

## Appendix 2: PCAST Publications 1990-2017

Title	Year	Topic	Type
<b>President George H.W. Bush</b>			
Achieving the Promise of the Bioscience Revolution: The Role of the Federal Government	1992	Research/Innovation; Health/Medicine	Report
<p>The report discusses the role of the federal government in achieving two overlapping goals: promoting the health of the American people and all mankind through research in the biosciences, and fostering a vigorous domestic biotechnology industry. The report is concerned with several facets of federal bioscience policy—research, education, technology transfer, regulation, and protection of intellectual property—with particular emphasis on research. PCAST recommends that the principal role of federally supported bioscience research should be to expand the knowledge base in areas of science and technology likely to have a broad impact on health and on bioscience-related industries.</p>			
High Performance Computing and Communications Panel Report	1992	Research/Innovation; Information Technology	Report; Review or Assessment
<p>This report offers advice on the strengths and weaknesses of the High Performance Computing and Communications Initiative (HPCCI). PCAST makes recommendations relating to four central issues: program strategy; balance among technology, applications, and infrastructure; program management; and program vision. Specifically, PCAST calls for increased participation from additional federal science agencies—NOAA, EPA, NIST, and the Department of Education—noting how increased computing capacity could help fulfill their missions. Additionally, PCAST suggests that the program's objectives should be expanded to include other facets of computing technology beyond computing speed, such as storage and user interfacing.</p>			
Learning to Meet the Science and Technology Challenge	1992	Education	Report
<p>This report provides analysis of President G.H.W. Bush's National Education Goals as they relate to how STEM education prepares students for a changing global economy, especially at the elementary and secondary levels. PCAST recommends developing national educational standards and a corresponding system for performance assessment; nurturing young, talented STEM students, especially women and minorities; and facilitating community partnerships to promote the importance of education for the benefit of the nation. PCAST argues for the continuation and growth of educational programs at NSF and the Department of Education and suggests summer laboratory programs at the Department of Energy and NASA for secondary school students and teachers, as well as fellowship and loan forgiveness programs for graduate students.</p>			

Science Advice to the President and the Role of PCAST

Megaprojects in the Sciences	1992	Research/Innovation	Report
<p>This report addresses the growing investment in scientific “megaprojects” and the conflict between “big” and “small” science in establishing national funding priorities. PCAST proposes three major recommendations: to increase engagement between the government and scientific community to initialize and develop proposals for future megaprojects; for OSTP and OMB to jointly create a specific scientific investment budget that would outline long-term expenses for megaprojects; and to establish an international framework for collaborative megascience efforts.</p>			
Renewing the Promise: Research-Intensive Universities and the Nation	1992	Research/Innovation; Education	Report
<p>This report focuses on government-university partnerships in light of the continued growth of research-intensive universities competing for federal funding. PCAST recommends universities to be strategic in selecting areas of focus, even if this requires the termination of less-than-world-class programs and facilities; to leave more applied research and development to industry; to not begin studies or programs without securing full funding; to more strongly emphasize teaching; and to cooperate and collaborate more regularly with industry.</p>			
Science, Technology, and National Security	1992	Defense/Security	Report
<p>The report addresses the importance of adapting science and technology policy to meet a changing national security environment. PCAST argues that the principal role of science and technology for national security is to bolster U.S. industrial competitiveness. In order to maintain technological dominance internationally, PCAST identified six actions: 1) utilize advances in STEM for gathering and interpreting information; 2) prevent the proliferation of weapons of mass destruction; 3) restructure the federal government’s methods for applying new technologies for defense and intelligence systems to better withstand budget cuts; 4) fill national security posts with technically qualified candidates; 5) explore new defense technologies; and 6) preserve the U.S.’s strong reputation for superior defense systems.</p>			
Technology and the American Standard of Living	1992	Research/Innovation	Letter
<p>This letter calls for a presidential commitment to American industrial effectiveness—to use technology and scientific knowledge to raise the American standard of living across all demographics. PCAST briefly outlines steps to bolster American innovation through basic research, commercialization of new technologies, and our nation’s manufacturing infrastructure.</p>			

President Bill Clinton

Report of the PCAST Panel on U.S.-Russian Cooperation to Protect, Control, and Account for Weapons-Useable Nuclear Materials	1995	Defense/Security	Report
This report addresses the adequacy of the cooperative efforts between the U.S. and the countries of the former Soviet Union to protect, control, and account for weapons-useable nuclear materials and makes nine recommendations for improving cooperation.			
The U.S. Program of Fusion Energy Research and Development	1995	Research/Innovation; Energy/Environment	Report
This report reviews the U.S. fusion energy research program at the Department of Energy (DOE). PCAST proposes that, in light of budgetary restraints, the DOE should prioritize the fusion program's science base—in particular plasma science and fusion technology—as well as negotiate cost-saving measures for the International Thermonuclear Experimental Reactor. The report also makes recommendations for funding levels for the full U.S. involvement in fusion energy research.			
PCAST Statement of Principles	1995	Research/Innovation	Letter
This letter provides a framework to help the president make funding decisions related to science and technology and evaluate options under periods of fiscal restraint in Congress. PCAST emphasizes that balanced, stable funding is critical to maintaining a healthy science and technology portfolio.			
Report on Academic Health Centers	1995	Research/Innovation; Health/Medicine	Letter
This letter makes recommendations for the nation's academic health centers—partnerships between hospitals and medical schools that treat a large percentage of the uninsured population—considering pending reforms to Medicare and Medicaid. PCAST recommends that the Graduate Medical Education (GME) mechanism be continued at its current funding levels, and that strain on the program could be offset if other entities shared costs.			
PCAST Principles on the U.S. Government's Investment Role in Technology	1996	Research/Innovation	Letter
This letter calls attention to the government's role in investing in technological innovations. The letter provides three criteria for framing the necessity of continued public support for scientific and technology research: 1) technology serves the public good, 2) the marketplace leaves gaps in private investment where public funds are necessary, and 3) the government plays a critical role in technology transfer and facilitating public-private partnerships.			

## Science Advice to the President and the Role of PCAST

Report on Research Universities	1996	Research/Innovation; Education	Letter
<p>This letter urges the president to take actions to ensure the vitality of the U.S. research university system by directing federal agencies to implement the recommendations found in the 1992 PCAST report “Renewing the Promise” and the 1994 Clinton administration strategy document “Science in the National Interest.”</p>			
Report on Preventing Deadly Conflict	1996	Defense/Security	Letter
<p>This letter focuses on developing science policy to understand the nature of deadly conflict and to build tools to resolve such conflicts and curb the use of violence globally. PCAST points to the role of science in building an international community that could help prevent future conflicts.</p>			
Letter Report on Second Term Initiatives for the Clinton Administration in Science and Technology	1996	Research/Innovation	Letter
<p>The letter identifies five science and technology issues that the administration should focus on during President Clinton’s second term: 1) increases to federal funding for energy R&amp;D, 2) training for biological and ecological sciences to understand the nation’s biological resources, 3) developing the use of information technology for education, 4) improving industry-government-university partnerships, and 5) improving systems for minimizing and protecting weapons-usable nuclear materials.</p>			
R&D Priorities for Sustainable Development	1997	Research/Innovation; Energy/Environment	Letter
<p>This letter details five sustainable development issues that offer potential for significant progress for a more sustainable future: climate change, biodiversity, energy, ecosystems, and food supplies.</p>			
Report to the President on the Use of Technology to Strengthen K-12 Education in the United States	1997	Education	Report
<p>This report makes six broad recommendations for using technology in K-12 classrooms—in particular, interactive computer programs and network-based technologies. PCAST calls attention to the current lack of funding for teaching research, and emphasizes that technology-related education expenditures should be significantly increased and equally distributed across all our nation’s schools regardless of socioeconomic status, race, ethnicity, gender, or geographical factors.</p>			
Letter Report on Cloning Technology	1997	Health/Medicine	Letter
<p>This letter endorses the administration’s prohibition on federal funding of cloning human beings and its request for the private sector to issue a self-imposed moratorium on cloning human beings. PCAST also suggests the president could request the National Academy of Sciences and the Institute of Medicine launch a public education campaign to help build scientific literacy on cloning.</p>			

Science Advice to the President and the Role of PCAST

Federal Energy Research and Development for the Challenges of the 21st Century	1997	Research/Innovation; Energy/Environment	Report
<p>This report reviews the U.S. energy R&amp;D portfolio and makes recommendations for funding, coordinating, and managing its programs. PCAST recommends the DOE increase funding for applied energy technology R&amp;D including renewable energy technologies, energy efficiency, and nuclear fusion and fission research. PCAST also suggests the DOE create a new position for an individual, reporting directly to the Secretary of Energy, to monitor the entire energy R&amp;D portfolio.</p>			
Teaming with Life: Investing in Science to Understand and Use America's Living Capital	1998	Research/Innovation; Health/Medicine; Energy/Environment; Information Technology	Report
<p>This report provides a roadmap to integrate information technology, sociology, and economics into the study and management of our nation's ecosystems. PCAST makes recommendations for funding levels for new programs to wed economics and the environment. Notably, PCAST calls for the establishment of the National Biological Information Infrastructure to create and organize various data repositories of biological and ecological information.</p>			
Letter Report on Global Cooperation to Develop and Commercialize Energy Technologies	1998	Research/Innovation; Energy/Environment	Letter
<p>This report addresses the U.S.'s involvement in international activities to mitigate anthropogenic climate change and calls for the president to continue to support technology designed to reduce greenhouse gases. PCAST offers to review the current energy R&amp;D activities in which the U.S. is involved, specifically its international cooperative activities, and to make recommendations on strategies for strengthening its commitments to fighting climate change globally.</p>			
Letter Report on Quantity, Quality, and Organization of Educational Research in the United States	1998	Research/Innovation; Education	Letter
<p>This letter discusses next steps for the president's Education Research Initiative, which in its first year allocated \$75 million toward developing new methodologies and training programs for teachers to collect and analyze data on student performance and contextual indicators. PCAST notes that the initiative resulted, in part, from PCAST's 1997 report on the use of technology to strengthen K-12 education and pushes for greater funding in future years to meet the report's \$1.5 billion annual target.</p>			
PCAST Letter on the Fiscal Year 2000 Budget	1998	Research/Innovation	Letter
<p>This letter supports the president's fiscal year 2000 budget, especially his "Twenty-First Century Research Fund," and reaffirms the need for a strong and balanced science and technology research portfolio. Along these lines, PCAST calls for basic research programs at the Department of Defense to be included in the Twenty-First Century Research Fund's selected programs.</p>			

## Science Advice to the President and the Role of PCAST

PCAST Letter on a Laboratory for National Information Infrastructure Protection (LNIIP)	1998	Defense/Security; Information Technology	Letter
<p>This letter recommends the president create a “Laboratory for National Information Infrastructure Protection,” which would focus largely on cybersecurity of U.S. networks. The laboratory, a public-private partnership now called the Institute for Information Infrastructure Protection (I3P), would have a number of research foci dedicated to advancing network security including vulnerability, detection and analysis, encryption, and system recovery.</p>			
Powerful Partnerships: The Federal Role in International Cooperation on Energy Innovation	1999	Research/Innovation; Energy/Environment	Report
<p>This report gives recommendations for strengthening the foundation for energy innovation and international cooperation relating to it, including capacity building, energy sector reform toward more efficient buildings and appliances, as well as new mechanisms for research, development, demonstration, and deployment of new energy technologies. PCAST calls for the president to invest \$250 million in a series of energy initiatives and to establish an Interagency Working Group on Strategic Energy Cooperation under the National Science and Technology Council.</p>			
PCAST Letter to the President Endorsing a National Nanotechnology Initiative	1999	Research/Innovation	Letter; Review or Assessment
<p>This letter reviews the National Nanotechnology Initiative (NNI) put forth by the National Science and Technology Council Working Group on Nanoscience, Engineering, and Technology. PCAST endorses the proposal for the initiative, as well as its funding levels, and recommends that a modest amount of money be put toward the social and ethical implications of nanotechnology.</p>			
PCAST Review of the Interim Report of the National Science Board on Environmental Science and Engineering for the 21st Century	1999	Energy/Environment	Letter
<p>This letter reviews the National Science Board’s interim report, “Environmental Science and Engineering for the 21st Century,” at the request of co-chair Neal Lane. PCAST largely endorses the recommendations made by NSB, offers several ongoing activities to coordinate federal environmental R&amp;D, and suggests that its recommendations on “scientific assessments” could be clarified. PCAST recommends that the Office of Management and Budget could possibly aid in evaluating the full portfolio of environmental R&amp;D programs, and notes that careful integration of NSF’s portfolio into existing research will be critical for advocating for the addition \$1 billion in funding the report sets as a target.</p>			
PCAST Letter to the President Regarding FY2001 Priorities	1999	Research/Innovation	Letter
<p>This letter supports the president’s fiscal year 2001 budget, including the 21st Century Research Fund, and offers six R&amp;D initiatives that could be developed with additional budgets: international energy R&amp;D; management of biological resources; STEM education and education research; management of weapons-useable nuclear materials; a national information infrastructure protection institute; and a nanotechnology initiative.</p>			

## Science Advice to the President and the Role of PCAST

Wellspring of Prosperity: Science and Technology in the U.S. Economy	2000	Research/Innovation	Report
<p>In response to a request from Vice President Gore, this report provides examples of how sustained funding for R&amp;D has benefited the U.S. economy and the daily lives of Americans. It covers six broad topics including information technology, GPS, biotechnology, food technologies, environmental science, and advanced manufacturing and computing.</p>			
Biodiversity: Connecting with the Tapestry of Life	2001	Energy/Environment	Report
<p>This report provides a brief overview of the concept of biodiversity and highlights its importance to human life, as well as current threats to North America's flora and fauna. PCAST, alongside the Smithsonian as its co-publisher, outlines the government's role as steward of our nation's ecosystem and offers concrete steps for conserving biodiversity.</p>			
Letter from PCAST to the President	2001	Research/Innovation	Letter
<p>This letter, authored by PCAST members David Hamburg and Shirley Malcolm, makes a call for increased attention toward international scientific initiatives, especially in the areas of emerging infectious diseases and science and technology in food and agriculture in developing countries.</p>			
Letter from PCAST to Neal Lane	2001	Research/Innovation	Letter
<p>This letter, authored by PCAST member Lilian Wu, collects lessons learned from President Clinton's PCAST to provide recommendations for future PCASTs and their products. It recommends that PCAST should have increased access to the president and vice president, a deeper involvement with issues relating to national security and foreign policy, and greater interaction with Congress, especially in following up with report findings and recommendations. The letter also includes a list of suggested areas for further study and investment, a list of PCAST reports and their recommendations, and a discussion on administration initiatives occurring in response to PCAST recommendations.</p>			

President George W. Bush

Maximizing the Contribution of Science and Technology within the New Department of Homeland Security	2002	Defense/Security	Report
<p>This report makes recommendations for the organization, content, and operation of the R&amp;D enterprise of the newly formed Department of Homeland Security (DHS). PCAST emphasizes that DHS should be an adaptive agency that can undertake new challenges as they arise and recommends that it appoint an under secretary for science and technology, who reports directly to the secretary for homeland security, to manage the DHS R&amp;D portfolio.</p>			
Assessing the U.S. R&D Investment	2002	Research/Innovation	Report
<p>This report examines historical trends in federal funding of R&amp;D and assesses how this funding meets the nation's economic, societal, and security needs. PCAST recommends that federal research programs in the physical sciences and engineering receive funding comparable to the recent increases to federal programs in the life sciences.</p>			
Building Out Broadband	2002	Information Technology	Report
<p>This report discusses challenges with demand-side broadband deployment and provides a series of activities to strengthen the nation's broadband infrastructure. PCAST makes a series of recommendations for federal activities, including making use of networks in K-12 classrooms, increasing investment in federal web-based services, and supporting interagency cooperation on telemedicine initiatives.</p>			
Improving Efficiency in the Nation's Electrical System	2003	Energy/Environment	Report
<p>This report reviews the nation's electrical generation, transmission, and distribution system and provides advice for improving its efficiency. PCAST recommends that the DOE address inefficiencies in coal-powered plants, including incentivizing reducing emissions and accelerating research on clean coal and carbon sequestration technologies; expanding the National Transmission Grid Study to include superconducting technologies; leading the development of protocols for distributed electrical generating devices; and producing a plan for coordinated demand-side management of electricity.</p>			
Technology Transfer of Federally Funded Research and Development	2003	Research/Innovation	Report
<p>This report reviews the government's role in technology transfer and finds that the extant legislation should not be altered, but makes suggestions for improvements. PCAST recommends that federal agencies formalize their oversight capacities and document their best practices to be disseminated among stakeholders.</p>			

Science Advice to the President and the Role of PCAST

The Science and Technology of Combating Terrorism	2003	Defense/Security	Report
<p>This report was published as a follow up to PCAST’s 2002 report “Maximizing the Contribution of Science and Technology within the New Department of Homeland Security” to provide detailed information about the government’s efforts—many of them already underway at DHS, in particular, interactive computer programs and network-based technologies—to increase preparedness for new types of terrorist attacks following 9/11. PCAST recommends action plans for citizen readiness and public health programs to respond to bioterrorism, chemical weapons, and cyberattacks.</p>			
Sustaining the Nation’s Innovation Ecosystems: Information Technology Manufacturing and Competitiveness	2004	Research/Innovation; Information Technology	Report
<p>This report addresses the competitiveness of the U.S.’s high-technology industries in light of a growing number of other countries developing similar ecosystems for innovation. PCAST recommends a series of actions to ensure the U.S.’s stature as a leader in nanotechnology, biotechnology, information technology, and advanced manufacturing, including robust investments in basic research, strengthening STEM education and workforce skills, and making the R&amp;D tax credit permanent.</p>			
Federal-State R&D Cooperation: Improving the Likelihood of Success	2004	Research/Innovation	Report
<p>This report developed from a PCAST-sponsored conference in Cleveland, Ohio in June 2004, which focused on the states’ role in the nation’s innovation ecosystem. The resulting consensus concluded that regional cooperation is integral for successful research practices, including regional strategy and competency building, agreed upon frameworks for technology transfer, and industrial and federal partnerships in the construction of major facilities.</p>			
Sustaining the Nation’s Innovation Ecosystems: Maintaining the Strength of Our Science and Engineering Capabilities	2004	Research/Innovation; Education	Report
<p>This report follows the earlier 2004 PCAST report “Sustaining the Nation’s Innovation Ecosystems: Information Technology Manufacturing and Competitiveness” to focus on issues in the American STEM education system and how it impacts the U.S. workforce, especially in an increasingly competitive global economy. Considering poor retention rates for American STEM students at the undergraduate and graduate levels, PCAST recommends reducing the time to Ph.D., expanding professional master’s degrees, and reforming teacher training and certification programs to make K-12 teaching more attractive as a profession but also rigorous in teaching performance standards.</p>			
S&T Collaboration: Ideas for Enhancing European-American Cooperation	2004	Research/Innovation	Report
<p>This report summarizes the findings from an October 2004 workshop convened by PCAST on U.S.-European scientific cooperation. The report addresses international partnerships for large-scale facilities, educational opportunities as a mechanism for fostering research collaboration, and the utility of shared research priorities to meet global challenges such as clean energy, food and water security, and access to healthcare. PCAST recommends the NNI could be improved by increasing partnerships with states and the industrial sector.</p>			

Science Advice to the President and the Role of PCAST

The National Nanotechnology Initiative at Five Years: Assessment and Recommendations of the National Nanotechnology Advisory Panel	2005	Research/Innovation	Report; Review or Assessment
This is the first review of the NNI as called for by the 21st Century Nanotechnology Research and Development Act of 2003 (P.L. 108-153) after President G.W. Bush assigned PCAST to serve as the National Nanotechnology Panel. PCAST concludes that the U.S. maintains its leadership internationally in nanotechnology, although other countries are also ramping up their efforts, and that NNI is well managed across a broad range of programs, including societal and environmental concerns.			
The Energy Imperative: Technology and the Role of Emerging Companies	2006	Research/Innovation; Energy/Environment	Report
This report reviews emerging technologies that could strengthen and diversify the U.S. energy portfolio while reducing emissions and environmental impacts. PCAST makes a strong call for investing in nuclear power, clean coal, and renewable energy sources, as well as transitioning toward hybrid electric and hydrogen-powered vehicles. The report also highlights the president's "Advanced Energy Initiative," which calls for a 22% increase to clean energy R&D and advocates for the program to be funded in full.			
Leadership Under Challenge: Information Technology R&D in a Competitive World: An Assessment of the Federal Networking and Information Technology R&D Program	2007	Research/Innovation; Information Technology	Report; Review or Assessment
This is the first review of the Federal Networking and Information Technology Research and Development (NITRD) program performed by PCAST. PCAST finds NITRD has largely been an effective mechanism for coordinating and implementing NIT policy across involved agencies. However, PCAST recommends that a higher priority be placed on secondary education, including changes to the visa policy for foreign national students working in related areas, as well as a restructuring of funding from short-term, low-risk R&D programs to longer-term, multidisciplinary research activities with high-risk, high-reward proposals.			
The National Nanotechnology Initiative: Second Assessment and Recommendations of the National Nanotechnology Advisory Panel	2008	Research/Innovation	Report; Review or Assessment
In this second assessment of the NNI, PCAST continues to support the overarching goals, organization, and activities of the initiative but further emphasizes the need for communication and outreach efforts relating to environmental, health, and safety and the characterization and risk assessment of new nanomaterials.			

## Science Advice to the President and the Role of PCAST

Addendum: Assessment of the NNI Strategy for Nanotechnology-Related Environmental, Health, and Safety Research	2008	Research/Innovation; Health/Medicine; Energy/Environment; Information Technology	Letter; Review or Assessment
<p>This letter reviews the National Science and Technology Council Subcommittee on Nanoscale Science, Engineering, and Technology Environmental, Health, and Safety strategy report, released shortly after PCAST’s second assessment of NNI. PCAST suggests risk assessments of nanomaterials be made in the context of their applications, such as new medical technologies that utilize nanoscale elements but may provide new, and more effective, treatments for chronic illnesses. PCAST also recommends that more efforts be dedicated towards identifying gaps in risk assessments and utilizing new information in the usage of nanomaterials in commercial and industrial sectors.</p>			
Priorities for Personalized Medicine	2008	Health/Medicine	Report
<p>This report provides background on personalized medicine (genomics-based diagnostics and therapeutics), discusses its potential to improve the U.S. health care system, and provides policy recommendations on integrating new medical advances into the current regulatory environment. PCAST recommends a sustained effort to coordinate and strengthen public and private sector R&amp;D efforts, clarify the FDA’s regulation process, and establish an office within the Department of Health and Human Services specifically for developments in personalized medicine.</p>			
University-Private Sector Research Partnerships in the Innovation Ecosystem	2008	Research/Innovation	Report
<p>This report identifies opportunities and challenges to building university-private sector partnerships. PCAST found that the U.S. funding system has become “inconsistent and fractured,” and advocates for stronger engagement between the private sector and the U.S. university system in light of increased academic research capacity and stagnant government funding. PCAST recommends strong federal investment in basic research, making the R&amp;D tax credit permanent, clarity and guidance for university technology transfer procedures, and improving metrics for R&amp;D assessment to guide innovation policy.</p>			
The Energy Imperative: Report Update	2008	Energy/Environment	Report
<p>This report updates PCAST’s 2006 report “The Energy Imperative: Technology and the Role of Emerging Companies,” which focuses on strengthening U.S. energy security while mitigating environmental impact. PCAST notes that net oil imports to the U.S. had decreased in the two years since the first report release, as well as significant advances to the commercial viability of emerging energy technologies. The report outlines policy changes benefiting a number of advanced energy technologies and comments on their challenges and benefits. PCAST states that improvements in U.S. energy policy and technological advances to alternate and renewable energy sources “[warrant] optimism” that the nation’s reliance on foreign oil will continue to decrease.</p>			
Transition Letter to the Next PCAST	2008	Research/Innovation	Letter
<p>This letter, authored by PCAST’s two co-chairs, provides a description of President G.W. Bush’s PCAST, including its formation, operational procedures, membership, and publications. The letter also makes recommendations for improving the organization and impact of future PCASTs, by limiting the size of the council to 20-25 people, keeping reports concise, and increasing engagement with the president, Congress, cabinet members, and senior agency officials.</p>			

President Barack Obama

U.S. Preparations for 2009-H1N1 Influenza	2009	Health/Medicine	Report
<p>The report addresses the implications of the then-upcoming fall 2009 H1N1 epidemic. PCAST offers a recommended course of action to mitigate the epidemic, including heightened surveillance and increasing the production of H1N1 vaccines.</p>			
The Third Assessment of the National Nanotechnology Initiative	2010	Research/Innovation	Report; Review or Assessment
<p>In this review of the NNI, PCAST finds that the program has been successful in catalyzing the growth of the U.S.'s nanotechnology industry, as well as maintaining U.S. leadership in nanotechnology R&amp;D. However, PCAST points to the growing prominence of China, South Korea, and the EU in the nanotechnology sector and makes suggestions for ensuring U.S. dominance. PCAST recommends OSTP designate more resources to the National Nanotechnology Coordination Office to broaden its impact and efficacy, and that NNI should put more emphasis on nanomanufacturing and commercialization of nano-based products and environmental, health, and safety risks and assessments.</p>			
Reengineering the Influenza Vaccine Production Enterprise to Meet the Challenges of Pandemic Influenza	2010	Health/Medicine	Report
<p>The report examines how the nation can scale and expedite the production of a reliable pandemic influenza vaccine. PCAST recommends actions to ensure more rapid detection of potential pandemics and delivery of effective vaccines, including increased surveillance of new pandemic threats, investment in applied research to shorten time and increase the reliability of preparation and testing of vaccines, and accelerated clinical research and regulatory approval of new influenza vaccines.</p>			
Prepare and Inspire: K-12 Science, Technology, Engineering, and Math (STEM) Education for America's Future	2010	Education	Report
<p>The report addresses three challenges to the U.S. science, technology, engineering, and mathematics (STEM) K-12 education system: declining performance measures in comparison to other nations, waning interest in STEM fields among American students, and performance and interest gaps among women and underrepresented minorities. To improve K-12 education, PCAST emphasizes that students must have a strong foundation in STEM subjects that are applicable to their daily lives, and they must be inspired to study STEM subjects early in their education. PCAST recommends that the government improve federal coordination on STEM education, support state-led efforts for shared standards in STEM education, and recognize and reward outstanding STEM teachers. PCAST includes the far-reaching goal of recruiting and training 100,000 new STEM middle school and high school teachers in 10 years.</p>			

## Science Advice to the President and the Role of PCAST

Accelerating the Pace of Change in Energy Technologies Through an Integrated Federal Energy Policy	2010	Research/Innovation	Report
<p>This report calls for the development of a coordinated government-wide energy policy in response to 21st century energy-related challenges, including the U.S.'s international competitiveness, climate change, and energy security. PCAST recommends initiating a Quadrennial Energy Review, analogous to the Department of Defense's Quadrennial Defense Review, to establish broad energy policy goals, coordinate agency efforts, and identify areas that require additional federal support. PCAST also recommends an annual budget of \$16 billion to support energy R&amp;D, demonstration, and deployment, to be supplemented with new revenue streams.</p>			
Realizing the Full Potential of Health Information Technology to Improve Healthcare for Americans: The Path Forward	2010	Health/Medicine; Information Technology	Report
<p>This report examines how information technology (IT) can improve and reduce the cost of healthcare and reviews existing federal programs advancing health-related IT. PCAST determines that IT can potentially increase access to patient data, streamline monitoring of public health patterns, improve the ability to conduct clinical trials, and lead to a new market with more jobs. PCAST recommends that the government facilitate the adoption of a universal language for healthcare information and invest in IT infrastructure to achieve the full benefits of integrating IT into medical and healthcare sectors.</p>			
Designing a Digital Future: Federally Funded Research and Development Networking and Information Technology	2010	Research/Innovation; Information Technology	Report; Review or Assessment
<p>This review of the NITRD program finds that the program is well coordinated and in sync with a vibrant computing research community. However, PCAST also found that a substantial portion of NITRD spending in R&amp;D has gone towards fields outside of networking and information technology. Thus, the U.S. is investing much less in this area than the stated \$4 billion. PCAST recommends that more accurate accounting and additional investments in NIT R&amp;D are needed.</p>			
Ensuring American Leadership in Advanced Manufacturing	2011	Research/Innovation	Report
<p>This report focuses on maintaining U.S. leadership in advanced manufacturing given recent declines in manufacturing as a share of GDP and employment. PCAST calls for a reform to the nation's innovation policy—creating an ideal environment for the cycle of invention and discovery to thrive in our public and private sectors through reforms to tax and business policies and funding basic research, and robust education and training for the STEM workforce. PCAST recommends that the government launch a federal Advanced Manufacturing Initiative to coordinate and implement the nation's new innovation policy.</p>			
Sustaining Environmental Capital: Protecting Society and the Economy	2011	Energy/Environment	Report
<p>This report centers on the intersection of the economy and environment. A follow-up to the 1998 PCAST report "Teaming with Life," PCAST updates the assessment of the nation's biodiversity and ecological resources and makes recommendations to the federal government for sustaining the nation's environmental capital, including strategies to mitigate climate change. PCAST outlines specific actions for agencies to coordinate and manage government-wide efforts to collect and utilize biological and ecological data.</p>			

Science Advice to the President and the Role of PCAST

Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics	2012	Education	Report
<p>The report focuses on increasing retention of STEM students during their transition from high school to postsecondary education, in an effort to ensure the nation has the knowledge and skill to compete in the 21<sup>st</sup> century global economy. PCAST sets the goal of producing 1 million additional STEM degrees—by increasing retention from 40% to 50% at the postsecondary level—in the next decade. To achieve this goal, PCAST sets forth five overarching recommendations: 1) facilitate widespread adoption of evidence-based teaching best practices; 2) advocate and provide support for replacing standard laboratory courses with discovery-based research courses; 3) address the mathematics-preparation gap at the postsecondary level; 4) diversify pathways to STEM careers; and 5) create a STEM Education Council to advise federal policy to reform undergraduate STEM education to improve student retention.</p>			
The Fourth Assessment of the National Nanotechnology Initiative	2012	Research/Innovation	Report; Review or Assessment
<p>This review of NNI finds that the program has had “catalytic and substantial” impact on the U.S. nanotechnology enterprise and applauds the uptake of PCAST’s previous recommendations to focus on commercialization and environmental, health, and safety issues. PCAST outlines that additional recommendations need to be made in strategic planning, program management, metrics for assessing impact, and increasing support for research on the environmental impacts of nanotechnology.</p>			
Capturing Domestic Competitive Advantage in Advanced Manufacturing	2012	Research/Innovation	Report
<p>This report serves as follow up to PCAST’s 2011 report “Ensuring American Leadership in Advanced Manufacturing,” prepared by the Advanced Manufacturing Partnership (AMP) and adopted by PCAST, on sustaining U.S. leadership in advanced manufacturing. PCAST makes recommendations in three areas: 1) enabling innovation, 2) securing the talent pipeline, and 3) improving the business climate. In particular, PCAST calls for investment in community colleges to ensure adequate training and placement for U.S. manufacturing firms, as well as trade, tax, regulatory, and energy policy reforms to maintain U.S. competitiveness among nations with emerging manufacturing bases.</p>			
Realizing the Full Potential of Government-Held Spectrum to Spur Economic Growth	2012	Information Technology	Report
<p>This report addresses the rapidly increasing demand for access to available wireless spectrum and suggests improving the efficiency of the federally held spectrum through spectrum-sharing pilot programs. The PCAST study concludes that a new potential spectrum architecture of federal bands—where the exclusivity of auctioned federal spectrum is replaced by sharing mechanisms—could lead to an increase of the effective capacity of the spectrum by a factor of 1000. PCAST recommends that 1,000 MHz of federal spectrum should be identified to pilot this new system.</p>			

## Science Advice to the President and the Role of PCAST

Propelling Innovation in Drug Discovery, Development, and Evaluation	2012	Research/Innovation; Health/Medicine	Report
<p>This report deals with the imbalance of new, commercially available therapeutics and the progress of scientific research related to drugs and drug delivery over the last several decades. PCAST recommends several measures to close this gap, including 1) catalyzing partnerships between various stakeholders to fill knowledge gaps and improve clinical trial capabilities, 2) accelerating approval of drugs meeting existing statutory standards and creating new pathways for drugs proven to be effective on specific subgroups of patients, and 3) improving and supporting the FDA’s tools for monitoring and communicating risks post-drug approval.</p>			
Transformation and Opportunity: The Future of the U.S. Research Enterprise	2012	Research/Innovation	Report
<p>This report makes a call for increased federal investment in the U.S. scientific and engineering enterprise due to shifting global trends in research and development—namely, that the U.S. is no longer the leader in R&amp;D investment as a share of GDP. PCAST recommends that the U.S. increase its R&amp;D expenditures, both public and private, to a level of 3% of the GDP; that it make its R&amp;D tax credit permanent; and that efforts be made to ensure the stability and predictability of research funding.</p>			
Agricultural Preparedness and the Agricultural Research Enterprise	2012	Energy/Environment	Report
<p>The report focuses on the government bolstering agricultural research to support the agriculture industry in America to address new challenges to our farming enterprise, including climate change. PCAST calls on the government to support R&amp;D in agriculture for both the public and private sectors as well as provide additional investments and adequate training for the next generation of farmers.</p>			
Designing a Digital Future: Federally Funded Research and Development in Networking and Information Technology	2013	Research/Innovation; Information Technology	Report; Review or Assessment
<p>This review of the NITRD program applauds the program’s responsiveness to PCAST’s 2010 recommendations in a report of the same name and its expansion to include new research areas of “big data,” health IT, and cybersecurity. However, PCAST found that R&amp;D levels were still failing to address a range of challenges in education technology, energy, and transportation, and recommends increased investment in these sectors. PCAST also recommends a new, high-level NITRD PCAST standing subcommittee and associated working group to provide strategic advice on this rapidly growing field.</p>			
Letter Report on Climate Change	2013	Energy/Environment	Letter
<p>This report focuses on mitigating climate change. PCAST recommends the government ensure U.S. leadership on climate change internationally by continuing to support decarbonization and technological research, establishing a national preparedness strategy for climate change, and conducting the first Quadrennial Energy Review called for in PCAST’s 2010 report “Accelerating the Pace of Change in Energy Technologies Through an Integrated Federal Energy Policy.”</p>			

Science Advice to the President and the Role of PCAST

Immediate Opportunities for Strengthening the Nation’s Cybersecurity	2013	Defense/Security; Information Technology	Report
<p>This reports identifies a number of executive actions that could bolster the nation’s defenses against a growing number of types of cyberattacks. PCAST outlines numerous measures to increase cybersecurity, including implementing third-party audits to incentivize improving standards and transparent reporting in the private sector, facilitating private sector partnerships that lead to data sharing, and investing in high-risk, high-return basic research to develop high-assurance computing systems.</p>			
Letter Report on Education Technology	2013	Education	Letter
<p>This letter focuses on massive open online courses (MOOCs) as a strategy for making college more affordable and increasing access to higher education for many Americans. PCAST recommends that the government must encourage innovation with MOOCs by letting the market proliferate on its own, encouraging accreditation of MOOCs by institutions, and supporting data-driven education research as MOOCs develop.</p>			
Big Data: A Technological Perspective	2014	Information Technology	Report
<p>This report accompanies a longer study from the Executive Office of the President, titled “Big Data: Seizing Opportunities, Preserving Values,” to provide background information and analysis, as well as policy recommendations relating to the nature of technology that generates and uses big data and associated risks and privacy concerns. PCAST recommends that policies regulating big data need to focus on the “outcomes” of technological advances, rather than the technology itself, to avoid becoming obsolete as technologies evolve. PCAST also emphasizes that policymakers need to continue to promote and support R&amp;D, commercialization, and training to facilitate innovation and new strategies to protect privacy.</p>			
Better Health Care and Lower Costs: Accelerating Improvement through Systems Engineering	2014	Health/Medicine; Information Technology	Report
<p>This report advocates for the U.S. healthcare system to adopt aspects of systems engineering to improve the efficiency, quality, and affordability of care. PCAST argues that the current medical billing system that incentivizes fee-for-service rather than fee-for-value payment models is the greatest barrier toward the uptake of a systems approach to healthcare, which would likely reduce net profits. PCAST recommends aligning payment systems with health outcomes, accelerating the development of the U.S. health data infrastructure, and providing technical assistance and training to healthcare professionals to integrate systems engineering into management and practicing of care.</p>			
Combating Antibiotic Resistant Bacteria	2014	Health/Medicine	Report
<p>This report outlines actions for the federal government to strengthen the nation’s ability to combat the rise of antibiotic-resistant bacteria. PCAST recommends improving surveillance of new strains of resistant bacteria, increasing the longevity of current antibiotics by using them appropriately, and establishing a robust pipeline by which new antibiotics will replace older lines lost to antibiotic resistance.</p>			

Science Advice to the President and the Role of PCAST

Information Technology for Targeting Job-Skills Training and Matching Talent to Jobs	2014	Education; Information Technology	Letter
<p>This letter argues that information technology can bridge the gap between employers and potential employees to provide “targeted training” and job opportunities. PCAST recommends improved cooperation between the Departments of Labor, Commerce, and Education and the private sector to share best practices and technical standards setting, as well as continued development of information technology to assess skill needs, identify training and certification programs necessary, and connect workers with employers in both the public and private sectors.</p>			
The Fifth Assessment of the National Nanotechnology Initiative	2014	Research/Innovation	Report; Review or Assessment
<p>This review of NNI argues that nanotechnology, and the government’s investment in it, has reached a “turning point.” PCAST recommends transitioning the bulk of NNI support and activities toward commercialization. PCAST puts forth the idea of a Grand Challenges framework to catalyze “revolutionary commercialized products” in nanoscale science, engineering, technology, and related activities.</p>			
Accelerating U.S. Advanced Manufacturing	2014	Research/Innovation	Report
<p>This report serves as a follow-up to PCAST’s and the Advanced Manufacturing Partnership’s 2012 report, “Capturing Domestic Competitive Advantage in Advanced Manufacturing,” to identify further steps the government could take to improve the U.S. manufacturing enterprise. PCAST calls for the federal government to develop a strategic plan for advanced manufacturing, establish a public-private partnership to cross the commercialization gap between early- and late-stage technology maturation, and facilitate the exchange of information and materials processing technologies between public and private research and manufacturing entities.</p>			
Ensuring Leadership in Federally Funded Research and Development in Information Technology	2015	Information Technology	Report; Review or Assessment
<p>This review of the NITRD program examines eight areas relating to information technology and makes recommendations for advancing the government’s support and coordination in each sector: cybersecurity, health IT, big data, human sensing and interfacing technologies, privacy, cyber-human systems, high-performance computing, and foundational IT research.</p>			
Aging America & Hearing Loss: Imperative of Improved Hearing Technologies	2015	Research/Innovation; Health/Medicine	Letter
<p>The report addresses age-related and progressive hearing loss and provides recommendations for opening the market for more innovative hearing technologies. PCAST recommends specific regulatory reforms within the Food and Drug Administration to increase access and reduce cost of hearing aids without compromising patient safety.</p>			

Science Advice to the President and the Role of PCAST

Report on Private Sector Efforts in Adaptation to Climate Change	2015	Energy/Environment	Letter
<p>This letter, building on PCAST’s 2013 letter addressing climate change, identifies ways in which the government can assist private sector initiatives that work to mitigate climate change and provide background on those activities. PCAST finds that in the private sector, long-term effects of climate change on operations, supply chains, and facilities are undervalued with respect to nearer-term effects and the government should take steps to communicate risks for long-term climate change to mitigate at-risk businesses. Additionally, PCAST suggests that the government could play a role in the development of metrics for assessing mitigation development and clarifying and disseminating existing information.</p>			
Technology and the Future of Cities	2016	Research/Innovation	Report
<p>This report examines the concept of “smart cities,” which have the potential to improve urban life through modernizing infrastructure and strategically using big data. PCAST recommends the federal government should integrate emerging energy, water, information, and transportation technologies into existing infrastructure and experiment with different models to establish and share best practices.</p>			
Independence, Technology, and Connection in Older Age	2016	Research/Innovation; Health/Medicine	Report
<p>Building on PCAST’s 2015 report “Aging America &amp; Hearing Loss: Imperative of Improved Hearing Technologies,” this report makes recommendations on how technology can improve mobility, cognitive functions, social engagement, and emotional health of the U.S.’s elderly population, as well as the role the government can play to facilitate advances in these areas.</p>			
Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods	2016	Research/Innovation	Report
<p>This study reviews existing literature on the validity of forensic science and outlines possible steps for the government to ensure the scientific validity of forensic evidence used in the U.S. legal system. PCAST determines that there are two gaps in existing practices: 1) lack of clarification of standards for the validity and reliability of forensic methods, and 2) lack of thorough evaluation of all forensic methods for their scientific merit to be valid and reliable. PCAST provides criteria under which scientific validity for forensic science in numerous “feature-comparison” methods can be judged and evaluates existing practices of those fields by those standards. PCAST concludes that the federal government should strengthen the scientific underpinnings of forensic practices and provides recommendations to the attorney general for actions to improve the use of forensic evidence in the judiciary system.</p>			
Action Needed to Protect against Biological Attack	2016	Health/Medicine; Defense/Security	Letter
<p>The report outlines measures the U.S. should take to prevent future biological attacks. PCAST recommends strengthening public health infrastructure by developing a national biodefense strategy for near- and long-term threats, with periodic updates on new issues addressing advances in biotechnology, as well as increased funding for surveillance and immediate and forward-thinking research on countermeasures for emerging types of bio-attacks. PCAST also suggests establishing a “Public Health Emergency Response Fund” at a cost of \$2 billion to support mobilization of rapid responses from federal entities.</p>			

## Science Advice to the President and the Role of PCAST

Science and Technology to Ensure the Safety of the Nation’s Drinking Water	2016	Health/Medicine; Energy/Environment	Report
<p>This report addresses the growing lack of confidence in publicly available safe drinking water following the continuing crisis in Flint, Michigan. PCAST makes recommendations to empower the federal government and their partnerships in academia, state governments, and the private sector to improve the safety of the U.S. drinking water through technological advances, monitoring, and improved data sharing and accessibility.</p>			
Ensuring Long-Term U.S. Leadership in Semiconductors	2017	Research/Innovation	Report
<p>This report examines the U.S. position in the semiconductor market, spurred by recent policies enacted by the Chinese government to “distort the market that undermine innovation, subtract from the U.S. market share, and put U.S. national security at risk.” PCAST concludes by stating that the U.S. will only maintain its leadership in the semiconductor industry by innovating at the cutting edge of research, creating a friendly environment for U.S.-based business, and pushing back against innovation-inhibiting Chinese national policies.</p>			
Letter Report on the Sixth Assessment of the National Nanotechnology Initiative	2017	Research/Innovation	Letter; Review or Assessment
<p>This review of the NNI concludes that it has been successful in deepening our understanding of nanotechnology and jumpstarting scientific discovery. The primary recommendation is that the NSTC builds on its uptake of PCAST’s previous 2014 NNI review to include at least two more nanotechnology-based Grand Challenges in the coming years.</p>			
Addendum to the PCAST Report on Forensic Science in Criminal Courts	2017	Research/Innovation	Letter
<p>This letter responds to stakeholder input after the 2016 PCAST report “Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods.” PCAST reaffirms its commitment to the need for empirically validated evidence of the scientific validity of existing forensic practices and urges the forensic science community to build on its existing momentum to establish standards through the formation of a Forensic Science Study Group to advance research, standards, and practices in the U.S. judicial system.</p>			