Back to the Endless Frontier
Science, the Endless Frontier

“New frontiers of the mind are before us, and if they are pioneered with the same vision, boldness, and drive with which we have waged this war we can create a fuller and more fruitful employment and a fuller and more fruitful life.”

– Letter from President Franklin D. Roosevelt to Vannevar Bush, November 17, 1944, prompting Vannevar Bush to write the historic report Science, the Endless Frontier.
Science, the Endless Frontier

1945: *Science, the Endless Frontier*, Vannevar Bush

1950: National Science Foundation Act
   The National Science Foundation
   The National Science Board

1950s -->
   The government-university-industry partnership
   The evolution of the “research university”
   Growth in the R&D budgets of mission agencies
Key Elements of Science the Endless Frontier

- The importance of government support of research
- The government-university-industry partnership
- The practice of federal support of competitive, peer-reviewed grants, and a framework for contractual relationships between universities and government sponsors.
- The support of investigators to engage in research of their own choosing in the hope that significant benefits would accrue to American society in the forms of military security, public health, and economic prosperity.
A Foundation for the 21st Century:

A Progressive Framework for the National Science Foundation

Report of the National Science Board Commission on the Future of the National Science Foundation

November 20, 1992
WILLIAM H. DANFORTH  
Co-Chair, Chancellor, Washington University, St. Louis

ROBERT GALVIN  
Co-Chair, Chairman, Executive Committee, Motorola

JOHN A. ARMSTRONG  
Vice President for Science and Technology, IBM

JACQUELINE BARTON  
Professor, California Institute of Technology

LINDY BOGGS  
Former Congresswoman, New Orleans, LA

LEWIS BRANSCOMB  
Albert Pratt Professor of Public Service, Harvard University

PETER EISENBERGER  
Director, Princeton Materials Institute

MARYE ANNE FOX  
M. June and J. Virgil Waggoner Regents Chair in Chemistry, University of Texas at Austin

C. PETER MAGRATH  
President, National Association of State Universities and Land-Grant Colleges

PERCY A. PIERRE  
Vice President of Research and Graduate Studies, Michigan State University

FRANK H. T. RHODES  
President, Cornell University

EARL RICHARDSON  
President, Morgan State University

IAN M. ROSS  
President-Emeritus, AT&T Bell Labs

WILLIAM J. RUTTER  
Chairman of the Board, Chiron Corporation

DONNA SHALALA  
Chancellor, University of Wisconsin — Madison
The United States should have a stronger and more coherent policy wherein science and engineering can contribute more fully to America’s strength.

Society’s support for NSF and university research is based on the confident expectation that the generation of new knowledge and the education of a skill workforce are necessary (though not sufficient) to address national priorities.
Danforth-Galvin Report (cont.)

- Strong support of investigator-initiated proposals and merit review by experts.
- The NSB, NSF, and S&E community must better come to grips with the reality that many fields not covered by traditional disciplines are worthy of strong support.
- To translate new knowledge into public good, it is appropriate that the NSB involve the private sector more fully in decisions.
National Science Board
Strategic Plan

National Science Foundation

November 19, 1998
National Academy Activities
The Gathering Storm
Dark clouds

- National Academies (COSEPUP)
- PCAST
- Council on Competitiveness
- National Science Board
- AAAS
- The Media
Disturbing Trends

- Large and growing imbalance in federal R&D funding (e.g., NIH = $32 B, NSF = $7 B)
- Federal R&D has declined from 70% of national R&D in 1970s to less than 30% in 2000..
- Increased emphasis on short-term R&D in industry and government-funded R&D
- Deterioration of engineering research infrastructure
- Declining interest of U.S. students in STEM careers
- Eroding ability of U.S. to attract (and retain) STEM students, scientists, and engineers from abroad.
RISING ABOVE THE GATHERING STORM

Energizing and Employing America for a Brighter Economic Future

NATIONAL ACADEMY OF SCIENCES;
NATIONAL ACADEMY OF ENGINEERING;
AND
INSTITUTE OF MEDICINE
OF THE NATIONAL ACADEMIES

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COMMITTEE ON PROSPERING IN THE GLOBAL ECONOMY OF THE 21ST CENTURY

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CHARLES M. VEST, President Emeritus, Massachusetts Institute of Technology, Cambridge, MA
GEORGE M. WHITESIDES, Woodford L. & Ann A. Flowers University Professor, Harvard University, Cambridge, MA
RICHARD N. ZARE, Marguerite Blake Wilbur Professor in Natural Science, Stanford University, Stanford, CA
Rising Above the Gathering Storm

- Double federal support of long-term basic research over next 7 years
- Create a program to support 200 of the nation’s promising young researchers with grants of $500,000 (over 5 years) at a cost of $100 million per year when fully implemented
- Institute a National Coordination Office for Research Infrastructure to manage a centralized research-infrastructure fund of $500 million per year over the next 5 years
- Provide federal research agencies with the discretion and resources to catalyze high-risk, high-payoff research
Rising Above the Gathering Storm

- Create in the Department of Energy (DOE) an organization like the Defense Advanced Research Projects Agency (DARPA) called the Advanced Research Projects Agency-Energy (ARPA-E)
- Institute a Presidential Innovation Award to stimulate scientific and engineering advances in the national interest.
- Preparation of K12 Math and Science teachers: 10,000 Teachers, 10 Million Minds
- Higher Education Policies: Developing the Best and the Brightest
- Economic Policy: Incentives for Innovation
Legislative Highlights :: July 31, 2007

The America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science Act (COMPETES)

H.R. 2272

Bill Summary and Status

H.R. 2272 Legislative Text

Amendments Adopted in Conference

Academic, Research and Business Groups Endorsing the Conference Report

Conference Completed, July 31, 2007

Signed Into Law by the President, August 9, 2007

Summary

Earlier this year, both the U.S. House and Senate passed comprehensive legislation (H.R. 2272, S. 761) to ensure our nation’s competitive position in the world through improvements to math and science education and a strong commitment to research.
Trends in Research by Agency, FY 1976-2010

in billions of constant FY 2009 dollars

FY 2009 and FY 2010 figures are latest estimates.
Research includes basic research and applied research.
1976-1994 figures are NSF data on obligations in the Federal Funds survey.
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RISING ABOVE
THE GATHERING STORM,
REVISITED

Rapidly Approaching Category 5

By Members of the 2005 “Rising Above the Gathering Storm” Committee

Prepared for the Presidents of the
National Academy of Sciences
National Academy of Engineering
Institute of Medicine

NATIONAL ACADEMY OF SCIENCES,
NATIONAL ACADEMY OF ENGINEERING,
AND
INSTITUTE OF MEDICINE
OF THE NATIONAL ACADEMIES

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Trends in Federal R&D, FY 1977-2016
in billions of constant FY 2015 dollars

Source: AAAS analyses of historical budget and appropriations data. Pre-1994 figures are NSF obligations data from the Federal Funds survey. FY 2016 is the President's request. R&D includes conduct and facilities. © 2015 AAAS
Federal R&D in the Budget and the Economy
Outlays as share of total, 1962 - 2016

R&D as a Share of the Federal Budget (Left Scale)
R&D as a Share of GDP (Right Scale)

Source: Budget of the United States Government, FY 2016. FY 2016 is the President's request. © 2015 AAAS
R&D as a Share of GDP by Funder

Source: National Science Foundation, *National Patterns of R&D Resources* series. © 2015 AAAS
Conclusions of RAGS Update

- The unanimous view of the committee members participating in the preparation of this report is that our nation’s outlook has worsened. While progress has been made in certain areas, the latitude to fix the problems being confronted has been severely diminished by the growth of the national debt over this period from $8 trillion to $13 trillion.

- Further, in spite of sometimes heroic efforts and occasional very bright spots, our overall public school system—or more accurately 14,000 systems—has shown little sign of improvement, particularly in mathematics and science.

- Finally, many other nations have been markedly progressing, thereby affecting America’s relative ability to compete effectively for new factories, research laboratories, administrative centers—and jobs.
The only promising avenue to the nation’s future, in the view of the Gathering Storm committee and many others, is through innovation. Unfortunately, it has increasingly placed shackles on that prowess such that, if not relieved, the nation’s ability to provide financially and personally rewarding jobs for its own citizens can be expected to decline at an accelerating pace.

The Gathering Storm Committee’s overall conclusion is that in spite of the efforts of both those in government and the private sector, the outlook for America to compete for quality jobs has further deteriorated over the past five years. The Gathering Storm increasingly appears to be a Category 5!
University R&D Funding by Source

RESEARCH UNIVERSITIES AND THE FUTURE OF AMERICA

Ten Breakthrough Actions Vital to Our Nation’s Prosperity and Security

SUMMARY
COMMITTEE ON RESEARCH UNIVERSITIES

Chad Holliday, Chair, Chairman of the Board, Bank of America, and Chairman and CEO, E. I. du Pont de Nemours and Company (DuPont) (retired) [NAE]
Peter Agre, University Professor and Director, Johns Hopkins Malaria Research Institute, Department of Molecular Microbiology and Immunology, Bloomberg School of Public Health, Johns Hopkins University [NAS/IOM]
Enriqueta Bond, President, Burroughs Wellcome Fund (retired) [IOM]
C. W. Paul Chu, T. L. L. Temple Chair of Science and Professor of Physics, University of Houston, and Former President, Hong Kong University of Science and Technology [NAS]
Francisco Cigarroa, Chancellor, The University of Texas System [IOM]
James Duderstadt, President Emeritus and University Professor of Science and Engineering, University of Michigan [NAS]
Ronald Ehrenberg, Irving M. Ives Professor of Industrial and Labor Relations and Economics, and Director, Cornell Higher Education Research Institute, Cornell University
William Frist, Distinguished University Professor, Owen Graduate School of Management, Vanderbilt University, and U.S. Senator (retired)
William Green, Chairman and CEO, Accenture
John Hennessy, President and Bing Presidential Professor, Stanford University [NAS/NAE]
Walter Massey, President, School of the Art Institute of Chicago, and President Emeritus, Morehouse College
Burton McMurtry, Former Silicon Valley Venture Capitalist and Former Chair, Stanford University Board of Trustees
Ernest Moniz, Cecil and Ida Green Professor of Physics and Engineering Systems, Director of the Energy Initiative, and Director of the Laboratory for Energy and the Environment at the MIT Department of Physics, Massachusetts Institute of Technology
Heather Munroe-Blum, Principal (President) and Vice Chancellor, and Professor, Faculty of Medicine, McGill University
Cherry Murray, Dean, Harvard School of Engineering and Applied Sciences, John A. and Elizabeth S. Armstrong Professor of Engineering and Applied Sciences, and Professor of Physics, Harvard University [NAS/NAE]
Hunter Rawlings, President Emeritus and Professor of Classical History, Cornell University*
John Reed, Chairman of the MIT Corporation and Chairman and CEO, Citigroup (retired)
Teresa Sullivan, President, University of Virginia
Sidney Taurel, Chairman and CEO, Eli Lilly & Company (retired)
Lee T. Todd, Jr., President, University of Kentucky
Laura D’Andrea Tyson, S. K. and Angela Chan Chair in Global Management, Haas School of Business, University of California Berkeley
Padmasree Warrior, Chief Technology Officer, Cisco Systems

*Hunter Rawlings resigned in May 2013 upon his appointment as President, Association of American Universities.
The danger signs

- Federal policies no longer place a priority on university research and graduate education.
- In the face of economic challenges and the priorities of aging populations, states no longer are either capable or willing to support their public research universities at world-class levels.
- Business and industry have largely ceded their basic research to research universities but with only minimal corporate support.
- Research universities themselves have failed to achieve the cost efficiency and productivity enhancement in teaching and research required of an increasingly competitive world.
Research Universities and the Future of America:
Ten Breakthrough Actions Vital to Our Nation’s Prosperity and Security

About the Report
Read online free
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This report examines the health and competitiveness of our nation’s research universities and their strong partnership with government and industry that is critical to the nation’s prosperity and national goals. The report responds to a request from Congress for “the top ten actions that Congress, the federal government, state governments, research universities, and others could take to assure the ability of the American research university to maintain the excellence in research and doctoral education needed to help the United States compete, prosper, and achieve national goals for health, energy, the environment, and security in the global community of the 21st century.”

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Revitalizing the Partnership

- The **federal government** should adopt stable and effective policies, practices, and funding for university-performed R&D and graduate education.
- **States** should provide strong, stable, and effective funding along with greater autonomy for public research universities.
- Strengthen the **business** role in the research partnership, facilitating the transfer of knowledge, ideas, and technology to society.
- Increase **university** cost-effectiveness and productivity in order to provide a greater return on investment.
Strengthen the Institutions

- The federal government should create a cost-sharing Strategic Investment Program that funds initiatives at research universities critical to advancing education and research in areas of key national priority.

- The federal government and other research sponsors should strive to cover the full costs of research projects and other activities they procure from research universities in a consistent and transparent manner.

- Reduce or eliminate regulations that increase administrative costs, impede research productivity, and deflect creative energy without substantially improving the research environment.
Building Talent

- Improve the capacity of graduate programs to attract talented students by addressing issues such as attrition rates, time to degree, funding, and alignment with both student career opportunities and national interests.

- Secure for the U.S. the full benefits of education for all Americans, including women and underrepresented minorities, in science, mathematics, engineering, and technology.

- Ensure that the U.S. will continue to benefit strongly from the participation of international students and scholars in our research enterprise.
RESTORING THE FOUNDATION

The Vital Role of Research in Preserving the American Dream
Restoring the Foundation

The Vital Role of Research in Preserving the American Dream

American Academy of Arts and Sciences
The U.S. has Fallen to 10th place in R&D Investment
U.S. ranking among OECD nations by national R&D investment
as a percentage of GDP
Prescriptions

- Secure America’s leadership in science and engineering research—especially basic research—by providing sustainable federal funding and setting long-term investment goals.
- Ensure that the American people receive maximum benefits from federal investments in research.
- Regain America’s standing as an innovation leader by establishing a more robust national government-university-industry research partnership.
Contentious markup expected today as House science panel takes up COMPETES bill
President’s science adviser attacks COMPETES bill in U.S. House, raises concern about NASA bill
Science and technology are at the heart of many of the most pressing challenges facing society today, including climate change, health care, energy, national security, economic competitiveness, and a variety of social issues. Over the last several decades, our nation’s investment in scientific research, particularly at universities, has provided a stream of ideas, insights, technologies, and talent that has been central to our ability to address evolving challenges while ensuring the health of our economy and our quality of life. Never has it been more important to sustain this investment and make effective use of the resources it funds.

The purpose of this conference is to bring together leaders from government and academia to explore how universities can more productively inform and engage in the formulation of national policies affecting the sciences and engineering and the effective application of science and technology to a host of societal challenges. An explicit goal is to develop and recommend specific action items for education, research, and engagement.

Among the key presenters will be:

John Holdren—Director of the White House Office of Science and Technology Policy and Co-Chair of the President’s Council on Science and Technology

Ralph Cicerone—President of the National Academy of Sciences

France Cordova—Director of the National Science Foundation

Rush Holt—Chief Executive Officer of the American Association for the Advancement of Science (AAAS) and former Member of Congress
Lessons Learned for Science Policy…

- Persistence and consistency are everything!
- So too is adaptability…
- Keep an eye out for unexpected opportunities…
- Fighting losing battles can sometimes open windows of opportunity!

But more is necessary…

- We must re-engage with the public and its elected representatives about the importance of enlightened federal science policies and strong support, returning to the spirit of the Endless Frontier!
“New frontiers of the mind are before us, and if they are pioneered with the same vision, boldness, and drive with which we have waged this war we can create a fuller and more fruitful employment and a fuller and more fruitful life.”

– Letter from President Franklin D. Roosevelt to Vannevar Bush, November 17, 1944, prompting Vannevar Bush to write the historic report *Science, the Endless Frontier*. 