in STEM fields.[287] • Ask for a report responding to the National Academies report *Rising Above the Gathering Storm* that discusses methods to increase the number of women in STEM fields and what effect this would have on enabling the United States to remain a leader in the global marketplace.[288] • Require agencies to proactively conduct Title IX compliance reviews at grantee institutions.[289] • Measure student achievement in science and disaggregate the results by sex, race, and socioeconomic status, and cross-tabulate the date.[290]

[285] Society of Women Engineers, *General Position Statement on the Application of Title IX to the science, technology, engineering, and mathematics (STEM) Fields,* June 2006.
[286] CGS.
[287] American Association of University Women, *Improve Girls' and Women's Opportunities in Science, Technology, Engineering, and Math.* Hereafter called "AAUW."
[288] AAUW.
[289] AAUW.
[290] AAUW.
[291] AAUW.
[292] AAUW.
[293] National Coalition for Women & Girls in Education, *Gender Equity Recommendations for the First Year of the Obama Administration.* Hereafter called "NCWGE."
[294] NCWGE.

Subcategory	Recommendation
	• Create more STEM teachers and train teachers to encourage girls and other underrepresented groups to pursue math and science careers in the face of gender-based differences, peer pressure, and parental expectations, particularly given the loss of girl's interest in science and math is particularly high by junior high.[291] • Incorporate STEM subjects and activities in after-school and summer programs to enable students to explore the field in a supportive atmosphere with a particular focus on providing information about the usefulness of engineering to everyday life and hands-on experiences with STEM help girls develop a sustained interest in these fields.[292] • Conduct systematic reviews of institutions' compliances with Title IX in STEM education.[293] • Ensure that all federal agencies that provide funding for education programs or activities, including the DOE, NASA, and NIH, monitor compliance with Title IX and that they fully enforce their own rules.[294]
Miscellaneous	• Cooperate at all levels of government to provide science, technology, engineering, and mathematics careers.[295] • Support the new university sustainability grants program authorized by the Higher Education Opportunity Act of 2008 at ED.[296] • Bolster research efforts to identify and disseminate promising practices, and to support programs that are effective in increasing student achievement in STEM.[297] • Support expanded research in mathematics education.[298] • Create policy incentives to encourage technical staff scientists and engineers to volunteer in local schools to

[295] CC Energy.
[296] AAU.
[297] BHEF.
[298] NCTM.
[299] CGS.

Subcategory	Recommendation
	promote STEM education and mentor students.[299] • Modernize instructional and related technologies in the nation's elementary and secondary education system, and include the professional development, instructional technology coaches, and technology IT support essential for successful implementation. ($5.976 billion) • Continue support, with increased budgets for the research of the Institute of Education Sciences in ED and the longitudinal surveys and basic data collections of its National Center for Education Statistics. [300] • Restore the Title VI and Fulbright-Hays budgets to the inflation-adjusted levels of the late 1960s, and restore cuts to the Javits Fellowship program.[301]

[300] COSSA.
[301] COSSA.

Table 3. Energy

Subcategory	Recommendation
Research	• Significantly increase research, development, and deployment of advanced clean energy technologies.[302] • Provide opportunities for businesses and venture capital firms to work within the DOE national laboratories to identify and create business plans to commercialize new advanced energy technologies being developed by the laboratories.[303] • Support a broad federal R&D portfolio on both the supply and demand sides, including energy efficiency, new energy sources, and advanced fuel and power delivery options. [304] • Double, at a minimum, the funding for federal energy technology R&D programs in real terms within five years.[305] • Triple the investment specific to energy-related research to fuel energy and energy efficiency innovations in transportation, appliances, green buildings, materials, fuels, power generation, and industrial processes.[306] • Triple the current federal investment in basic and applied energy R&D across all federal agencies and departments.[307] • Continue to increase R&D investments to make clean and efficient energy technologies more cost-competitive.[308] • Harness the federal government's innovation and scientific and engineering resources to address the major energy and environmental challenges facing the nation including ensuring that the initiative includes significant

[302] CC Energy
[303] CC Energy.
[304] CC Energy.
[305] CC Energy.
[306] CoC Compete.
[307] CoC Compete.
[308] President's Council of Advisors on Science and Technology, *The Energy Imperative: Report Update*, November 2008. Hereafter called "PCAST Energy."

Subcategory	Recommendation
	support for basic research, creating a new program to encourage high-risk, high-reward research in energy-related fields, ensuring DOD plays a significant role, expanding DOE fellowship programs, expanding NSF social science and economics research, and integrating energy research with existing and future research on and scientific understanding concerning climate change. [309] • Implement and support the new Energy Frontier Research Centers program.[310] • Increase federal research support across federal agencies, including full funding of the America COMPETES Act, to strengthen and expand exciting basic energy research and education efforts at universities and national laboratories.[311] • Support transformational energy research in which risk may be high, but success would provide dramatic benefits for the nation.[312] • Invest in research not only in the physical sciences and engineering, but also in the social and behavioral sciences, economics, and complex systems needed to understand which energy systems and technologies will be most effective and able to compete in the market.[313] • Fully fund all federal energy research activities authorized by EPAct 2005.[314] • Authorize $100 million for new university-based nuclear physics program, $500 million annually for R&D in advanced fuel cycles and reprocessing/recycling of spent nuclear fuel, and $1 billion annually for R&D in oil

[309] AAU.
[310] AAU.
[311] Energy Sciences Coalition, *We Need Basic Energy Research to Meet America's Energy Goals: Strong and Stable Funding and Multi-Agency, Multi-Disciplinary Approach Required.* Hereafter called "ESC."
[312] ESC.
[313] ESC.
[314] National Association of Manufacturers, *Energy Security for American Competitiveness: NAS Comprehensive Legislative Proposal.* Hereafter called "NAM Energy."
[315] NAM Energy.
[316] American Chemical Society, *Statement on Department of Energy Science & Technology: FY2009.*

Subcategory	Recommendation
	shales, coal liquefication and production of natural gas from methane hydrate formations, while providing incentives for the production of petroleum from oil shales and transportation fuels from coal liquefication.[315] • Renew federal support for coal-related research, and coordinate this research across agencies, states, and the industrial sector. ($190 million/year) • Approve the President's recommended FY2009 budget allocation of $4.7 billion for the DOE Office of Science, an increase of $749 million (18.9% over FY2008).[316]
Energy Technology Portfolio	• Establish and fund an Electric Energy Storage Initiative to coordinate and fund research into energy storage technologies with the goal of developing cost-effective technology capable of storing 50 to 100 MW of power.[317] • Establish the "High-Performance Computing Transmission Initiative," creating a consortium of national laboratories, universities, industry and organized labor to model and simulate the design, construction and operation of an intelligent, self-healing, electrical grid—integral to a national high-performance transmission system.[318] • Invest in cellulosic biofuels and energy storage technologies for plug-in hybrid electric vehicle (PHEVs) and electric vehicle (EVs) as they have the potential to displace a large portion of US petroleum consumption.[319]
Management of Federal Energy Research Activities	• Created Advanced Research Projects Agency-Energy (ARPA-E) in the DOE to support creative "out-of-the-box" transformational generic research.[320] ($1000 million per year at peak) • Establish and fund a new ARPA-E program or its equivalent to assess, prioritize, select, and support high-risk, exploratory research on innovative concepts and enabling technologies that have great potential for breakthroughs. [321]

[317] CC Energy.
[318] CoC Prioritize.
[319] PCAST Energy.
[320] Gathering Storm.
[321] CC Energy.

Subcategory	Recommendation
	• Provide an additional $150 million for the DOE's new Energy Frontier Research Centers to stimulate university energy research and training capacity. [322] • Invest in energy efficient and alternative energy technologies to a level commensurate with their operational and financial value at DOD.[323] • Separate the position of Undersecretary for Science and the Director of the Office of Science at DOE. [324] • Develop a multi-agency strategy to coordinate basic energy research, including, principally, DOE, working with DOD, USDA, DOT, NSF, NIST, EPA, and others.[325] • Establish a new research entity within the DOE, designed to bridge the gap between scientific research and technology-oriented energy R&D activities.[326]
Demonstration and Deployment	• Establish and capitalize a $200 billion National Clean Energy Bank, modeled on the U.S. Export-Import Bank and Overseas Private Investment Corporation, to provide long-term financing for the market deployment of energy efficiency and clean energy products, technologies, services, and projects that reduce, avoid, or sequester carbon. Make the commercialization of utility-scale clean energy systems a priority.[327] • Create a 21st Century Clean Energy Leadership Initiative, a public-private partnership funded at $5 billion over 10 years, matched by state and private sector investments, to create regionally-based research and development testbeds, while leveraging the existing federal energy research and development infrastructure. [328] • Create a Small Business Administration "Clean Energy

[322] AAU.
[323] Defense Science Board, *Report of the Defense Science Board Task Force on DOD Energy Strategy 'More Fight – Less Fuel,'* February 2008.
[324] AAU.
[325] ESC.
[326] NAM Energy.
[327] CoC Compete.
[328] CoC Compete.

Subcategory	Recommendation
	Entrepreneurs Initiative" to support the job engines of America's economy—small- and medium-sized businesses—in the development and deployment of clean energy technologies. [329] • Allocate at least 10 percent of the existing funding for technology pre-commercialization programs across all federal agencies to accelerate development and deployment of mature clean energy technologies across the R&D portfolio. [330] • Direct the Secretary of Energy to establish and operate a web-based "Clean Energy Resource Center" to serve as a one-stop clearinghouse for information on all federally-funded energy programs, pilots, test-beds, projects and RD&D and to track international energy initiatives and developments. [331] • Better connect basic energy research to applied research and development efforts to ensure that new basic research discoveries can be transferred quickly from academic and national laboratories to commercial markets to build new industries, create high-paying jobs, and address energy and environmental challenges.[332] • Fully fund and implement all existing energy technology laws, as well as all incentives and loan guarantees that encourage the development of new energy technologies.[333] • Make targeted investments in demonstration projects bridging development and commercialization, particularly those involving high-potential, yet high-risk technologies.[334] • Explore and support new R&D consortia and public/private partnership models (with appropriate cost-

[329] CoC Compete.
[330] CoC Compete.
[331] CoC Compete.
[332] ESC.
[333] U.S. Chamber of Commerce, *The Road to U.S. Economic Growth.*
[334] ACS/AICHE.
[335] ACS/AICHE.

Subcategory	Recommendation
	sharing, tax benefits, and intellectual property protections) to foster R&D on targeted and market-relevant energy technologies.[335]
Fiscal Policy	• Level the playing field on subsidies, while creating incentives to discover and deploy new energy sources, consistent with environmental safeguards and standards, so as to immediately develop and utilize all sustainable sources of energy. [336] • Provide a tax credit of 50% for investments in energy efficient equipment.[337] • Modify the R&D tax credit to foster long-term energy R&D and research collaborations with universities, national laboratories, and nonprofits, and place emphasis on tax incentives that encourage industry-government partnerships in the demonstration of new, efficient, and renewable energy sources.[338]
International	• Work with the private sector standard-setting bodies to accelerate the development, rapid adoption, and international recognition of the world's leading energy efficiency standards, together with a labeling, measurement, and verification system.[339] • Facilitate U.S. leadership in international research and technology collaborations to address domestic and global energy programs. [340] • Invest strongly in science and technology related to energy efficiency, zero-carbon energy resources and carbon-removing technologies in G-8 countries, and strengthen economic and technological exchange with developing countries, in order to leapfrog to cleaner and more efficient modern technologies.[341]
Human Resources	• Develop new educational resources to support the infrastructure and talent base required to create a clean

[336] CoC Compete.
[337] ITIF Stimulus.
[338] ACS/AICHE.
[339] Council on Competitiveness, *Prioritize: A 100-Day Energy Action Plan for the 44th President of the United States*, September 2008. Hereafter known as "CoC Prioritize."
[340] ACS/AICHE.
[341] *Joint Science Academies' Statement on Growth and Responsibility: Sustainability, Energy Efficiency and Climate Protection,* May 2007.

Subcategory	Recommendation
	energy future with dramatically less foreign dependence.[342] • Create a $300 million "Clean Energy Workforce Readiness Program," augmented by state and private sector funding, to foster partnerships between the energy industry, universities, community colleges, workforce boards, technical schools, labor unions and the U.S. military to attract, train and retain the full range of skilled workers for America's clean energy industries.[343] • Assess, classify and widely publicize the demand-driven needs for energy-related occupations and align federal workforce investment programs and state-directed resources to support skills training and career path development in energy fields for American citizens.[344] • Create a DOE energy training initiative as authorized by the America COMPETES Act.[345] • Require all federal agencies to commit 1 percent of their R&D budgets to competitive, portable undergraduate and graduate fellowships in energy-related disciplines for American students. [346] • Promote the integration of DOE National Laboratories into communities as a resource to enhance math and science skills including allowing science and engineering staff at national labs to teach in specialty schools and share resources, offering summer internships at national laboratories, and establishing programs to support a Center of Excellence in Math and Science at one public secondary school located in the region of the national

[342] ESC.
[343] CoC Prioritize.
[344] CoC Prioritize.
[345] AAU.
[346] CoC Prioritize.
[347] NAM Energy.
[348] NAM Energy.
[349] ACS/AICHE.
[350] Alliance to Save Energy, Edison Electric Institute, Energy Future Coalition, and Natural Resources Defense Council, *Energy Efficiency and Economic Recovery Initiative*, December 19, 2008.

Subcategory	Recommendation
	laboratory.[347] • Fund a new ED office to promote increased visibility of energy concepts with primary and secondary education curricula.[348] • Raise the public's knowledge of science through education to boost awareness of the science and technology underlying energy supply and demand and to increase student interest in energy-related science and technology. [349] • Provide $50 million, to be administered through DOE until expended, for the Industrial Assessment Centers, housed in university engineering departments, to provide free energy audits and recommendations to industrial facilities while training students to perform these skills.[350]

Table 4. Environment

Subcategory	Recommendation
Research	• Focus EPA research activities more strategically, rather than incrementally, so that research programs focus more on new and emerging environmental problems and less on yesterday's issues.[351] • Increase funding for sustainability and global change, ecosystems research, STAR extramural and fellowship programs, and economics and decision sciences research program at EPA.[352] • Develop a higher-level research planning effort that can consider and adjust the balance and focus among major program areas and increase coordination and collaboration across program areas at EPA.[353] • Make science and technology a higher priority within the EPA budget, and return the Office of Research and Development funding to $646 million in FY2009.[354] • Fund EPA's Science to Achieve Results (STAR), which supports high-quality, peer-reviewed research grants and related fellowships at $110 million (a 124% increase over FY2008).[355] • Fully support the Science and Technology for Sustainability program, which includes the STAR Technology for Sustainable Environment program, the P3 program, and other extramural funding programs that support the governmental interest to work closely with industry and others to maintain the long-term health of the planet.[356]

[351] EPA Science Advisory Board, "Comments on EPA's Strategic Research Directions and Research Budget for FY2008: An Advisory Report of the U.S. Environmental Protection Agency Science Advisory Board, March 13, 2007. Hereafter called "SAB Research."
[352] SAB Research.
[353] SAB Research.
[354] American Chemical Society, *Statement on Environmental Protection Agency: FY2009*. Hereafter called "ACS EPA."
[355] ACS EPA.
[356] ACS EPA.
[357] ACS EPA.
[358] COSSA.

Subcategory	Recommendation
	• Restore internal and extramural programs for research in environmental sustainability, including green chemistry and engineering, as well as global climate change.[357] • Maintain support for research activity relating to the human dimensions of global climate change, particularly at NOAA and EPA, and direct all mission agencies in the U.S. Climate Change Research Plan to allocate funds to the human dimensions of climate change.[358]
Workforce	• Invest in EPA's ability to recruit, develop, and retain an effective scientific workforce including providing more stability in EPA's priorities, practices, structure, and funding, and providing EPA's scientific workforce with the ability to stay active in the broader scientific community.[359]
Fiscal Policy	• Strengthen and make permanent the R&D tax credit enhancing the credit for green technology.[360]
Assessment	• Increase funding for exposure assessment in the context of manufacturing and disposal of nanomaterials and products incorporating relevant quantities of nanomaterials.[361] • Enhance EPA's Report on the Environment by developing long-term trend analysis, interpreting and statistically analyzing data, and increase the financial investment and permanently embed this analysis in EPA's core mission-directed activities.[362] • Apply quantitative efficiency metrics (e.g., inputs, outputs, intermediate outcomes) to measure the process efficiency, and expert review panels to evaluate the investment efficiency (e.g., relevance, quality, performance) of EPA and other agency research programs.[363]

[359] ACS EPA.
[360] National Association of Manufacturers, *A Responsible Approach to Climate Change: NAM Comprehensive Legislative Proposal*.
[361] President's Council of Advisors on Science and Technology, Letter Addendum to PCAST report *The National Nanotechnology Initiative: Second Assessment and Recommendations of the National Nanotechnology Advisory Panel*, July 22, 2008.
[362] EPA Science Advisory Board, *SAB Advisory on EPA's Draft "Report on the Environment 2007: Science Report,"* April 18, 2008.
[363] National Research Council, *Evaluating Research Efficiency in the U.S. Environmental Protection Agency*, 2008.

Table 5. Health

Subcategory	Recommendations
Research	• Develop a strategic, long-term plan that coordinates public and private sector efforts to advance R&D relevant to personalized medicine, and evaluates the proper balance of government funding for discovery versus translational research.[364] • End current restrictions on federal funding of human embryonic stem cell research.[365] • Support diverse avenues of stem cell research, including especially embryonic stem cell research, to better understand the potential value and limitations of each approach.[366] • Establish a new, strategic initiative fund to enable the secretary to support cross-agency and cross-departmental activities that exhibit innovation in responding to twenty-first century challenges, and to respond quickly to new, unforeseen, or expanding public health threats.[367] • Allocate sufficient, predictable funding for NIH, CDC, FDA, and the Agency for Healthcare Research and Quality (AHRQ) in order to preserve and enhance these agencies' scientific missions.[368] • Make NIH funding a priority by providing $31.2 billion for FY2009.[369]

[364] President's Council of Advisors on Science and Technology, *Priorities for Personalized Medicine*, September 2008. Hereafter called "PCAST Medicine." According to the report, " 'Personalized medicine' refers to the tailoring of medical treatment to the individual characteristics of each patient. It does not literally mean the creation of drugs or medical devices that are unique to a patient, but rather the ability to classify individuals into subpopulations that differ in their susceptibility to a particular disease or their response to a specific treatment. Preventive or therapeutic interventions can then be concentrated on those who will benefit, sparing expense and side effects for those who will not."

[365] AAU.

[366] American Association for the Advancement of Science, *Statement Regarding the President's Veto of the Stem Cell Research Enhancement Act and the New Executive Order*.

[367] Institute of Medicine, *HHS in the 21st Century: Charting a New Course for a Healthier America*, December 2008. Hereafter called "IOM."

[368] IOM.

[369] Federation of American Societies for Experimental Biology, *Federal Funding for Biomedical and Related Life Sciences Research: FY2009.* Hereafter called "FASEB FY2009."

Subcategory	Recommendations
	• Increase NIH's FY2009 funding by 6.7% to $30.8 billion, emphasize shorter proposals, diverse review panels, and longer outcome timeless such as the Bridging the Sciences program that funds research at the interface between the chemical, biological, and other sciences; the EUREKA grant program to fund exceptionally innovative research; and the New Innovator Award program that supports promising new investigators.[370] • Provide predictable, regular expansion of the nation's investment in medical research by increasing NIH's budget by 6.6%, an increase of $1.9 billion.[371] • Restore sustainable funding levels for research at NIH, emphasize investigator initiated research, and continue efforts to improve the operations of NIH programs.[372] • Provide federal funding for human embryonic stem cell research.[373] • Continue to support social/behavioral research related to health and behavior issues.[374] • Restore the CDC's National Center for Health Statistics' visibility and increase its resources so that the Health Interview Survey and the National Health and Nutrition Examination Survey can remain important sources of our nation's health information. [375] • Provide sufficient resources dedicated to enhancing the Agency for Healthcare Research and Quality's (AHRQ) efforts to support research designed to improve health care quality, reduce costs, advance patient safety, decrease medical errors, and broaden access to essential services.[376]
Human Resources	• Invest in the future generation of biomedical and health

[370] American Chemical Society, *Statement on National Institutes of Health: FY2009.*
[371] Association of American Medical Colleges, *Policy Priorities to Improve the Nation's Health from America's Medical Schools and Teaching Hospitals*. Hereafter called "AAMC."
[372] Federation of American Societies for Experimental Biology, *FASEB Recommendations for the NIH Transition Team.* Hereafter called "FASEB Transition."
[373] AAMC.
[374] COSSA.
[375] COSSA.
[376] COSSA.

Subcategory	Recommendations
	services researchers, enabling the continued discovery of new, more effective methods of preventing, treating, and curing disease, promoting health, improving health care delivery and organization, and controlling health system costs.[377] • Continue to foster the development of the research workforce.[378] • Provide sufficient funding to NIH and other HHS agencies to strengthen the research workforce by increasing training budget and stipend levels, providing high-quality education and training that includes supportive mentoring, effective career guidance, adequate financial support, and cultivation of relevant skills being made available to all graduate students and postdoctoral scholars. [379] • Reward transdisciplinary research needed to understand the determinants of health by addressing at NIH hiring, promotion, and tenure policies that acknowledge the contributions of collaborators on transdisciplinary teams; peer review that includes reviewers who have experience with inter- or transdisciplinary research and are educated about the complexity and challenges involved in such research; mechanisms for peer review of research grants that ensure the appropriate evaluation of transdisciplinary research projects; and credit for collaborators in teams, such as NIH acknowledgement of co-investigators and university sharing of incentive funds.[380]
Tools	• Make critical investments in the enabling tools and resources essential to moving beyond genomic discoveries to personalized medicine products and services of patient and public benefit.[381]
Assessment	• Enhance peer review at NIH by engaging the best reviewers by providing benefits and flexibility and enhancing reviewer training, improving the quality and

[377] IOM.
[378] FASEB Transition.
[379] AAMC.
[380] Institute of Medicine, *Genes, Behavior, and the Social Environment: Moving Beyond the Nature/Nurture Debate*, 2006. According to the IOM, transdisciplinary research "implies the conception of research questions that transcend the individual departments or specialized knowledge bases because they are intended to solve research questions that are, by definition, beyond the purview of the individual disciplines."
[381] PCAST Medicine.

Subcategory	Recommendations
	transparency of review, and ensuring balanced and fair review across scientific fields and career stages, and reducing administrative burden by funding the best science earlier, clustering applications in review, and early stage and new investigator policies.[382]
Health Information Technology	• Enact legislation to spur the deployment of health IT initiatives such as electronic medical records to address the rising cost of health care for U.S. businesses. [383] • Provide a tax credit for investments in health information technology made in 2009.[384] • Pass health IT legislation that enables patients and providers to access critical patient information using secure, industry-wide, interoperability standards.[385] • Incentivize clinical performance gains rather than acquisition of IT per se.[386] • Encourage development of standards and measures of health care IT; interdisciplinary research in organizational systems-level research, computable knowledge structures and models, and human-computer interaction in a clinical context; and initiatives to empower iterative process improvement and small-scale optimization.[387] • Encourage (or at least do not impede) efforts by health care institutions and communities to aggregate data about health care people, processes, and outcomes from all sources subject to appropriate protection of privacy and confidentiality. [388] • Support additional education and training efforts at the intersection of health care, computer science, and health/biomedical informatics. [389]

[382] National Institutes of Health, *Enhancing Peer Review at NIH*.
[383] AeA.
[384] ITIF Stimulus.
[385] ITIC.
[386] National Research Council, *Computational Technology for Effective Health Care: Immediate Steps and Strategic Directions*, 2009. Hereafter called "NRC Health."
[387] NRC Health.
[388] NRC Health.
[389] NRC Health.

Table 6. Space

Subcategory	Recommendations
Research	• Direct the National Research Council (NRC) to conduct a "decadal" survey to prioritize life and physical sciences research with a goal of influencing the FY2010 budget request.[390] • Seek and embrace input from industry and academia in formulating the National Aeronautics Research and Development Policy (Executive Order 13419) implementation plan; identify executable tasks, milestones, agency responsibilities and budget requirements; and fund plan at level necessary to achieve goals and objectives. [391] • Optimize the projected science return from NASA's astrophysics program by ensuring a diversified portfolio of large and small missions that reflect the science priorities in the 2001 NRC decadal survey Astronomy and Astrophysics in the New Millennium, and investing in the work required to bring science missions to their full potential (e.g., technology development, data analysis, data archiving, and theory.)[392] • Reestablish a space life and physical sciences program at NASA, and direct NSF and NIH to contribute research funding for at least the next 5 years to International Space Station National Laboratory (ISSNL).[393] • Maintain US human spaceflight leadership including appropriating funds at level authorized by Congress, initiating long-term development efforts, and providing domestically-controlled access to earth orbit so US will have means for continued US crew member access to ISSNL. [394] • Examine seriously the mismatch between the tasks assigned to NASA and the resources that the agency has

[390] AIAA.
[391] AIAA.
[392] National Research Council, *A Performance Assessment of NASA's Astrophysics Program*, 2007.
[393] AIAA.
[394] AIAA.

Subcategory	Recommendations
	been provided to accomplish them and should identify actions that will make the agency's portfolio of responsibilities sustainable.[395] • Move immediately to correct the problems caused by reductions in the base of research and analysis programs, small missions, and initial technology work on future missions before the essential pipeline of human capital and technology is irrevocably disrupted.[396] • Undertake independent, systematic, and comprehensive evaluations of the cost-to-complete of each of NASA's space and Earth science missions that are under development, for the purpose of determining the adequacy of budget and schedule.[397] • Engage with NASA's reconstituted advisory committees to determine how to create in the space and Earth science program a proper balance among large, medium, and small missions, and research and analysis programs, and for evaluating the advice in and the consequences of the results from the comprehensive reviews of the major missions.[398]
Technology	• Pursue government research and technology programs to investigate and demonstrate less mature, but potentially more revolutionary system technologies, such as evolved and advanced propulsion systems. [399] • Sponsor a long-term plan for improving the reliability and responsiveness of space transportation systems while also reducing their costs. [400] • Ensure American competitiveness in the aeronautics market by supporting investments in aeronautical R&D and commercialization of aeronautical technology.[401]

[395] National Research Council, *An Assessment of Balance in NASA's Science Programs*, 2006. Hereafter called "NRC NASA Science."
[396] NRC NASA Science.
[397] NRC NASA Science.
[398] NRC NASA Science.
[399] AIAA.
[400] AIAA.
[401] NGA Research.

Subcategory	Recommendations
	• Review the process used in NASA's Exploration Systems Mission Directorate (EMSD) to manage technology development to ensure the timely delivery of technologies for seamless integration into its flight programs.[402] • Preserve the essential ground-based and flight research that will be required to enable long-duration human spaceflight and to continue to foster a viable community that ultimately will be responsible for producing the essential knowledge required to execute the human spaceflight goals of the Vision for Space Exploration.[403] • Translate NASA's national aeronautics policy into a strategic or mission focus that is in better alignment with the resources available to it — its budget, personnel, and technical capabilities — taking into account stakeholder needs, aligning core competencies of the NASA research centers and those of the external performers that the agency supports, and balancing between near-term needs and longer term investments required to achieve transformational national capabilities.[404] • Place a high priority at NASA on establishing a stable aeronautics research and technology (R&T) plan, with the expectation that the plan will receive sustained funding for a decade or more, as necessary, for activities that are demonstrating satisfactory progress; and use five common themes to make the most efficient use of civil aeronautics R&T resources: physics-based analysis tools, multidisciplinary design tools, advanced configurations, intelligent and adaptive systems, and complex interactive systems.[405] • Ensure that NASA's civil aeronautics R&T plan features the substantive involvement of universities and industry,

[402] National Research Council, *A Constrained Space Exploration Technology Program: A Review of NASA's Exploration Technology Development Program.*
[403] NRC NASA Science.
[404] National Research Council, *Aeronautics Innovation: NASA's Challenges and Opportunities,* 2006.
[405] National Research Council, *Decadal Survey of Civil Aeronautics: Foundation for the Future,* 2006. Hereafter called "NRC Civil."
[406] NRC Civil.
[407] NRC Civil.
[408] NRC Civil.

Subcategory	Recommendations
	including a more balanced allocation of funding between in-house and external organizations than currently exists.[406] • Consult with non-NASA researchers to identify the most effective facilities and tools applicable to key aeronautics R&T projects and facilitate collaborative research to ensure that each project has access to the most appropriate research capabilities, including test facilities; computational models and facilities; and intellectual capital, available from NASA, the Federal Aviation Administration, the Department of Defense, and other interested research organizations in government, industry, and academia.[407] • Conduct a high-level review of organizational options for ensuring U.S. leadership in civil aeronautics.[408]
Human Resources	• Continue to provide strong support for Earth system science and climate education programs and resources that impact science curriculum across disciplines, make NASA Earth science education programs that emphasize pre- and in-service teacher education and professional development a high priority, and provide the broad formal and informal educational communities access to Earth observations data and tools as well as the necessary training and education resources for understanding and using this data.[409] • Provide 50 educational grants of $1 million to $2 million annually to universities in each of the 50 states to enable institutions to build research satellites as student projects and to train a new generation of space engineers and scientists, and launch these satellites at government expense.[410] • Continue to engage in K-12 education activities at NASA capitalizing on NASA's primary strengths and resources in the mission directorates including the agency's scientific discoveries, technology and aeronautical developments, space exploration activities; scientists,

[409] Institute for Global Environmental Strategies, *Statement on NASA Earth Science Education to Presidential Transition Team*, by Theresa Schwerin, January 6, 2009.
[410] National Space Society. Hereafter called "NSS."

Subcategory	Recommendations
	engineers, and other technical staff (both internal and external), and the unique excitement generated by space flight and space exploration.[411] • Pay particular importance to incorporating engineering and technology development projects in NASA's education programs as these subjects are not well covered in K-12 curricula.[412] • Provide opportunities for teachers and students to deepen their knowledge about NASA-supported areas of science and the nature of science and engineering through educational activities that engage them with the science and engineering carried out by the mission directorates. [413]

[411] National Research Council, *NASA's Elementary and Secondary Education Program: Review and Critique*, 2008. Hereafter called "NRC NASA Education."
[412] NRC NASA Education.
[413] NRC NASA Education.

Table 7. Security

Subcategory	Recommendation
Research	• Focus on "staying ahead" in facilitating the rapid and affordable acquisition of needed weapons, systems, and services by adequately funding "Engines of Innovation" by focusing a significant share of the military services on "disruptive" architectures and technologies; emphasizing competitive prototypes and technology demonstrations; establishing "prospectors" for commercial and foreign technologies; encouraging dual-use technology; adequately funding fundamental research; and establishing increased budgets and higher Small Business Innovation Research (SBIR) limits on firm size and award amounts.[414] • Require R&D funding for next-generation prototypes to achieve lower cost and higher performance, and create profit incentives to encourage development of cost savings and improved productivity.[415] • Develop a memorandum of understanding between DOD and DHS that institutionalizes coordination and integration of planning, R&D, acquisition, operations, and training activities.[416] • Continue to provide strong support for the Minerva Initiative, which draws upon social science research and researchers to better understand to new global security threats, and to work with the NSF to implement and operate the program.[417] • Ensure that DOD has significant design and funding rules, along with the DOE, in any major government crosscutting energy research initiative as finding alternative sources of energy is key to U.S. national security. [418]

[414] Defense Science Board, Task Force on Defense Industrial Structure for Transformation, *Creating an Effective National Security Industrial Base for the 21st Century: An Action Plan to Address the Coming Crisis*, July 2008. Hereafter called "DSB Industry."
[415] DSB Industry.
[416] Defense Science Board, *Report of the Defense Science Board Task Force on Critical Homeland Infrastructure Protection*, January 2007. Hereafter called "DSB Infrastructure."
[417] AAU.
[418] AAU.

Subcategory	Recommendation
	• Provide $2.08 billion for FY2009 (a $300 million/16.8% increase over FY2008) to the peer-reviewed basic research in DOD's 6.1 account.[419] • Reserve 3% of the DOD budget for S&T as called for by the Defense Science Board, and provide $1 billion over five years for the basic research 6.1 account as recommended in the National Academies *Rising Above the Gathering Storm* report.[420] • Remove the arbitrary 35% cap on reimbursement of indirect costs to institutions of higher education imposed in FY2008 as this cap creates a disincentive for universities to conduct defense basic research, and instead continue the previous policy where these rates are negotiated between the federal government and each individual institution to reflect the actual cost of maintaining research infrastructure and capability, which varies significantly by region and school.[421] • Increase funds for the Defense Research and University Research Initiative programs, which sponsor competitively awarded research, and in core, peer-reviewed DOD research in chemistry, materials, and engineering.[422] • Continue expansion of DOD's efforts in the social, behavioral, and economic sciences, including enhancing efforts to understand the human and cultural aspects of military and defense operations, and providing more language and cultural training for U.S. troops. [423]
Homeland Security Research	• Develop standards and technologies for unmanned aerial vehicles (UAVs) to operate in the National Airspace, and certify collision avoidance technologies and policies that will expedite UAV operations in the National Airspace to meet national emergency and homeland security needs. [424]

[419] American Chemical Society, *Statement on Department of Defense Science & Technology: FY2009*. Hereafter called "ACS DOD."
[420] ACS DOD.
[421] ACS DOD.
[422] ACS DOD.
[423] COSSA.
[424] AIAA.

Subcategory	Recommendation
	• Build capabilities in research, training, and education to equip the United States for leadership and security in cyberspace to build long-term capabilities to respond to international conflict and competition.[425] • Provide the DHS Science & Technology Directorate with funding of $869 million in FY2009 (4.7% increase over FY2008).[426] • Increase DHS' investments in multi-year research projects essential for research stability.[427] • Encourage DHS to be more customer-focused in its research and technology development activities.[428] • Maintain support for the DHS' Centers for Excellence.[429] • Implement the recommendations in the 2006 National Research Council report *Facing Hazards and Disasters*.[430] • Give particular attention at DHS to understanding and preparing for the societal response that will occur following a major chemical incident when investing in and utilizing behavioral and social science research, explore ways to enable rapid analysis and communication of data for decision making and communication to the public during and after an emergency, and support research directed toward enhancing emergency preparedness, emergency response, and disaster recovery.[431]

[425] Center for Strategic and International Studies, Commission on Cybersecurity for the 44th Presidency, *Securing Cyberspace for the 44th Presidency*, December 2008.
[426] American Chemical Society, *American Chemical Society Statement on Homeland Security Science & Technology: FY2009*. Hereafter called "ACS DHS."
[427] ACS DHS.
[428] ACS DHS.
[429] COSSA.
[430] COSSA.
[431] National Research Council, *Terrorism and the Chemical Infrastructure: Protecting People and Reducing Vulnerabilities*, 2006. Hereafter called "NRC Terrorism."
[432] NRC Terrorism.
[433] NRC Terrorism.
[434] NRC Terrorism.

Subcategory	Recommendation
	• Support R&D at DHS to foster cost-effective, inherently safer chemistries and chemical processes, and to determine the combinations of incentives and disincentives that would best encourage the private sector to invest in safety and security.[432] • Seek ways to improve the safety and security of chemical storage in both fixed facilities and transportation as a central element of a longer-term DHS research program, and invest in S&T to enhance real-time monitoring of breaches in containment, the chemical infrastructure and any disruptions to it, and any resulting consequences of an event.[433] • Complete an overall risk assessment at DHS that would consist of analyzing the combination of vulnerability, threat or likelihood, and consequences of an event when considering investments to prevent or mitigate vulnerabilities. [434]
Collaboration and Coordination of Research	• Develop a joint DOD and DHS R&D program to fund "Grand Challenges," whose solutions will require top teams from academia, laboratories, government, and industry, and the adaptation of useful technologies from other military areas to Homeland Security.[435] • Continue DHS collaborative activities with other federal agencies having legacy homeland security interests including DOE, EPA, and DOD.[436] • Establish a comprehensive chemical security program rooted in identifying, developing, and leveraging the use of safer and more secure technologies including investing in collaborative research to identify safer, more secure alternatives.[437] • Increase funding for the social sciences, particularly for area studies and languages, at NSF, DOD, and DHS. [438]

[435] DSB Infrastructure.
[436] ACS DHS.
[437] Center for American Progress, *Chemical Security 101: What you Don't Have Can't Leak, or Be Blown Up by Terrorists*, by Paul Orum and Reece Rushing, November 2008.
[438] ACS DHS.

Subcategory	Recommendation
	• Work collaboratively at NSF, DOD, DHS, HHS, and intelligence agencies should work together to fund additional research in the fields of security risk assessment and cost-benefit analyses of security strategies affecting university research and the global movement of students and scholars, rather than emphasizing risk minimization which does not balance the costs and lost benefits against the magnitude and likelihood of the risk.[439] • Establish a mechanism for follow-up on the cybersecurity research agency that builds on the efforts of the National Coordination Office for Networking and Information Technology Research and Development to develop a reasonably complete picture of cybersecurity research efforts that the government supports, paying substantial attention to infrastructural issues (such as the collection of open testbeds, tools, datasets, and other activities that enable research progress), and providing sufficient and stable research support to expand the pool of cybersecurity researchers.[440]
Contracts and Grants	• Ensure that federal research funding agencies that award grants and contracts for fundamental research to institutions of higher learning abide by the principles of National Security Defense Directive 189 (NSDD-189), which states it is the policy of the U.S. government to not restrict, to the maximum extent possible, the products of unclassified fundamental research, and incorporate these principles into each agency's contracting and granting procedures in a more uniform manner and into all research contracts to universities for basic and applied research in science and engineering as stated in the Federal Acquisition Regulations (FAR) 27.404(g)(2).[441] • Make clear to industrial awardees that the restrictive publication and foreign national clauses placed in government awards that would not apply to universities should not be passed down to university subawardees conducting fundamental research in federal contracts with the industry awardees.[442]

[439] ACS DHS.
[440] National Research Council, *Toward a Safer and More Secure Cyberspace*, 2007.
[441] NRC Security.
[442] NRC Security.

Subcategory	Recommendation
Human Resources	• Streamline the security clearance process while still meeting the needs and requirements for the national security workforce, including implementing universal reciprocity and portability among agencies.[443] • Move aggressively to strengthen the quality, stature, and training of future high-quality, high skill, government acquisition workforce, including those skilled in system engineering, program management, and advanced information technology, by actions such as rewarding creative, innovative DOD workforce behavior, introducing "Presidential Management Fellow"-type programs to attract top candidates from graduate programs, and encouraging industry-to-government, and government-to-industry rotations.[444] • Expand the DOD National Defense Education Program (NDEP) that provides scholarships and fellowships to students in critical fields of science, mathematics, and engineering in return for a commitment of federal public service.[445] • Repeal the National Security Personnel System (NSPS) at DOD for GS workers.[446] • Strengthen and harmonize the institutional review of life sciences research by developing an education program on the basic principles of risk-based biosafety and biosecurity review at HHS and other agencies that conduct and fund life sciences research. [447]
Export Controls	• Improve existing export control regime, and identify what export control regime reforms are necessary and appropriate in post-9/11 environment to reduce processing

[443] AIA.
[444] DSB Industry.
[445] AAU.
[446] IFPTE.
[447] ACS DHS.
[448] AIAA.
[449] Gathering Storm.
[450] CGS.
[451] ITIC.

Subcategory	Recommendation
	delays and to increase collaborations with international partners overseas.[448] • Reform "deemed exports" policy to provide international students and researchers engaged in fundamental research in the US with access to information and research equipment.[449] ($0) • Maintain "deemed export" policies that do not inappropriately constrain international students' ability to pursue graduate research. [450] • Ensure U.S. export policy enhances U.S. security and economic interests by supporting policies that facilitate U.S. cooperation with international partners and allies, and focus finite regulatory and corporate resources on protecting truly sensitive exports.[451] • Conduct regular government-wide reviews of export control policy at DOC and DOS with special emphasis on streamlining, removal of outdated items, and updating the Commerce Control List and the U.S. Munitions List to reflect the current status in technology and science and to identify truly unique and military critical technologies unavailable elsewhere.[452] • Restructure the export control process within the federal government so that the balancing of interests can be achieved more efficiently and harm can be prevented to the nation's security and technology base, and to promote U.S. economic competitiveness by taking actions such as articulating a rational basis for each restriction, apply "sunset" requirements to all items on export control lists, and establishing a new administrative entity as a coordinating center for export controls and an independent export license appeals panel.[453] • Direct that executive authorities under the Arms Export Control Act and the Export Administrative Act be

[452] NRC Security.
[453] NRC Fortress.
[454] NRC Fortress.

Subcategory	Recommendation
	administered to assure the scientific and technological competitiveness of the United States by maintaining the fundamental research exemption as provided in NSDD-189, and creating an economic competitiveness exemption that eliminates export controls on dual-use technologies where they, or their functional equivalents, are available without restrictions in open markets outside the United States.[454]
Organization	• Evaluate and assess the current DARPA structure and operations to assure that it is responding to its original mission of supporting high-risk, high-payoff research. [455] • Extend DHS' Homeland Security Science and Technology Advisory Committee that expired on January 31, 2008.[456] • Take full advantage of the National Science Advisory Board for Biosecurity's international work, as well as that being undertaken by other HHS agencies, to develop policies and procedures for the oversight of dual-use life sciences research that foster international collaboration and control strategies, with the goal of harmonizing the mechanisms of local oversight. [457] • Establish a deliberative, standing entity called the Science and Security Commission, co-chaired by the National Security Advisor and the OSTP Director, to address ongoing shared concerns of the security and academic communities such as the implementation of NSDD-189, interpretation of deemed export policies, and visa policies and practices.[458]
Miscellaneous	• Create and provide support for better government analysis of US and foreign innovation systems.[459] • Support programs that assist defense firms to adapt their innovations to civilian markets. [460]

[455] AAU.
[456] ACS DHS.
[457] NRC Security.
[458] NRC Security.
[459] ASTRA Rising Tide.
[460] ITIF Stimulus.

Table 8. Indicators

Subcategory	Recommendation
Research	• Improve measurement of intangibles, such as intellectual property, and explore potential use of patent and trademark applicant data.[461] • Improve service sector data and increase survey coverage to provide data needed to improve estimates from the integrated GPD/productivity accounts and supplemental innovation data.[462] • Support funding necessary to implement the above recommendations.[463] • Develop and apply improved tools and metrics to measure the outputs of research partnerships and innovation to guide policies and incentive structures. [464] • Develop innovation indicators and metrics for knowledge-based economy; use indicators to drive policy and strategy. [465] • Increase the statistical system's capacity to measure activities of nascent and young businesses, especially those positioned in fast-growing and innovative sectors of the economy, that are central to understanding business dynamics; better coordinate the coverage and depth of business data; and shift the legal and organizational environments to accommodate data sharing and confidentiality protections to enhance cost efficiency.[466]
Economic Returns	• Develop annual, industry-level measures of total factor productivity by restructuring the National Income and Product Accounts (NIPAs) to allow for consistent

[461] Advisory Committee on Measuring Innovation in the 21st Century Economy, *Innovation Measurement: Tracking the State of Innovation in the American Economy*, January 2008, Department of Commerce. Hereafter known as ACMI.
[462] ACMI.
[463] ACMI.
[464] PCAST Partnerships.
[465] ASTRA Rising Tide.
[466] National Research Council, *Understanding Business Dynamics: An Integrated Data System for American's Future*, 2007.
[467] ACMI.
[468] ACMI.

Subcategory	Recommendation
	estimation of the contributions of innovation to economic growth. [467] • Create a supplemental innovation account for the NIPA's to expand the categories of innovation input. [468] • Consider development of a national innovation index when more work has been done on data collection and analysis of innovation drivers. [469] • Better leverage existing data among the government statistical agencies to allow for the consistent estimation of the contributions of innovation in the GDP and productivity accounts and to develop greater understanding of innovation. [470] • Develop more robust classification methods; for example, classify firms on the basis of both domestic and international activities. [471] • Collect data to track the implications of the globalization of manufacturing and services in high technology industries for the U.S. economy.[472] • Seek means to assess more accurately nanotechnology-related innovation and commercialization of National Nanotechnology Initiative research results, and coordinate these efforts with those of the Organization for Economic Cooperation and Development (OECD) to assess the economic impact of nanotechnology internationally.[473]
Education	• Develop student performance metrics that are aligned with national STEM content guidelines, ensure assessments under No Child Left Behind promote STEM learning, and provide a forum to share and disseminate information on best practices in STEM teaching and learning.[474] • Establish data systems and performance measures that

[469] ACMI.
[470] ACMI.
[471] ACMI.
[472] NSB Competitiveness.
[473] PCAST Nanotechnology.
[474] NSB Education.

Subcategory	Recommendation
	provide transparency for comparing academic attainment across educational systems. [475] • Protect investments in education and job training programs by holding them accountable for student performance. [476]
Workforce	• Make federal agencies accountable for aerospace workforce development by evaluating the effectiveness of these activities in OMB's Program Assessment Rating Tool (PART).[477] • Establish feedback mechanisms within pertinent agencies of the federal government to assess the performance of workforce development initiatives, research the effectiveness of existing mechanisms, and to inform future initiatives.[478] • Measure and monitor the economic health of the STEM enterprise by indicators such as employment, unemployment, underemployment, and volume of off-shored STEM jobs and tasks.[479]
Societal Outcomes	• Provide information on 20 indicators that provide a broad picture of America's health and the nation's health systems in the areas of health outcomes, health-related behaviors, and health systems.[480] • Develop a national system of cross-cutting environmental indicators that are results-oriented, support priority-setting, track trends over time, highlight geographical differences, point the way to effective action, and measure the effectiveness of preventive, protective, and remedial actions.[481]

[475] NAM Workforce.
[476] NAM Workforce.
[477] AIAA.
[478] AIAA.
[479] IEEE.
[480] Institute of Medicine, *State of the USA Health Indicators*, 2008. The health outcome measures are life expectancy at birth, infant mortality, life expectancy at age 65, injury-related mortality, self-reported health status, unhealthy days: physical and mental, chronic disease prevalence, and serious psychological distress. Health-related behavior measures are smoking, physical activity, excessive drinking, nutrition, obesity, and condom use. Health systems measures are health care expenditures; insurance coverage; unmet medical, dental, and prescription drug needs; preventative services; preventable hospitalization; and childhood immunization.
[481] National Academy of Public Administration, *A Green Compass: Institutional Options for Developing a National System of Environmental Indicators*, 2007.

Subcategory	Recommendation
International	• Continue participation in the international dialogue related to measuring and analyzing innovation and ensure that U.S. efforts are internationally compatible to the extent possible.[482]
Miscellaneous	• Increase access to data to facilitate more robust innovation research.[483] • Convene one or more workshops under auspices of Chamber of Commerce to discuss innovation drivers, impediments, and enablers.[484]

[482] ACMI.
[483] ACMI.
[484] ACMI.

Appendix A. Organizations Surveyed

Organization Type	Organization
Federal advisory committees	• National Science Board (NSB) • President's Council of Advisors on Science and Technology (PCAST) • National Institutes of Health (NIH) Advisory Committee to the Director (ACD) • Environmental Protection Agency (EPA) Science Advisory Board (SAB) • Department of Defense (DOD) Defense Science Advisory Board (DSB)
Congressionally-chartered honorific organizations	• National Academies --National Academy of Sciences (NAS), National Academy of Engineering (NAE), Institute of Medicine (IOM), National Research Council (NRC) • National Academy of Public Administration (NAPA)
Policy institutes	• Center for Strategic and International Studies (CSIS) • Council on Competitiveness (CoC) • Resources for the Future (RFF) • World Resources Institute (WRI) • Woodrow Wilson International Center for Scholars • Urban Institute • American Enterprise Institute • Center for American Progress • Heritage Foundation • Brookings Institution • Council on Foreign Relations • Cato Institute

Professional organizations and disciplinary societies	• National Science Teacher's Association (NSTA) • National Society of Teacher's of Mathematics (NSTM) • National Society of Professional Engineers (NSPE) • American Society of Civil Engineers (ASCE) • American Society of Mechanical Engineers (ASME) • Institute of Electrical and Electronics Engineers (IEEE) • American Institute of Aeronautics and Astronautics (AIAA) • American Association for the Advancement of Science (AAAS) • American Physical Society (APS) • American Chemical Society (ACS) • Federation of Societies in Experimental Biology (FASEB) • American Mathematical Society (AMS) • Consortium of Social Science Organizations (COSSA) • American Geophysical Union (AGU) • Association of Women in Science (AWIS) • Society of Women Engineers (SWE) • National Action Council for Minorities in Engineering (NACME) • Center for the Advancement of Hispanics in Science and Engineering (CAHSE)
University and college associations	• Association of American Universities (AAU) • National Association of State Universities and Land Grant Colleges (NASULGC) • Association of American Colleges and Universities (AAC&U) • Council of Graduate Schools (CGS) • Association of American Medical Colleges (AAMC)
Advocacy, special interest, or action groups	• Union of Concerned Scientists (UCS) • Federation of American Scientists (FAS) • Center for Science in the Public Interest (CSPI) • Research! America • National Resources Defense Council (NRDC) • Environmental Defense Fund (EDF) • Task Force on the Future of American Innovation

Industry and trade associations	• U.S. Chamber of Commerce • National Association of Manufacturers (NAM) • Biotechnology Industry Organization (BIO) • Electronic Industries Alliance (EIA) • American Petroleum Institute (API) • American Chemistry Council (ACC) • Pharmaceutical Manufacturers of America (PHRMA) • American Electronics Association (AEA) • Aerospace Industries Association (AIA) • Business Roundtable (BRT)
Labor	• American Federation of Labor and Congress of Industrial Organizations (AFL-CIO) • Washington Alliance of Technology Workers • Communication Workers of America (CWA) • National Postdoctoral Association (NPA) • Association of University Professors (AAUP • United Auto Workers (UAW) • International Union, United Automobile, Aerospace, and Agricultural Implement Workers of America

Appendix B. Abbreviations

Abbreviation	Meaning
AAAS	American Association for the Advancement of Science
AAMC	Association of American Medical Colleges
AAU	Association of American Universities
AAUW	American Association of University Women
ACMI	Advisory Committee on Measuring Innovation in the 21st Century Economy
ACS	American Chemical Society
AeA	American Electronics Association
AHRQ	Agency for Healthcare Research and Quality
AIA	Aerospace Industry Association
AIAA	American Institute of Aeronautics and Astronautics
AIChE	American Institute of Chemical Engineers
AMACAD	American Academy of Arts & Sciences
AP	Advanced Placement
ARPA-E	Advanced Research Projects Agency – Energy
ASTRA	Alliance for Science & Technology Research in America
Benton	Benton Foundation
BHEF	Business Higher Education Forum
Bio	Biotechnology Industry Organization
BRT	Business Roundtable
CC	Chamber of Commerce
CDC	Centers for Disease Control
CEBUS	Clean Energy Bank of the United States
CGS	Council of Graduate Schools
CoC	Council on Competitiveness
DARPA	Defense Advanced Research Projects Agency
DHS	Department of Homeland Security
DOC	Department of Commerce
DOD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
DSB	Defense Science Board
ED	Department of Education
EPA	Environmental Protection Agency
EPAct 2005	Energy Policy Act of 2005
ESC	Energy Sciences Coalition
FASEB	Federation of American Societies for Experimental Biology
FDA	Food and Drug Administration
GAANN	Graduate Assistance in Areas of National Need
Gathering Storm	National Academies Rising Above the Gathering Storm report
GPS	Global Positioning System

Abbreviation	Meaning
HHS	Department of Health and Human Services
IA	Innovation Alliance
IB	International Baccalaureate
IEEE	Institute of Electrical and Electronics Engineer
IFPTE	International Federation of Professional & Technical Engineers
IGERT	Integrative Graduate Education and Research Traineeship
IOM	Institute of Medicine
IP	Intellectual Property
IPEC	Intellectual Property Enforcement Coordinator
IRD&D	Industry Research, Development and Demonstration
ISSNL	International Space Station National Laboratory
ITER	International Thermonuclear Experimental Reactor
ITIC	Information Technology Industry Council
ITIF	Information Technology & Innovation Institute
K-12	Kindergarten through 12^{th} grade
K-8	Kindergarten through 8^{th} grade
NAE	National Academy of Engineering
NAM	National Association of Manufacturers
NAPA	National Academy of Public Administration
NAS	National Academy of Sciences
NASA	National Aeronautics and Space Administration
NCAA	National Collegiate Athletic Association
NCTM	National Council of Teachers of Mathematics
NCWGE	National Coalition for Women & Girls in Education
NDGPS	Nationwide Differential Global Positioning System
NGA	National Governors Association
NIF	National Innovation Foundation
NIH	National Institutes of Health
NIPA	National Income and Product Accounts
NIST	National Institute of Standards and Technology
NIT	Networking and Information Technology
NNI	National Nanotechnology Initiative
NOAA	National Oceanic and Atmospheric Administration
NOL	Net Operating Losses
NPA	National Postdoctoral Association
NPA	National Postdoctoral Association
NRC	National Research Council
NSABB	National Science Advisory Board for Biosecurity
NSB	National Science Board
NSDD	National Security Defense Directive
NSF	National Science Foundation
NSS	National Space Society
NSTC	National Science and Technology Council
OMB	President's Office of Management and Budget

Abbreviation	Meaning
OSTP	President's Office of Science and Technology Policy
P-16	Pre-school through undergraduate education
P-20	Pre-school through graduate education
PCAST	President's Council of Advisors on Science and Technology
PTO	Patent and Trademark Office
R&D	Research and Development
S&T	Science and Technology
SAB	Environmental Protection Agency Science Advisory Board
STAR	EPA's Science to Achieve Results program
STEM	Science, Technology, Engineering, and Mathematics
SWE	Society of Women Engineers
T&E	Technology and Engineering
Title IX	Title IX of the Educational Amendments of 1972
UAV	Unmanned Aerial Vehicle
UCS	Union of Concerned Scientists
USDA	Department of Agriculture
Wash Tech	Washington Alliance of Technology Workers

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